This disclosure describes compositions and methods for delivering and localizing repair cells to therapeutic targets.
TECHNICAL FIELD

[01] The disclosed inventions are in the field of targeted therapeutics.

[02] Each reference cited in this disclosure is incorporated herein in its entirety.

BRIEF DESCRIPTION OF THE FIGURES

[03] FIG. 1. Graph demonstrating qualitative analysis of targeting of Raji cells stained with Compound 20 on different tissues.

[04] FIG. 2. Photomicrographs demonstrating targeting of rabbit mesenchymal stem cells (rbMSCs) incubated with Compound 20 to different organs from Balb/c mice.

[05] FIG. 3A. Photomicrographs demonstrating that Compound 4 promotes adherence of Raji cells to meniscus explants.

[06] FIG. 3B. Photomicrographs demonstrating that Compound 4 and Compound 20 (FIG. 3B) promote cell adherence of Raji cells to meniscus explants.

[07] FIG. 4. Photomicrographs demonstrating the presence of Compound 4 in the knees of rats up to 24 hours after intra-articular injection.

[08] FIGS. 5A-B. Photomicrographs demonstrating that Compound 4 stains the small intestine (FIG. 5A) but not Peyer's patches (FIG. 5B) after oral administration.

[09] FIGS. 6A-6B. Photomicrographs demonstrating the location of safranin-0 and Compound 4 staining in in various tissues 24 hours after oral administration. FIG. 6A, thymus, liver, heart, lung. FIG. 6B, spleen, small intestine.


DETAILED DESCRIPTION

[12] "Aryl" refers to an unsaturated aromatic carbocyclic group having a single ring (e.g., phenyl) or multiple condensed rings (e.g., naphthyl or anthryl) which condensed rings may or may not be aromatic. In one variation, the aryl group contains from 6 to 14 annular carbon atoms (e.g., 6-14, 6-13, 6-12, 6-11, 6-10, 6-9, 6-8, 6-7, 7-14, 7-13, 7-12, 7-11, 7-10, 7-9, 7-8, 8-14, 8-13, 8-12, 8-11, 8-10, 8-9, 9-14, 9-13, 9-12, 9-11, 9-10, 10-14, 10-13, 10-12, 10-11, 11-14, 11-13, 11-12, 12-14, 12-13, 13-14, 6, 7, 8, 9, 10, 11, 12, 13, or 14). An aryl group having more than one ring where at least one ring is non-aromatic may be connected to the parent structure at either an aromatic ring position or at a non-aromatic ring position. In one variation, an aryl group having more than one ring where at least one ring is non-aromatic is connected to the parent structure at an aromatic ring position.

[13] "Heteroaryl" refers to an unsaturated aromatic carbocyclic group having from 2 to 10 annular carbon atoms (e.g., 2-10, 2-9, 2-8, 2-7, 2-6, 2-5, 2-4, 2-3, 3-10, 3-9, 3-8, 3-7, 3-6, 3-5, 3-4, 4-10, 4-9, 4-8, 4-7, 4-6, 4-5, 5-10, 5-9, 5-8, 5-7, 5-6, 6-10, 6-9, 6-8, 6-7, 7-10, 7-9, 7-8, 8-10, 8-9, 9-10, 2, 3, 4, 5, 6, 7, 8, 9, or 10) and at least one annular heteroatom, including but not limited to heteroatoms such as nitrogen, oxygen and sulfur. A heteroaryl group may have a single ring (e.g., pyridyl, furyl) or multiple condensed rings (e.g., indolizinyl, benzothienyl) which condensed rings may or may not be aromatic. A heteroaryl group having more than one ring where at least one ring is non-aromatic may be connected to the parent structure at either an aromatic ring position or at a non-aromatic ring position. In one variation, a heteroaryl group having more than one ring where at least one ring is non-aromatic is connected to the parent structure at an aromatic ring position.

[14] "Cycloalkyl" is a saturated cyclic hydrocarbon structure and can consist of one ring, such as cyclohexyl, or multiple rings, such as adamantyl. A cycloalkyl comprising more than one ring may be fused, spiro or bridged, or combinations thereof. A cycloalkyl can be a saturated cyclic hydrocarbon having from 3 to 13 annular carbon atoms (e.g., 3-13, 3-12, 3-11, 3-10, 3-9, 3-8, 3-7, 3-6, 3-5, 3-4, 4-13, 4-12, 4-11, 4-10, 4-9, 4-8, 4-7, 4-6, 4-5, 5-13, 5-12, 5-11, 5-10, 5-9, 5-8, 5-7, 5-6, 6-13, 6-12, 6-11, 6-10, 6-9, 6-8, 6-7, 7-13, 7-12, 7-11, 7-10, 7-9, 7-8, 8-13, 8-12, 8-11, 8-10, 8-9, 9-13, 9-12, 9-11, 9-10, 10-13, 10-12, 10-11, 11-13, 11-12, 12-13, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, or 13 annular carbon atoms). Examples of cycloalkyl groups include adamantyl, decahydronaphthalenyl, cyclopropyl, cyclobutyl, cyclopentyl, and cyclohexyl.

[15] "Heterocyclyl" refers to a saturated or an unsaturated non-aromatic group having a single ring or multiple condensed rings, and having from 1 to 10 annular carbon atoms (e.g., 1-10, 1-9,
disclosed methods, a repair cell is a chondrocyte. In some variations of the disclosed methods, a repair cell is a particular type that differentiates exposed cells and secretes components needed to repair an injury to a joint (e.g., hyaline cartilage, tendon, meniscus). In some variations of the disclosed methods, a repair cell is a chondrocyte. In some variations of the disclosed methods, a repair cell is a chondrocyte. In some variations of the disclosed methods, a repair cell is a chondrocyte. In some variations of the disclosed methods, a repair cell is a chondrocyte.

DETAILED DESCRIPTION

This disclosure describes compositions and methods for delivering and localizing repair cells to the sites of cartilage injuries. A "repair cell" as used herein includes cells which, when exposed to appropriate conditions, differentiate into an appropriate cell type for repair of a particular target tissue, as well as cells which are at least partially differentiated into the appropriate cell type for the tissue to be repaired. For example, in some variations a repair cell differentiates into a cell which produces and secretes components needed to repair an injury to a joint (e.g., hyaline cartilage, tendon, meniscus). In some variations of the disclosed methods, a repair cell is a chondrocyte. In some variations of the disclosed methods, a repair cell is a chondrocyte. In some variations of the disclosed methods, a repair cell is a chondrocyte.
mesenchymal stem cell (MSC). Methods of obtaining, culturing, and expanding populations of MSCs are well known in the art. See, e.g., US 2004/0009157; US 2012/0148548; U.S. Patent 5,486,359; and U.S. Patent 5,226,914. Typically, autologous MSCs are used. In some embodiments, allogenic MSCs are used (e.g., MSCs obtained from banks of umbilical cord MSCs, MHC-matched MSCs, or MSCs engineered to not have comprise immunogenic MHCs).

[18] In the disclosed methods, a population of repair cells, e.g., MSCs, is incubated with a compound which is a cationic dye multimer, described below, under conditions sufficient for the compound to bind to the surface of the repair cells, then the population is subjected to centrifugation to form a pellet composition. A "pellet composition" as used herein, unless otherwise specified, does not imply that the pelleted have been cultured in vitro (as in the optional culture step disclosed below).

**Conditions for Incubating Repair Cells with a Cationic Dye Multimer**

[19] Examples of conditions sufficient for a cationic dye multimer, such as compound 4 or compound 20, to bind to the surface of cells are provided in the working examples, below. These conditions include incubation with the compound at room temperature for 1, 5, 15, or 30 minutes. Conditions for other compounds disclosed herein can readily be determined using the working examples as a starting point.

[20] In some variations, the repair cells (e.g., MSCs) are incubated with a cationic dye multimer for 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, or 30 minutes.

[21] In some variations, about 0.5-1 x 10^6 repair cells (e.g., MSCs) are incubated with a cationic dye multimer (e.g., compound 4 or compound 20). In some variations, about 10^5 repair cells (e.g., MSCs) are incubated with a cationic dye multimer (e.g., compound 4 or compound 20).

**Pelleting the Repair Cells**

[22] Pellet cultures of MSCs are known in the art (e.g., US 2003/0026786; US 2005/0019865; Bosnakovski et al., Experimental Hematology 32, 502-09, 2004; Chen et al., PLoS One 9, e91561, 1-11, 2014; Miyanashi et al., Tissue Engineering 12, 1419-28, 2006; Ong et al., Biomaterials 27, 2-87-08, 2006; Kawamura et al., Experimental Hematology 33, 865-72, 2005; Safshekan et al., Artificial Organs 36, 1065-71, 2012; Ullah et al., BioResearch Open Access 1, 297-305, 2012), and examples of suitable conditions for forming a pellet of a population of
MSCs after incubation of the MSCs with a compound of formula (I) are provided in the working examples, below. Pellet cultures of other types of repair cells can be similarly prepared.

Optional Culture of Repair Cell Pellet

[23] In some variations, the pellet is not cultured before applying the pellet to the site of the injury. In some variations, the pellet is cultured for varying periods of time before applying the pellet to the site of the injury, as described in the paragraphs below.

[24] In some variations, the pellet is cultured for 1-21 days, 1-20 days, 1-19 days, 1-18 days, 1-17 days, 1-16 days, 1-15 days, 1-14 days, 1-13 days, 1-12 days, 1-11 days, 1-10 days, 1-9 days, 1-8 days, 1-7 days, 1-6 days, 1-5 days, 1-4 days, 1-3 days, or 1-2 days. In some variations, the pellet is cultured for less than 1-21 days, 1-20 days, 1-19 days, 1-18 days, 1-17 days, 1-16 days, 1-15 days, 1-14 days, 1-13 days, 1-12 days, 1-11 days, 1-10 days, 1-9 days, 1-8 days, 1-7 days, 1-6 days, 1-5 days, 1-4 days, 1-3 days, or 1-2 days.

[25] In some variations, the pellet is cultured for 2-21 days, 2-20 days, 2-19 days, 2-18 days, 2-17 days, 2-16 days, 2-15 days, 2-14 days, 2-13 days, 2-12 days, 2-11 days, 2-10 days, 2-9 days, 2-8 days, 2-7 days, 2-6 days, 2-5 days, 2-4 days, or 2-3 days. In some variations, the pellet is cultured for less than 2-21 days, 2-20 days, 2-19 days, 2-18 days, 2-17 days, 2-16 days, 2-15 days, 2-14 days, 2-13 days, 2-12 days, 2-11 days, 2-10 days, 2-9 days, 2-8 days, 2-7 days, 2-6 days, 2-5 days, 2-4 days, or 2-3 days.

[26] In some variations, the pellet is cultured for 3-21 days, 3-20 days, 3-19 days, 3-18 days, 3-17 days, 3-16 days, 3-15 days, 3-14 days, 3-13 days, 3-12 days, 3-11 days, 3-10 days, 3-9 days, 3-8 days, 3-7 days, 3-6 days, 3-5 days, or 3-4 days. In some variations, the pellet is cultured for less than for 3-21 days, 3-20 days, 3-19 days, 3-18 days, 3-17 days, 3-16 days, 3-15 days, 3-14 days, 3-13 days, 3-12 days, 3-11 days, 3-10 days, 3-9 days, 3-8 days, 3-7 days, 3-6 days, 3-5 days, or 3-4 days.

[27] In some variations, the pellet is cultured for 4-21 days, 4-20 days, 4-19 days, 4-18 days, 4-17 days, 4-16 days, 4-15 days, 4-14 days, 4-13 days, 4-12 days, 4-11 days, 4-10 days, 4-9 days, 4-8 days, 4-7 days, 4-6 days, or 4-5 days. In some variations, the pellet is cultured for less than 4-21 days, 4-20 days, 4-19 days, 4-18 days, 4-17 days, 4-16 days, 4-15 days, 4-14 days, 4-13 days, 4-12 days, 4-11 days, 4-10 days, 4-9 days, 4-8 days, 4-7 days, 4-6 days, or 4-5 days.

[28] In some variations, the pellet is cultured for 5-21 days, 5-20 days, 5-19 days, 5-18 days, 5-17 days, 5-16 days, 5-15 days, 5-14 days, 5-13 days, 5-12 days, 5-11 days, 5-10 days, 5-9 days, 5-8 days, 5-7 days, or 5-6 days. In some variations, the pellet is cultured for less than 5-21 days,
5-20 days, 5-19 days, 5-18 days, 5-17 days, 5-16 days, 5-15 days, 5-14 days, 5-13 days, 5-12 days, 5-11 days, 5-10 days, 5-9 days, 5-8 days, 5-7 days, or 5-6 days.

[29] In some variations, the pellet is cultured for 6-21 days, 6-20 days, 6-19 days, 6-18 days, 6-17 days, 6-16 days, 6-15 days, 6-14 days, 6-13 days, 6-12 days, 6-11 days, 6-10 days, 6-9 days, 6-8 days, or 6-7 days. In some variations, the pellet is cultured for less than 6-21 days, 6-20 days, 6-19 days, 6-18 days, 6-17 days, 6-16 days, 6-15 days, 6-14 days, 6-13 days, 6-12 days, 6-11 days, 6-10 days, 6-9 days, 6-8 days, or 6-7 days.

[30] In some variations, the pellet is cultured for 7-21 days, 7-20 days, 7-19 days, 7-18 days, 7-17 days, 7-16 days, 7-15 days, 7-14 days, 7-13 days, 7-12 days, 7-11 days, 7-10 days, or 7-8 days. In some variations, the pellet is cultured for less than 7-21 days, 7-20 days, 7-19 days, 7-18 days, 7-17 days, 7-16 days, 7-15 days, 7-14 days, 7-13 days, 7-12 days, 7-11 days, 7-10 days, 7-9 days, or 7-8 days.

[31] In some variations, the pellet is cultured for 8-21 days, 8-20 days, 8-19 days, 8-18 days, 8-17 days, 8-16 days, 8-15 days, 8-14 days, 8-13 days, 8-12 days, 8-11 days, 8-10 days, or 8-9 days. In some variations, the pellet is cultured for less than 8-21 days, 8-20 days, 8-19 days, 8-18 days, 8-17 days, 8-16 days, 8-15 days, 8-14 days, 8-13 days, 8-12 days, 8-11 days, 8-10 days, or 8-9 days.

[32] In some variations, the pellet is cultured for 9-21 days, 9-20 days, 9-19 days, 9-18 days, 9-17 days, 9-16 days, 9-15 days, 9-14 days, 9-13 days, 9-12 days, 9-11 days, or 9-10 days. In some variations, the pellet is cultured for less than 9-21 days, 9-20 days, 9-19 days, 9-18 days, 9-17 days, 9-16 days, 9-15 days, 9-14 days, 9-13 days, 9-12 days, 9-11 days, or 9-10 days.

[33] In some variations, the pellet is cultured for 10-21 days, 10-20 days, 10-19 days, 10-18 days, 10-17 days, 10-16 days, 10-15 days, 10-14 days, 10-13 days, 10-12 days, or 10-11 days. In some variations, the pellet is cultured for less than 10-21 days, 10-20 days, 10-19 days, 10-18 days, 10-17 days, 10-16 days, 10-15 days, 10-14 days, 10-13 days, 10-12 days, or 10-11 days.

[34] In some variations, the pellet is cultured for 11-21 days, 11-20 days, 11-19 days, 11-18 days, 11-17 days, 11-16 days, 11-15 days, 11-14 days, 11-13 days, or 11-12 days. In some variations, the pellet is cultured for less than 11-21 days, 11-20 days, 11-19 days, 11-18 days, 11-17 days, 11-16 days, 11-15 days, 11-14 days, 11-13 days, or 11-12 days.

[35] In some variations, the pellet is cultured for 12-21 days, 12-20 days, 12-19 days, 12-18 days, 12-17 days, 12-16 days, 12-15 days, 12-14 days, or 12-13 days. In some variations, the
pellet is cultured for less than 12-21 days, 12-20 days, 12-19 days, 12-18 days, 12-17 days, 12-16 days, 12-15 days, 12-14 days, or 12-13 days.

[36] In some variations, the pellet is cultured for 13-21 days, 13-20 days, 13-19 days, 13-18 days, 13-17 days, 13-16 days, 13-15 days, or 13-14 days. In some variations, the pellet is cultured for less than 13-21 days, 13-20 days, 13-19 days, 13-18 days, 13-17 days, 13-16 days, 13-15 days, or 13-14 days.

[37] In some variations, the pellet is cultured for 14-21 days, 14-20 days, 14-19 days, 14-18 days, 14-17 days, 14-16 days, or 14-15 days. In some variations, the pellet is cultured for less than 14-21 days, 14-20 days, 14-19 days, 14-18 days, 14-17 days, 14-16 days, or 14-15 days.

[38] In some variations, the pellet is cultured for 15-21 days, 15-20 days, 15-19 days, 15-18 days, 15-17 days, or 15-16 days. In some variations, the pellet is cultured for less than 15-21 days, 15-20 days, 15-19 days, 15-18 days, 15-17 days, or 15-16 days.

[39] In some variations, the pellet is cultured for 16-21 days, 16-20 days, 16-19 days, 16-18 days, or 16-17 days. In some variations, the pellet is cultured for less than 16-21 days, 16-20 days, 16-19 days, 16-18 days, or 16-17 days.

[40] In some variations, the pellet is cultured for 17-21 days, 17-20 days, 17-19 days, or 17-18 days. In some variations, the pellet is cultured for less than 17-21 days, 17-20 days, 17-19 days, or 17-18 days.

[41] In some variations, the pellet is cultured for 18-21 days, 18-20 days, or 18-19 days. In some variations, the pellet is cultured for less than 18-21 days, 18-20 days, or 18-19 days.

[42] In some variations, the pellet is cultured for 19-21 days or 19-20 days. In some variations, the pellet is cultured for less than 19-21 days or 19-20 days.

[43] In some variations, the pellet is cultured for 20-21 days. In some variations, the pellet is cultured for less than 20-21 days.

[44] In some variations, the pellet is cultured for 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, or 21 days. In some variations, the pellet is cultured for less than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, or 21 days.

[45] In some of the variations about in which the pellet, e.g., an MSC pellet, is cultured before applying it to the site of injury, the culture medium does not comprise TGFp.
In some of the variations about in which the pellet, e.g., an MSC pellet, is cultured before applying it to the site of injury, the culture medium comprises TGFp.

In some of the variations about in which the pellet, e.g., an MSC pellet, is cultured before applying it to the site of injury, the culture medium is a basal culture medium.

In some of the variations about in which the pellet, e.g., an MSC pellet, is cultured before applying it to the site of injury, the culture medium is a chondrocyte differentiation medium.

Methods of Chondrogenic Differentiation of MSCs

Using the culture conditions described above, this disclosure also provides methods of differentiating MSCs in pellet cultures which do not require the use of chondrogenic medium or TGFp. See example B5, below.

Administration of a Pellet Composition to the Site of a Tissue Injury

Pellet compositions comprising repair cells can be used to treat injured or diseased tissues, including, but not limited to, pancreas, kidney, intestine (e.g., small intestine, cecum), heart, cartilage (e.g., trachea, femoral cartilage), thymus, liver, brain, bladder, blood.

Administration of a Pellet Composition to the Site of a Cartilage Injury

Administration of one or more pellet compositions of MSCs can be carried out during an arthroscopic or open joint procedure and can be used to treat cartilage injuries at joints such as the acromioclavicular, carpometacarpal (finger or thumb), coracoclavicular, humeroulnar, humeroradial, radioulnar (distal, intermedial, proximal), intermetacarpal, interphalangeal, metacarpophalangeal, midcarpal, radiocarpal, shoulder, sternoclavicular, wrist, temporomandibular, sternocostal, xiphisternal, lumbosacral, sacroiliac, talocrural (ankle), hip, metatarsophalangeal, tarsometatarsal, tibiofemoral (knee) joints, and zygapophyseal joints.

Types of cartilage injuries which can be treated include damage to cartilage at a synovial joint occurring as a result of mechanical destruction due to trauma or progressive degeneration (osteoarthritis; wear and tear) or associated with a disease or disorder, such as osteoarthritis, rheumatoid arthritis, gout, reactive arthritis, psoriatic arthritis, or juvenile arthritis. Other injuries include damage to tendons, ligaments, and the meniscus. Use of tissue engineering, including stem cell therapy, to treat such injuries has been reviewed. See, e.g. Nesic, et al. "Cartilage Tissue Engineering for Degenerative Joint Disease," Advanced Drug Delivery Reviews (2006), 58(2):300-322; Johnstone, et al. "Tissue Engineering for Articular Cartilage Repair - The State of the Art," European Cells and Materials (2013) 25:248-267; Dragoo, et al. "Healing Full-

**Pharmaceutical Compositions**

[53] Pellet compositions can be provided in a pharmaceutical composition comprising a pharmaceutically acceptable carrier. A "pharmaceutically acceptable carrier" carrier is a material that is not biologically or otherwise undesirable, e.g., the material may be incorporated into a pharmaceutical composition administered to an individual without causing significant undesirable biological effects or interacting in a deleterious manner with any of the other components of the composition in which it is contained. Pharmaceutically acceptable carriers meet the required standards of toxicological and manufacturing testing and/or are included on the Inactive Ingredient Guide prepared by the U.S. Food and Drug administration.

**Compounds**

[54] The compounds depicted herein, by virtue of their cationic nature, are typically present as salts even if salts are not depicted and thus are accompanied by a pharmaceutically acceptable counterion, forming a pharmaceutically acceptable salt. A "pharmaceutically acceptable counterion" is an ionic portion of a salt that is not toxic when released from the salt upon administration to a recipient. Pharmaceutically acceptable salts may be formed with many acids, including but not limited to hydrochloric, sulfuric, acetic, lactic, malic, succinic, hydrogen bisulfide, salicylic, tartaric, bitartaric, ascorbic, maleic, besylic, fumaric, gluconic, gluconic, formic, glutamic, methanesulfonic, ethanesulfonic, benzenesulfonic, lactic, oxalic, para-bromophenylsulfonic, carbonic, succinic, citric, benzoic and acetic acid, and related inorganic and organic acids. Such pharmaceutically acceptable counterions thus include sulfate, pyrosulfate, bisulfate, sulfite, bisulfate, phosphate, monohydrogenphosphate, dihydrogenphosphate, metaphosphate, pyrophosphate, chloride, bromide, iodide, acetate, propionate, decanoate, caprylate, acrylate, formate, isobutyrate, caprate, heptanoate, propiolate, oxalate, malonate, succinate, suberate, sebacate, fumarate, maleate, butyne-1,4-dioate, hexyne-
1,6-dioate, benzoate, chlorobenzoate, methylbenzoate, dinitrobenzoate, hydroxybenzoate, methoxybenzoate, phthalate, terephthalate, sulfonate, xylenesulfonate, phenylacetate, phenylpropionate, phenylbutyrate, citrate, lactate, β-hydroxybutyrate, glycolate, maleate, tartrate, methanesulfonate, propanesulfonate, naphthalene-1-sulfonate, naphthalene-2-sulfonate, mandelate and the like.

[55] Where tautomeric forms may be present for any of the compounds described herein, each and every tautomeric form is intended even though only one or some of the tautomeric forms may be explicitly depicted. The tautomeric forms specifically depicted may or may not be the predominant forms in solution or when used according to the methods described herein.

[56] Compounds useful for preparing pellet compositions described above are cationic dye multimers, as described below.

**Cationic Dye Multimers**

[57] Cationic dye multimers can be linear, branched, or cyclic. In some variations, a cationic dye multimer is a dimer, in which two cationic dye moieties are linked with a linker as described below. In other variations, a cationic dye multimer is a trimer or higher order multimer containing, e.g., 3, 4, or 5 cationic dye moieties joined in various configurations by linkers such that the multimer is linear, branched, or cyclic. The cationic dye moieties in a multimer, as well as the linkers, can be the same or different, in various combinations, as set forth in the description below. In some embodiments, the binding capacity of a cationic dye multimer can be tuned based on the polarity/electron density of the charged multimer system such that, for example, the cationic dye multimer exhibits differential binding affinities to, e.g., cartilage and MSCs.

[58] The linker moieties comprise a multivalent, rigid or non-rigid, alkyl chain containing appropriate functionality at the termini to bond with the cationic dye moieties, as also set forth in the description below. Such linkers could, for example, comprise a bivalent chain thus having a cationic dye at each end resulting in a dimer. Other combinations and configurations are similarly described herein.

**Cationic Dyes**

[59] In some variations, cationic dyes which can be used to make cationic dye multimers as described herein have a planar tri-aromatic core with the potential to have a positive charge at physiological pH. Representative examples of such cationic dyes are shown below, with the
"wiggle line" indicating one possible point of attachment to a linker to a dimer or higher oligomer:

[Image of molecular structures]

**Linkers**

[60] The amino groups on cationic dyes such as safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue are unreactive. These amino groups can however be functionalized through reactions that provide "handles" which comprise a carboxylic acid or an amine; cationic dyes comprising such handles are referred to herein as "cationic dye moieties."

[61] As provided in the Examples herein, synthetic routes to dyes presented herein can result in positional isomeric products, for example those shown below for Safranin:

[Image of molecular structures]

37-diamino-2,6-dimethyl-5-phenylphenazin-5-iurn 37-diamino-2,8-dimethyl-5-phenylphenazin-5-iurn

wherein as presented here a methyl group can be at the 6- or 8-position. Commercially available sources of such reagents can comprise a mixture of such regioisomers. All compounds presented herein encompass any and all derivatives from such regioisomeric dyes.
Cationic dye moieties can be functionalized with the appropriately substituted linkers described below using reactions known to those skilled in the art; this is illustrated for safranin-0 in the schematic below:

For example, compounds 14, 15, 16, 17, 18, and 19 in Table 1, below, can be synthesized using terephthalic acid (CAS # 100-21-0), 2,5-pyridinedicarboxylic acid (CAS# 100-26-5), 4,5-imidazoledicarboxylic acid (CAS# 570-22-9), 2-(ethoxycarbonyl)-1,3-thiazole-4-carboxylic acid (CAS# 911466-96-1), 1,4-cyclohexanedicarboxylic acid (CAS# 1076-97-7), and 4-oxo-cyclopentane-1,2-dicarboxylic acid diethyl ester (CAS# 914637-96-0), respectively, as a reagent.

In some cationic dye multimers in which at least one of the cationic dye multimers is safranin-O, the pendant phenyl ring of the safranin-0 is unsubstituted. In some cationic dye multimers in which at least one of the cationic dye multimers is safranin-O, the pendant phenyl ring of the safranin-0 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. Examples of electron-donating groups include —NH₂, —NHR, —NR₂, —OH, —O⁻, —NHOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). Examples of electron-withdrawing groups include —N₂, —NR₃⁺, halo (e.g., F, Br, CI, I), trihalides (e.g., —CF₃, —CCl₃, —Br₃, —Cl₂), —CN, —S₃H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4,
C1-C3, C1-C2, CI, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[65] In some variations, linkers comprise a positive charge, which can be provided by a positive charged substituent such as an amino alkyl, amino heterocyclyl, or N-containing heteroaromatic group. In some variations, positively charged linkers comprise amino acids such as Lys, Arg, or His. If a rigid linker is desired, one or more aromatic rings, cycloalkyl rings, heteroaromatic rings, or heterocyclyl rings, can be used to provide rigidity. Rigidity can also be increased by restricting rotation of the linker through use of sp- or sp$^2$-hybridized carbon atoms in a chain, for example with double- or triple-bonds, keto groups, and the like, as well as by employing bulky side-chains such as, for example, gem-dialkyl groups. Linkers which can be used in cationic dye multimers include linkers (a), (a.1), (a.2), (b), (b.1), (c), (c.1), (c.2), (d), (e), (e.1), (f), (f.1), (f.2), (g), (g.1), (g.2), (h), (h.1), (h.2), (i), (i.1), (i.2), (j), (j.1), (j.2), (k), (l), (1), (1.1), (1.2), (m), (m.1), (n), (n.1), (n.2), (o), (p), (q), (r), and (s), below:

(a) , in which n is 1-6, \( n \) is 1-4, and each * is an attachment site for a cationic dye moiety;

(a.1) , in which n is 1-6, \( n \) is 1-4, and * is a an attachment site for a cationic dye moiety;

(a.2) , in which n is 1-6, \( n \) is 1-4, and * is an attachment site for a cationic dye moiety;

(b) , in which n is 0-6, \( n \) is 1-4, and each * is an attachment site for a cationic dye moiety;
(b.1) in which \( n \) is 0-6, \( ni \) is 1-4, and * is an attachment site for a cationic dye moiety;

(c) in which \( n \) is 0-6; \( ni \) is 1-4; for each independent instance of \( R_a \) and \( R_b \), (1) \( R_a \) and \( R_b \) independently are H or CH\(_3\), or (2) \( R_a \) and \( R_b \) are \( \text{or} \); or (3) two of CR\(_a\)R\(_b\) are \( \text{or} \); and each * is an attachment site for a cationic dye moiety. Examples of linker (c) include

\[
\begin{align*}
\text{Examples of linker (c) include} \\
\end{align*}
\]

(c.1) in which \( n \) is 0-6; \( ni \) is 1-4; for each independent instance of \( R_a \) and \( R_b \), (1) \( R_a \) and \( R_b \) independently are H or CH\(_3\) or (2) \( R_a \) and \( R_b \) are \( \text{or} \); or (3) two of CR\(_a\)R\(_b\) are \( \text{or} \); and each * is an attachment site for a cationic dye moiety;
(c.2) in which \( n \) is 0-6; \( ni \) is 1-4; for each independent instance of \( R_a \) and \( R_b \), (1) \( R_a \) and \( R_b \) independently are \( \text{H} \) or \( \text{CH}_3 \) or (2) \( R_a \) and \( R_b \) are \( \text{O} \) \( \text{C} \) \( \text{C} \) or \( \text{O} \) \( \text{C} \) \( \text{C} \); or (3) two of \( \text{CR}_a \text{R}_b \) are \( \text{O} \) \( \text{C} \) \( \text{C} \); and * is an attachment site for a cationic dye moiety;

(d) where \( k \) is 2-10; for each independent instance of \( R_a \) and \( R_b \), \( R_a \) and \( R_b \) (1) independently are \( \text{H} \) or \( \text{CH}_3 \), or (2) \( R_a \) and \( R_b \) are \( \text{O} \) \( \text{C} \) \( \text{C} \) or \( \text{O} \) \( \text{C} \) \( \text{C} \), or (3) two of \( \text{CR}_a \text{R}_b \) are \( \text{O} \) \( \text{C} \) \( \text{C} \); and each * is an attachment site for a cationic dye moiety;

(e) in which \( n \) is 0-6, \( \nu \) is 1-4, and each * is an attachment site for a cationic dye moiety;

(e.1) in which \( n \) is 0-6, \( \nu \) is 1-4, and * is an attachment site for a cationic dye moiety;

(f) in which \( ni \) is 0-5, \( \nu_2 \) is 1-5 and each * is an attachment site for a cationic dye moiety;

(f.1) in which \( ni \) is 0-5, \( n_2 \) is 1-5 and * is an attachment site for a cationic dye moiety;
, in which \( n_1 \) is 0-5, \( n_2 \) is 1-5 and * is an attachment site for a cationic dye moiety;

, in which \( n_1 \) is 0-5, \( n_2 \) is 1-5 and each * is an attachment site for a cationic dye moiety;

, in which \( n_1 \) is 0-5, \( n_2 \) is 1-5 and * is an attachment site for a cationic dye moiety;

, in which \( n_1 \) is 0-5, \( n_2 \) is 1-5 and * is an attachment site for a cationic dye moiety;

, in which \( n_1 \) is 0-5, \( n_2 \) is 1-5, and each * is an attachment site for a cationic dye moiety;
(h.1) in which \( n \) is 0-5, \( n_2 \) is 1-5, and * is an attachment site for a cationic dye moiety;

(h.2) in which \( n \) is 0-5, \( n_2 \) is 1-5, and * is an attachment site for a cationic dye moiety;

(i) in which \( n \) and \( n_2 \) independently are 1-5 and each * is an attachment site for a cationic dye moiety;

(i.1) in which \( n \) and \( n_2 \) independently are 1-5 and * is an attachment site for a cationic dye moiety;

(.2) in which \( n \) and \( n_2 \) independently are 1-5 and * is an attachment site for a cationic dye moiety;
, in which \( n_2 \) is 1-5 and each * is an attachment site for a cationic dye moiety;

, in which \( n_2 \) is 1-5 and * is an attachment site for a cationic dye moiety;

, in which \( n_2 \) is 1-5 and * is an attachment site for a cationic dye moiety;

, in which \( l_1 \) and \( l_2 \) independently are 1-4, \( n \) is 1-4; **ring A** is aryl, heteroaryl, cycloalkyl, or heterocyclyl; for each independent instance of \( R_{a1} \) and \( R_{b1} \), \( R_{a1} \) and \( R_{b1} \) (1) independently are \( H \) or \( \text{CH}_3 \), or (2) \( R_{a1} \) and \( R_{b1} \) independently are \( \text{C} \text{H} \) or \( \text{O} \), or (3) two of \( \text{CR}_{a1} \text{R}_{b1} \) are \( \text{C} \text{H} \text{C} \) for each
independent instance of R₂ and R₃, R₂ and R₃ (1) independently are H or CH₃,

or (2) R₂ and R₃ independently are \[\text{structure} \], or (3) two of C R₂ R₃ are \[\text{structure} \]; and each * is an attachment site for a cationic dye moiety;

![Diagram](image)

, in which \( I₁, I₂, n, O₁, \) and \( O₂ \) independently are 1-4; ring \( A \) is aryl, heteroaryl, cycloalkyl, or heterocyclyl; for each independent instance of R₁,i and R₂,i, R₁,i and R₂,i (1) independently are H or CH₃,

or (2) R₁,i and R₂,i independently are \[\text{structure} \], or (3) two of C R₁,i R₂,i are \[\text{structure} \]; for each independent instance of R₁,2 and R₂,2, R₁,2 and R₂,2 (1)

independently are H or CH₃, or (2) R₁,2 and R₂,2 independently are \[\text{structure} \], or (3) two of C R₁,2 R₂,2 are \[\text{structure} \]; for each independent instance of R₁,2 and R₂,2, R₁,2 and R₂,2 (1) independently are H or CH₃, or (2) R₁,2 and R₂,2

independently are \[\text{structure} \], or \[\text{structure} \], for each independent instance of R₁,2 and R₂,2, R₁,2 and R₂,2 (1) independently are H or CH₃, or (2) R₁,2 and R₂,2

independently are \[\text{structure} \] or \[\text{structure} \]; and each * is an attachment site for a cationic dye moiety;

![Diagram](image)

, in which \( I₁, I₂, n, O₁, \) and \( O₂ \) independently are 1-4; ring \( A \) is aryl, heteroaryl, cycloalkyl, or heterocyclyl; for each independent instance of R₁,i and R₂,i, R₁,i and R₂,i (1) independently are H or CH₃, or (2) R₁,i
and $R_{b,i}$ independently are $\text{R}^{\text{V7}}_{\text{b}}$ or $\text{R}^{\text{0}}_{\text{b}}$, or (3) two of $\text{CR}_{\text{a},i}R_{\text{b},i}$ are $\text{R}^{\text{V7}}_{\text{b}}$ or $\text{R}^{\text{0}}_{\text{b}}$; for each independent instance of $R_{a,2}$ and $R_{b,2}$, $R_{c,2}$ and $R_{d,2}$ (1) independently are H or CH$_3$, or (2) $R_{a,2}$ and $R_{b,2}$ independently are $\text{R}^{\text{V7}}_{\text{b}}$ or $\text{R}^{\text{0}}_{\text{b}}$, or (3) two of $\text{CR}_{\text{a},2}R_{\text{b},2}$ are $\text{R}^{\text{V7}}_{\text{b}}$; for each independent instance of $R_{c,1}$ and $R_{d,1}$, $R_{c,1}$ and $R_{d,1}$ (1) independently are H or CH$_3$, or (2) $R_{c,1}$ and $R_{d,1}$ independently are $\text{R}^{\text{V7}}_{\text{b}}$ or $\text{R}^{\text{0}}_{\text{b}}$, or (3) two of $\text{CR}_{\text{c},i}R_{\text{d},i}$ are $\text{R}^{\text{V7}}_{\text{b}}$; for each independent instance of $R_{c,2}$ and $R_{d,2}$, $R_{c,2}$ and $R_{d,2}$ (1) independently are H or CH$_3$, or (2) $R_{c,2}$ and $R_{d,2}$ independently are $\text{R}^{\text{V7}}_{\text{b}}$ or $\text{R}^{\text{0}}_{\text{b}}$, or (3) two of $\text{CR}_{\text{c},2}R_{\text{d},2}$ are $\text{R}^{\text{V7}}_{\text{b}}$; and $\ast$ is an attachment site for a cationic dye moiety.

(1,2)

, in which $l_1$, $l_2$, $n$, $o_1$, and $o_2$ independently are 1-4; ring A is aryl, heteroaryl, cycloalkyl, or heterocyclyl; for each independent instance of $R_{a,1}$ and $R_{b,1}$, $R_{a,i}$ and $R_{b,i}$ (1) independently are H or CH$_3$, or (2) $R_{a,1}$ and $R_{b,1}$ independently are $\text{R}^{\text{V7}}_{\text{b}}$ or $\text{R}^{\text{0}}_{\text{b}}$, or (3) two of $\text{CR}_{\text{a},i}R_{\text{b},i}$ are $\text{R}^{\text{V7}}_{\text{b}}$; for each independent instance of $R_{a,2}$ and $R_{b,2}$, $R_{a,2}$ and $R_{b,2}$ (1) independently are H or CH$_3$, or (2) $R_{a,2}$ and $R_{b,2}$ independently are $\text{R}^{\text{V7}}_{\text{b}}$ or $\text{R}^{\text{0}}_{\text{b}}$, or (3) two of $\text{CR}_{\text{a},2}R_{\text{b},2}$ are $\text{R}^{\text{V7}}_{\text{b}}$; for each independent instance of $R_{i}$ and $R_{j}$, $R_{i}$ and $R_{d,i}$ (1) independently are H or CH$_3$, or (2) $R_{i}$ and $R_{d,i}$ independently are $\text{R}^{\text{V7}}_{\text{b}}$ or $\text{R}^{\text{0}}_{\text{b}}$, or (3) two of $\text{CR}_{\text{i},i}R_{\text{d},i}$ are $\text{R}^{\text{V7}}_{\text{b}}$; for each independent instance of $R_{c,2}$ and $R_{q,2}$, $R_{c,2}$ and $R_{q,2}$ (1) independently are H or CH$_3$, or (2) $R_{c,2}$ and $R_{q,2}$
independently are \( \text{O} \) \( \text{X} \) \( \text{O} \), or (3) two of \( \text{CR}_2 \text{R}_d \text{R}_2 \) are \( \text{O} \) \( \text{X} \) \( \text{O} \); and * is an attachment site for a cationic dye moiety;

\[ \text{(m)} \]

\[ \text{(m.1)} \]

\[ \text{(n)} \]

\[ \text{'n.1)} \]

, in which \( n \) is 0-6, \( \tilde{n} \) is 1-4, and each * is an attachment site for a cationic dye moiety;
, in which $n_2$ is 1-5 and * is an attachment site for a cationic dye moiety;

, in which in which $n_1$ is 0-5, $\frac{3}{4}$ is 1-5, $n_3$ is 0-5, and * is the attachment site for a cationic dye moiety;

, in which $n_2$ is 1-5, $n_3$ is 0-5, and * is the attachment site for a cationic dye moiety;

, in which $n_4$ is 0-5, $n_2$ is 1-5, and * is an attachment site for a cationic dye moiety;
Cationic Dyes Comprising Linkers

This disclosure also provides cationic dye moieties which comprise one or more linkers, which are suitable for preparing the conjugates and the cationic dimers disclosed herein. Cationic dyes useful for these embodiments include, but are not limited to, safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue. In some embodiments, the cationic dye moiety is present as a monomer. In other embodiments, the cationic dye moiety is present as a multimer. In either of these embodiments, the cationic dye moiety comprises one or more linkers, which may be the same or different. Suitable linkers include, but are not limited to, linkers (a), (a.1), (a.2), (b), (b.1), (c), (c.1), (c.2), (d), (e), (e.1), (f), (f.1), (f.2), (g), (g.1), (g.2), (h), (h.1), (h.2), (i), (i.1), (i.2), (j), (j-D), (j-2), (k), (l), (l.1), (l.2), (m), (m.1), (n), (n.1), (n.2), (o), (p), (q), (r), and (s), described above.

Examples of Cationic Dye Dimers

Some cationic dye dimers fall within formula (1):
[68] (1), in which each of D1 and D2 is a cationic dye moiety, n is 1-6, and ni is 1-4. In some variations of formula (1), D1 and D2 are different cationic dye moieties. In other variations of formula (1), D1 and D2 are the same cationic dye moiety. In some variations of formula (1), D1 and D2 independently are selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

[69] In some variations of formula (1) described in the paragraphs above, n is 1-6, 1-5, 1-4, 1-3, 1-2, 1-6, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 1, 2, 3, 4, 5, or 6.

[70] In some variations of formula (1) described in the paragraphs above, ni is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[71] In some variations of formula (1) described in the paragraphs above, D1 is safranin-O. In some variations of formula (1) described in the paragraphs above, D2 is safranin-O. In some variations of formula (1) described in the paragraphs above, D1 and D2 are safranin-O.

[72] In some variations of formula (1) described in the paragraph above, the pendant phenyl ring of D1 is unsubstituted. In some variations of formula (1) described in the paragraph above, the pendant phenyl ring of D1 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O⁻, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NÖ₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).
In some variations of formula (1) described in the paragraph above, the pendant phenyl ring of D2 is unsubstituted. In some variations of formula (1) described in the paragraph above, the pendant phenyl ring of D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₂), —CN, —S₀H, —COOH, —COOR, —CHO, and —COR, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl).

Some cationic dye dimers fall within formula (2):

\[
\text{D1} \quad \begin{array}{c}
\text{N} \\
\text{H}
\end{array} \\
n \quad \begin{array}{c}
\text{N} \\
\text{H}
\end{array} \\
\text{D2}
\]

In which each of D1 and D2 is a cationic dye moiety, n is 0-6, and \(\tilde{n}\) is 1-4.

In some variations of formula (2), D1 and D2 are different cationic dye moieties. In other variations of formula (2), D1 and D2 are the same cationic dye moiety. In some variations of formula (2), D1 and D2 are independently selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

In some variations of formula (2) described in the paragraphs above, n is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

In some variations of formula (2) described in the paragraphs above, \(\tilde{n}\) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.
In some variations of formula (2) described in the paragraphs above, D1 is safranin-O. In some variations of formula (2) described in the paragraphs above, D2 is safranin-O. In some variations of formula (2) described in the paragraphs above, D1 and D2 are safranin-O.

In some variations of formula (2) described in the paragraph above, the pendant phenyl ring of D1 is unsubstituted. In some variations of formula (2) described in the paragraph above, the pendant phenyl ring of D1 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NH2, —NHR, —NR2, —OH, —O’, —NHCOC3H, —NHCOR, —OCH3, —OR, —C2H5, —R, and —C6H5, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NO2, —NR3+, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF3, —CCl3, —CBr3, —Cl3), —CN, —SO2H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

In some variations of formula (2) described in the paragraph above, the pendant phenyl ring of D2 is unsubstituted. In some variations of formula (2) described in the paragraph above, the pendant phenyl ring of D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NH2, —NHR, —NR2, —OH, —O’, —NHCOC3H, —NHCOR, —OCH3, —OR, —C2H5, —R, and —C6H5, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NO2, —NR3+, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF3, —CCl3, —CBr3, —Cl3), —CN, —SO2H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).
Some cationic dye dimers fall within formula (3):

\[ \text{(3)} \]

\[ D_1 + \text{R}_a + \text{R}_b + \text{R}_n + D_2 \]

, in which each of \( D_1 \) and \( D_2 \) is a cationic dye moiety; \( n \) is 0-6, and \( n \) is 1-4; and, for each independent instance of \( \text{R}_a \) and \( \text{R}_b \), (1) \( \text{R}_a \) and \( \frac{3}{4} \), independently are H or CH₃, or (2) \( \text{R}_a \) and \( \text{R}_b \) are \( \text{O} \) or \( \text{O} \), or (3) two of \( \text{C} \text{R}_a \text{R}_b \) are.

In some variations of formula (3), \( D_1 \) and \( D_2 \) are different cationic dye moieties. In other variations of formula (3), \( D_1 \) and \( D_2 \) are the same cationic dye moiety. In some variations of formula (3), \( D_1 \) and \( D_2 \) are independently selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

In some variations of formula (3) described in the paragraphs above, \( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

In some variations of formula (3) described in the paragraphs above, \( n \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (3) described in the paragraphs above in which \( n \) is 1, \( \text{R}_a \) and \( \text{R}_b \) are both H. In some variations of formula (3) described in the paragraphs above in which \( n \) is 1, \( \text{R}_a \) is H and \( \text{R}_b \) is CH₃. In some variations of formula (3) described in the paragraphs above in which \( n \) is 1, \( \text{R}_a \) and \( \text{R}_b \) are both CH₃. In some variations of formula (3) described in the paragraphs above in which \( n \) is 1, \( \text{R}_a \) and \( \text{R}_b \) are.

In some variations of formula (3) described in the paragraphs above in which \( n \) is 2, the two instances of \( \text{R}_a \) and \( \text{R}_b \) are indicated as \( \text{R}_{a1} \) and \( \text{R}_{b1} \) and \( \text{R}_{a2} \) and \( \text{R}_{b2} \), respectively. In some variations of formula (3) described in the paragraphs above in which \( n \) is 2, each of \( \text{R}_{a1} \) and \( \text{R}_{b1} \) and \( \text{R}_{a2} \) and \( \text{R}_{b2} \) is H. In some variations of formula (3) described in the paragraphs above in which \( n \) is 2, each of \( \text{R}_{a1} \) and \( \text{R}_{b1} \) and \( \text{R}_{a2} \) and \( \text{R}_{b2} \) is CH₃. In some variations of formula (3) described in the paragraphs above in which \( n \) is 2, each of \( \text{R}_{a1} \) and \( \text{R}_{a2} \) is H and each of \( \text{R}_{b1} \) and
In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 2, each of \( R_{a1} \), \( R_{a2} \), and \( R_{b1} \) is H and \( R_{b2} \) is \( \text{CH}_3 \).

In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 2, each of \( R_{a1} \) and \( R_{b1} \) is H and \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \). In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 2, each of \( R_{a1} \) and \( R_{b1} \) is \( \text{CH}_3 \) and \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \).

In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 2, \( R_{a1} \) is H, \( R_{b1} \) is \( \text{CH}_3 \), and \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \). In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 2, \( R_{a1} \) is \( \text{CH}_3 \), \( R_{b1} \) is H, and \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \). In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 2, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), and \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \).

In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 2, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), and \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \). In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 2, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), and \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \).

In variations of formula (3) described in the paragraphs above in which \( n_i \) is 3, the three instances of \( R_a \) and \( R_b \) are indicated as \( R_{a1} \) and \( R_{b1} \); \( R_{a2} \) and \( R_{b2} \); and \( R_{a3} \) and \( R_{b3} \), respectively. In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 3, each of \( R_{a1} \), \( R_{b1} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), and \( R_{b3} \) is \( \text{H} \). In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 3, each of \( R_{a1} \), \( R_{b1} \), \( R_{b2} \), \( R_{a3} \), and \( R_{b3} \) is \( \text{CH}_3 \). In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 3, each of \( R_{a1} \), \( R_{b1} \), \( R_{a2} \), and \( R_{b2} \) is H and...
each of $R_{a3}$ and $R_{b3}$ is CH$_3$. In some variations of formula (3) described in the paragraphs above in which $n_i$ is 3, each of $R_{a1}$, $R_{b1}$, and $R_{b2}$, is CH$_3$ and each of $R_{a3}$ and $R_{b3}$ is H. In some variations of formula (3) described in the paragraphs above in which $n_i$ is 3, each of $R_{a1}$, $R_{a2}$, and $R_{b2}$, is H and each of $R_{a3}$, $R_{b1}$, and $R_{b3}$ is CH$_3$. In some variations of formula (3) described in the paragraphs above in which $n_i$ is 3, each of $R_{a1}$ and $R_{a2}$ is H and each of $R_{b1}$ and $R_{b2}$ is CH$_3$, and $R_{a3}$ and $R_{b3}$ are.

[89] In some variations of formula (3) described in the paragraphs above in which $n_i$ is 3, each of $R_{a1}$, $R_{b1}$, and $R_{b2}$, is H and each of $R_{a3}$ and $R_{b3}$ are.

[90] In some variations of formula (3) described in the paragraphs above in which $n_i$ is 3, each of $R_{a1}$, $R_{b1}$, and $R_{b2}$, is H and each of $R_{a3}$ and $R_{b3}$ are.

[91] In some variations of formula (3) described in the paragraphs above in which $n_i$ is 3, $R_{a1}$, and $R_{b1}$ are.
R_{b2} are $\Delta$, and each of R_{a3} and R_{b3} is CH₃. In some variations of formula (3) described in the paragraphs above in which $n_i$ is 3, R_{a1} and R_{b1} are $\Delta$, R_{a2} and R_{b2} are $\Delta$, R_{a3} is H, and R_{b3} is CH₃. In some variations of formula (3) described in the paragraphs above in which $n_I$ is 3, R_{a1} and R_{b1} are $\Delta$, R_{a2} and R_{b2} are $\Delta$, and each of R_{a3} and R_{b3} is H. In some variations of formula (3) described in the paragraphs above in which $n_I$ is 3, R_{a1} and R_{b1} are $\Delta$, R_{a2} and R_{b2} are $\Delta$, and each of R_{a3} and R_{b3} is CH₃. In some variations of formula (3) described in the paragraphs above in which $n_I$ is 3, R_{a1} and R_{b1} are $\Delta$, R_{a2} and R_{b2} are $\Delta$, R_{a3} is H, and R_{b3} is CH₃.

[92] In some variations of formula (3) described in the paragraphs above in which $n_I$ is 3, R_{a1} and R_{b1} are $\Delta$, R_{a2} and R_{b2} are $\Delta$, and each of R_{a3} and R_{b3} is H. In some variations of formula (3) described in the paragraphs above in which $n_I$ is 3, R_{a1} and R_{b1} are $\Delta$, R_{a2} and R_{b2} are $\Delta$, and each of R_{a3} and R_{b3} is CH₃. In some variations of formula (3) described in the paragraphs above in which $n_I$ is 3, R_{a1} and R_{b1} are $\Delta$, R_{a2} and R_{b2} are $\Delta$, R_{a3} is H, and R_{b3} is CH₃. In some variations of formula (3) described in the paragraphs above in which $n_I$ is 3, R_{a1} and R_{b1} are $\Delta$, R_{a2} and R_{b2} are $\Delta$, and each of R_{a3} and R_{b3} is CH₃. In some variations of formula (3) described in the paragraphs above in which $n_I$ is 3, R_{a1} and R_{b1} are $\Delta$, R_{a2} and R_{b2} are $\Delta$, R_{a3} is H, and R_{b3} is CH₃.
In some variations of formula (3) described in the paragraphs above in which \( n_1 \) is 3, \( R_a \) and \( R_b \) are \( \gamma \), \( R_{a2} \) and \( R_{b1} \) are \( \gamma \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (3) described in the paragraphs above in which \( ni \) is 3, \( R_a \) and \( R_b \) are \( \gamma \), \( R_{a2} \) and \( R_{b1} \) are \( \gamma \), and each of \( R_{a3} \) and \( R_{b3} \) is \( CH_3 \). In some variations of formula (3) described in the paragraphs above in which \( n_1 \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \gamma \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (3) described in the paragraphs above in which \( ni \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \gamma \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma \), and each of \( R_{a3} \) and \( R_{b3} \) is \( CH_3 \). In some variations of formula (3) described in the paragraphs above in which \( n_1 \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \gamma \), \( R_{a2} \) and \( R_{b2} \) together are \( \gamma \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (3) described in the paragraphs above in which \( ni \) is 3, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \gamma \), and each of \( R_{a3} \) and \( R_{b3} \) is \( CH_3 \). In some variations of formula (3) described in the paragraphs above in which \( n_1 \) is 3, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \gamma \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (3) described in the paragraphs above in which \( ni \) is 3, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \gamma \), and each of \( R_{a3} \) and \( R_{b3} \) is \( CH_3 \). In some variations of formula (3) described in the paragraphs above in which \( n_1 \) is 3, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \gamma \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (3) described in the paragraphs above in which \( ni \) is 3, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \gamma \), and each of \( R_{a3} \) and \( R_{b3} \) is \( CH_3 \). In some variations of formula (3) described in the paragraphs above in which \( n_1 \) is 3, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \gamma \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (3) described in the paragraphs above in which \( ni \) is 3, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \gamma \), and each of \( R_{a3} \) and \( R_{b3} \) is \( CH_3 \). In some variations of formula (3) described in the paragraphs above in which \( n_1 \) is 3, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \gamma \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (3) described in the paragraphs above in which \( ni \) is 3, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \gamma \), and each of \( R_{a3} \) and \( R_{b3} \) is \( CH_3 \).
respectively. In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, \frac{3}{2} > 2, R_{a3}, \frac{3}{2} > 3, R_{a4}, \) and \( R_{b4} \) is H. In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3}, \frac{3}{2} > 3, \frac{3}{2} > 4, \) and \( R_{b4} \) is CH\(_3\). In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3}, R_{b3} \) is H and each of \( R_{a4} \) and \( R_{b4} \) is CH\(_3\). In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, R_{b2} \) is H and each of \( R_{a3}, R_{b3}, R_{a4}, \) and \( R_{b4} \) is CH\(_3\). In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3}, \) and \( R_{b3} \) is CH\(_3\) and each of \( R_{a4} \) and \( R_{b4} \) is H.

[96] In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, each of \( R_{a1}, R_{a2}, \) and \( R_{a3} \) is H and each of \( R_{b1}, R_{b2}, \) and \( R_{b3} \) is CH\(_3\). In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, \( R_{a1} \) is H, \( R_{b1} \) is CH\(_3\), and each of \( R_{a2}, R_{b2}, R_{a3}, \) and \( R_{b3} \) is H. In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, each of \( R_{a1} \) and \( R_{a2} \) is H, each of \( R_{b1} \) and \( R_{b2} \) is CH\(_3\), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, each of \( R_{a1} \) and \( R_{a2} \) is H, each of \( R_{b1} \) and \( R_{b2} \) is CH\(_3\), and each of \( R_{a3} \) and \( R_{b3} \) is CH\(_3\).

[97] In some variations of formula (3) described in the paragraphs above in which \( n_j \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are H, \( R_{a3} \) and \( R_{b3} \) are H, and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{2} > 3, \frac{3}{2} > 4 \). In some variations of formula (3) described in the paragraphs above in which \( n_j \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are H, \( R_{a3} \) and \( R_{b3} \) are CH\(_3\), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{2} > 3, \frac{3}{2} > 4 \). In some variations of formula (3) described in the paragraphs above in which \( n_j \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are CH\(_3\), \( R_{a3} \) and \( R_{b3} \) are CH\(_3\), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{2} > 3, \frac{3}{2} > 4 \). In some variations of formula (3) described in the paragraphs above in which \( n_j \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are H, \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{2} > 3, \frac{3}{2} > 4 \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{2} > 3, \frac{3}{2} > 4 \). In some
variations of formula (3) described in the paragraphs above in which \( n \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are CH\(_3\), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH} \(_3\)\). In some variations of formula (3) described in the paragraphs above in which \( n \) is 4, \( R_{a1} \) and \( R_{b1} \) are CH\(_3\), \( R_{a2} \) and \( R_{b2} \) are CH\(_3\), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH} \(_3\)\). In some variations of formula (3) described in the paragraphs above in which \( n \) is 4, \( R_{a1} \) is H, \( R_{b1} \) is CH\(_3\), \( R_{a2} \) is H, \( R_{b2} \) is CH\(_3\), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH} \(_3\)\). In some variations of formula (3) described in the paragraphs above in which \( n \) is 4, \( R_{a1} \) is H, \( R_{b1} \) is CH\(_3\), \( R_{a2} \) is H, \( R_{b2} \) is \( \text{CH} \(_3\)\), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH} \(_3\)\). In some variations of formula (3) described in the paragraphs above in which \( n \) is 4, \( R_{a1} \) and \( R_{b1} \) are CH\(_3\), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH} \(_3\)\), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH} \(_3\)\). In some variations of formula (3) described in the paragraphs above in which \( n \) is 4, \( R_{a1} \) and \( R_{b1} \) are CH\(_3\), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH} \(_3\)\), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH} \(_3\)\).
described in the paragraphs above in which \( n \) is 4, \( R_{\text{a}i} \) and \( R_{\text{b}i} \) are CH$_3$, \( R_{\text{a}2} \) and \( R_{\text{b}2} \) are CH$_3$.

\[
\text{R}_{\text{a}3} \text{ and } R_{\text{b}3} \text{ are } \text{CH}_3, \text{ and } R_{\text{a}4} \text{ and } R_{\text{b}4} \text{ are } \text{CH}_3. 
\]

[101] In some variations of formula (3) described in the paragraphs above in which \( n \) is 4, \( R_{\text{a}i} \) and \( R_{\text{b}i} \) are H, \( R_{\text{a}2} \) and \( R_{\text{b}2} \) are H, \( R_{\text{a}3} \) and \( R_{\text{b}3} \) are CH$_3$, \( R_{\text{a}4} \) and \( R_{\text{b}4} \) are CH$_3$. In some variations of formula (3) described in the paragraphs above in which \( n \) is 4, \( R_{\text{a}i} \) and \( R_{\text{b}i} \) are CH$_3$, \( R_{\text{a}2} \) and \( R_{\text{b}2} \) are CH$_3$, \( R_{\text{a}3} \) and \( R_{\text{b}3} \) are CH$_3$, \( R_{\text{a}4} \) and \( R_{\text{b}4} \) are CH$_3$. In some variations of formula (3) described in the paragraphs above in which \( n \) is 4, \( R_{\text{a}i} \) is H, \( R_{\text{b}i} \) is CH$_3$, \( R_{\text{a}2} \) is H, \( R_{\text{b}2} \) is CH$_3$, \( R_{\text{a}3} \) and \( R_{\text{b}3} \) are CH$_3$, \( R_{\text{a}4} \) and \( R_{\text{b}4} \) are CH$_3$. In some variations of formula (3) described in the paragraphs above in which \( n \) is 4, \( R_{\text{a}i} \) is H, \( R_{\text{b}i} \) is CH$_3$, \( R_{\text{a}2} \) is H, \( R_{\text{b}2} \) is CH$_3$, \( R_{\text{a}3} \) and \( R_{\text{b}3} \) are CH$_3$, \( R_{\text{a}4} \) and \( R_{\text{b}4} \) are CH$_3$. In some variations of formula (3) described in the paragraphs above in which \( n \) is 4, \( R_{\text{a}i} \) is H, \( R_{\text{b}i} \) is CH$_3$, \( R_{\text{a}2} \) is H, \( R_{\text{b}2} \) is CH$_3$, \( R_{\text{a}3} \) and \( R_{\text{b}3} \) are CH$_3$, \( R_{\text{a}4} \) and \( R_{\text{b}4} \) are CH$_3$. In some variations of formula (3) described in the paragraphs above in which \( n \) is 4, \( R_{\text{a}i} \) is H, \( R_{\text{b}i} \) is CH$_3$, \( R_{\text{a}2} \) is H, \( R_{\text{b}2} \) is CH$_3$, \( R_{\text{a}3} \) and \( R_{\text{b}3} \) are CH$_3$, \( R_{\text{a}4} \) and \( R_{\text{b}4} \) are CH$_3$.
In some variations of formula (3) described in the paragraphs above in which \( n \) is 4, \( R\text{a}_i \) and \( R\text{b}_i \) are \( \text{CH}_3 \), \( R\text{a}_2 \) and \( R\text{b}_2 \) are \( \text{H} \), and \( R\text{a}_3 \) and \( R\text{b}_3 \) are \( \text{H} \). In some variations of formula (3) described in the paragraphs above in which \( t\text{ii} \) is 4, \( R\text{a}_i \) and \( R\text{b}_i \) are \( \text{CH}_3 \), and \( R\text{a}_4 \) and \( R\text{b}_4 \) are \( \text{H} \). In some variations of formula (3) described in the paragraphs above in which \( n \) is 4, \( R\text{a}_i \) and \( R\text{b}_i \) are \( \text{CH}_3 \), and \( R\text{a}_4 \) and \( R\text{b}_4 \) are \( \text{H} \).
In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{O} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{O} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{O} \). In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( 3/4 \), \( R_{a2} \) and \( R_{b2} \) are \( 3/4 \), \( R_{a3} \) and \( R_{b3} \) are \( 3/4 \), and \( R_{a4} \) and \( R_{b4} \) are \( 3/4 \).

[107] In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{O} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{O} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{O} \). In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{O} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{O} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{O} \). In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{O} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{O} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{O} \).

R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{O} \).

[109] In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{O} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{O} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{O} \).

[110] In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \text{O} \). In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \text{O} \). In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, \( R_{a1} \) and \( R_{a2} \) are \( \text{H} \), \( R_{b1} \) and \( R_{b2} \) are \( \text{CH}_3 \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \text{O} \).
In some variations of formula (3) described in the paragraphs above in which \( n = 4 \), \( R_a \) and \( R_{bi} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( H \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( H \). In some variations of formula (3) described in the paragraphs above in which \( n = 4 \), \( R_a \) and \( R_{bi} \) are \( O \), \( R_{a2} \) and \( R_{b2} \) are \( O \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( O \). In some variations of formula (3) described in the paragraphs above in which \( n = 4 \), \( R_a \) and \( R_{bi} \) are \( O \), \( R_{a2} \) and \( R_{b2} \) are \( O \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( O \). In some variations of formula (3) described in the paragraphs above in which \( n = 4 \), \( R_a \) and \( R_{bi} \) are \( O \), \( R_{a2} \) and \( R_{b2} \) are \( O \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( O \). In some variations of formula (3) described in the paragraphs above in which \( n = 4 \), \( R_a \) and \( R_{bi} \) are \( O \), \( R_{a2} \) and \( R_{b2} \) are \( O \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( O \). In some variations of formula (3) described in the paragraphs above in which \( n = 4 \), \( R_a \) and \( R_{bi} \) are \( O \), \( R_{a2} \) and \( R_{b2} \) are \( O \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( O \). In some variations of formula (3) described in the paragraphs above in which \( n = 4 \), \( R_a \) and \( R_{bi} \) are \( O \), \( R_{a2} \) and \( R_{b2} \) are \( O \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( O \).
In some variations of formula (3) described in the paragraphs above in which \( n_i \) is 4, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \text{--}N\text{O}_2 \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \text{--}\text{N}R_3^+ \), wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from \( \text{--}\text{NH}_2 \), \( \text{--}\text{NHR} \), \( \text{--}\text{NR}_2 \), \( \text{--}\text{OH} \), \( \text{--}\text{O}^+ \), \( \text{--}\text{NHCOCH}_3 \), \( \text{--}\text{NHCOR} \), \( \text{--}\text{OCH}_3 \), \( \text{--}\text{OR} \), \( \text{--}C_2\text{H}_5 \), \( \text{--}R \), and \( \text{--}C_6\text{H}_5 \) wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

In some variations of formula (3) described in the paragraphs above, D1 is safranin-O. In some variations of formula (3) described in the paragraphs above, D2 is safranin-O. In some variations of formula (3) described in the paragraphs above, D1 and D2 are safranin-O.

In some variations of formula (3) described in the paragraph above, the pendant phenyl ring of D1 is unsubstituted. In some variations of formula (3) described in the paragraph above, the pendant phenyl ring of D1 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from \( \text{--}\text{NO}_2 \), \( \text{--}\text{NR}_3^+ \), halo (e.g., F, Br, Cl, I), trihalide (e.g., \( \text{--}\text{CF}_3 \), \( \text{--}\text{CCl}_3 \), \( \text{--}\text{CBr}_3 \), \( \text{--}\text{Cl}_3 \) ), \( \text{--}\text{CN} \), \( \text{--}\text{SO}_2\text{H} \), \( \text{--}\text{COOH} \), \( \text{--}\text{COOR} \), \( \text{--}\text{CHO} \), and \( \text{--}\text{COR} \) wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

In some variations of formula (3) described in the paragraph above, the pendant phenyl ring of D2 is unsubstituted. In some variations of formula (3) described in the paragraph above, the pendant phenyl ring of D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from \( \text{--}\text{NH}_2 \), \( \text{--}\text{NHR} \), \( \text{--}\text{NR}_2 \), \( \text{--}\text{OH} \), \( \text{--}\text{O}^+ \), \( \text{--}\text{NHCOCH}_3 \), \( \text{--}\text{NHCOR} \), \( \text{--}\text{OCH}_3 \), \( \text{--}\text{OR} \), \( \text{--}C_2\text{H}_5 \), \( \text{--}R \), and \( \text{--}C_6\text{H}_5 \) wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from \( \text{--}\text{NO}_2 \), \( \text{--}\text{NR}_3^+ \), halo (e.g., F, Br, Cl, I), trihalide
(e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₃H, —COOH, —COOR, —CHO, and
—COR, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-
C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-
C₆, C₅, or C₆ linear or branched alkyl).

[119] Some cationic dye dimers fall within formula (4):

![Diagram](image)

(4)

, in which each of D₁ and D₂ is a cationic dye moiety; k is 2-10 and, for each independent instance of Rₐ and Rₐ, Rₐ and Rₐ (1) independently are H or
CH₃, or (2) Rₐ and Rₐ are or, or (3) two of CRₐRₐ are .

[120] In some variations of formula (4), D₁ and D₂ are different cationic dye moieties. In other variations of formula (4), D₁ and D₂ are the same cationic dye moiety. In some variations of formula (4), D₁ and D₂ are independently selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

[121] In some variations of formula (4) described in the paragraphs above, k is 2-10, 2-9, 2-8,
2-7, 2-6, 2-5, 2-4, 2-3, 3-10, 3-9, 3-8, 3-7, 3-6, 3-5, 3-4, 4-10, 4-9, 4-8, 4-7, 4-6, 4-5, 5-10, 5-9, 5-
8, 5-7, 5-6, 6-10, 6-9, 6-8, 6-7, 7-10, 7-9, 7-8, 8-10, 8-9, 9-10, 2, 3, 4, 5, 6, 7, 8, 9, or 10.

[122] In some variations of formula (4) described in the paragraphs above, each Rₐ is H and each Rₐ is H. In some variations of formula (4) described in the paragraphs above, each Rₐ is H and each Rₐ is CH₃. In some variations of formula (4) described in the paragraphs above, each
Rₐ and Rₐ is . In some variations of formula (4) described in the paragraphs above, each
Rₐ and Rₐ is . In some variations of formula (4) described in the paragraphs above, each
two of CRₐRₐ are .

[123] In some variations of formula (4) described in the paragraphs above, in a first occurrence
of Rₐ and Rₐ, each of Rₐ and Rₐ is H, and the remaining occurrences of Rₐ and Rₐ are as defined
above for formula (4). In some variations of formula (4) described in the paragraphs above, in a
first occurrence of Rₐ and Rₐ, each of Rₐ and Rₐ is CH₃, and the remaining occurrences of Rₐ

and $R_\text{b}$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in a first occurrence of $R_\text{a}$ and $R_\text{b}$, a first $R_\text{a}$ is H, a first $R_\text{b}$ is CH$_3$, and the remaining occurrences of $R_\text{a}$ and $R_\text{b}$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in a first occurrence of $R_\text{a}$ and $R_\text{b}$, $R_\text{a}$ and $R_\text{b}$ are \[\delta_3\delta\delta\], and the remaining occurrences of $R_\text{a}$ and $R_\text{b}$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in a first occurrence of $R_\text{a}$ and $R_\text{b}$, $R_\text{a}$ and $R_\text{b}$ are \[\delta_3\delta\delta\], and the remaining occurrences of $R_\text{a}$ and $R_\text{b}$ are as defined above for formula (4).

[124] In some variations of formula (4) described in the paragraphs above, in two occurrences of $R_\text{a}$ and $R_\text{b}$, each of $R_\text{a}$ and $R_\text{b}$ is H, and the remaining occurrences of $R_\text{a}$ and $R_\text{b}$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in two occurrences of $R_\text{a}$ and $R_\text{b}$, each of $R_\text{a}$ and $R_\text{b}$ is CH$_3$, and the remaining occurrences of $R_\text{a}$ and $R_\text{b}$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in two occurrences of $R_\text{a}$ and $R_\text{b}$, two of $R_\text{a}$ are H, two of $R_\text{b}$ are CH$_3$, and the remaining occurrences of $R_\text{a}$ and $R_\text{b}$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in two occurrences of $R_\text{a}$ and $R_\text{b}$, $R_\text{a}$ and $R_\text{b}$ are \[\delta_3\delta\delta\], and the remaining occurrences of $R_\text{a}$ and $R_\text{b}$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in two occurrences of $R_\text{a}$ and $R_\text{b}$, $R_\text{a}$ and $R_\text{b}$ are \[\delta_3\delta\delta\], and the remaining occurrences of $R_\text{a}$ and $R_\text{b}$ are as defined above for formula (4).

[125] In some variations of formula (4) described in the paragraphs above, in three occurrences of $R_\text{a}$ and $R_\text{b}$, each of $R_\text{a}$ and $R_\text{b}$ is H, and the remaining occurrences of $R_\text{a}$ and $R_\text{b}$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in three occurrences of $R_\text{a}$ and $R_\text{b}$, each of $R_\text{a}$ and $R_\text{b}$ is CH$_3$, and the remaining occurrences of $R_\text{a}$ and $R_\text{b}$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in three occurrences of $R_\text{a}$ and $R_\text{b}$, three of $R_\text{a}$ are H, three of $R_\text{b}$ are CH$_3$, and the remaining occurrences of $R_\text{a}$ and $R_\text{b}$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in three occurrences of $R_\text{a}$ and $R_\text{b}$, $R_\text{a}$ and $R_\text{b}$ are \[\delta_3\delta\delta\], and the remaining occurrences of $R_\text{a}$ and $R_\text{b}$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in three occurrences of $R_\text{a}$ and $R_\text{b}$, $R_\text{a}$ and $R_\text{b}$ are \[\delta_3\delta\delta\], and the remaining occurrences of $R_\text{a}$ and $R_\text{b}$ are as defined above for formula (4).
some variations of formula (4) described in the paragraphs above, in three occurrences of $R_a$ and $R_b$, $R_a$ and $R_b$ are $\text{\textcircled{H}}$, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4).

[126] In some variations of formula (4) described in the paragraphs above, in four occurrences of $R_a$ and $R_b$, each of $R_a$ and $R_b$ is H, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in four occurrences of $R_a$ and $R_b$, each of $R_a$ and $R_b$ is CH$_3$, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in four occurrences of $R_a$ and $R_b$, four of $R_a$ are H, four of $R_b$ are CH$_3$, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in four occurrences of $R_a$ and $R_b$, $R_a$ and $R_b$ are $\text{\textcircled{H}}$, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4).

[127] In some variations of formula (4) described in the paragraphs above, in five occurrences of $R_a$ and $R_b$, each of $R_a$ and $R_b$ is H, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in five occurrences of $R_a$ and $R_b$, each of $R_a$ and $R_b$ is CH$_3$, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in five occurrences of $R_a$ and $R_b$, five of $R_a$ are H, five of $R_b$ are CH$_3$, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in five occurrences of $R_a$ and $R_b$, $R_a$ and $R_b$ are $\text{\textcircled{H}}$, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in five occurrences of $R_a$ and $R_b$, $R_a$ and $R_b$ are $\text{\textcircled{H}}$, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4).
In some variations of formula (4) described in the paragraphs above, in six occurrences of $R_a$ and $R_b$, each of $R_a$ and $R_b$ is H, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in six occurrences of $R_a$ and $R_b$, each of $R_a$ and $R_b$ is CH$_3$, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in six occurrences of $R_a$ and $R_b$, six of $R_a$ are H, six of $R_b$ are CH$_3$, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in six occurrences of $R_a$ and $R_b$, eight of $R_a$ are H, eight of $R_b$ are CH$_3$, and

In some variations of formula (4) described in the paragraphs above, in seven occurrences of $R_a$ and $R_b$, each of $R_a$ and $R_b$ is H, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in seven occurrences of $R_a$ and $R_b$, each of $R_a$ and $R_b$ is CH$_3$, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in seven occurrences of $R_a$ and $R_b$, seven of $R_a$ are H, seven of $R_b$ are CH$_3$, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in seven occurrences of $R_a$ and $R_b$, eight of $R_a$ are H, eight of $R_b$ are CH$_3$, and

In some variations of formula (4) described in the paragraphs above, in eight occurrences of $R_a$ and $R_b$, each of $R_a$ and $R_b$ is H, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in eight occurrences of $R_a$ and $R_b$, each of $R_a$ and $R_b$ is CH$_3$, and the remaining occurrences of $R_a$ and $R_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in eight occurrences of $R_a$ and $R_b$, eight of $R_a$ are H, eight of $R_b$ are CH$_3$, and
the remaining occurrences of \( R_a \) and \( R_b \) as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in eight occurrences of \( R_a \) and \( R_b \), \( R_a \) and \( R_b \) are \( \text{O} \), and the remaining occurrences of \( R_a \) and \( R_b \) are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in eight occurrences of \( R_a \) and \( R_b \), \( R_a \) and \( R_b \) are \( \text{O} \), and the remaining occurrences of \( R_a \) and \( R_b \) are as defined above for formula (4).

[131] In some variations of formula (4) described in the paragraphs above, in nine occurrences of \( R_a \) and \( R_b \), each of \( R_a \) and \( R_b \) is H, and the remaining occurrences of \( R_a \) and \( R_b \) are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in nine occurrences of \( R_a \) and \( R_b \), each of \( R_a \) and \( R_b \) is CH\(_3\), and the remaining occurrences of \( R_a \) and \( R_b \) are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in nine occurrences of \( R_a \) and \( R_b \), nine of \( R_a \) are H, nine of \( R_b \) are CH\(_3\), and the remaining occurrences of \( R_a \) and \( R_b \) are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in nine occurrences of \( R_a \) and \( R_b \), \( R_a \) and \( R_b \) are \( \text{O} \), and the remaining occurrences of \( R_a \) and \( R_b \) are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in nine occurrences of \( R_a \) and \( R_b \), \( R_a \) and \( R_b \) are \( \text{O} \), and the remaining occurrences of \( R_a \) and \( R_b \) are as defined above for formula (4).

[132] In some variations of formula (4) described in the paragraphs above, in ten occurrences of \( R_a \) and \( R_b \), each of \( R_a \) and \( R_b \) is H, and the remaining occurrences of \( R_a \) and \( R_b \) are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in ten occurrences of \( R_a \) and \( R_b \), each of \( R_a \) and \( R_b \) is CH\(_3\), and the remaining occurrences of \( R_a \) and \( R_b \) are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in ten occurrences of \( R_a \) and \( R_b \), ten of \( R_a \) are H, ten of \( R_b \) are CH\(_3\), and the remaining occurrences of \( R_a \) and \( R_b \) are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in ten occurrences of \( R_a \) and \( R_b \), \( R_a \) and \( R_b \) are \( \text{O} \), and the remaining occurrences of \( R_a \) and \( R_b \) are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, in ten occurrences of \( R_a \) and \( R_b \), \( R_a \)
and $\mathbf{R}_h$ are $\mathbf{R}_a$, and the remaining occurrences of $\mathbf{R}_a$ and $\mathbf{R}_b$ are as defined above for formula (4).

[133] In some variations of formula (4) described in the paragraphs above, two occurrences of $\mathbf{R}_a$ and $\mathbf{R}_b$ are $\mathbf{R}_a$, and the remaining occurrences of $\mathbf{R}_a$ and $\mathbf{R}_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, four occurrences of $\mathbf{R}_a$ and $\mathbf{R}_b$ are $\mathbf{R}_a$, and the remaining occurrences of $\mathbf{R}_a$ and $\mathbf{R}_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, six occurrences of $\mathbf{R}_a$ and $\mathbf{R}_b$ are $\mathbf{R}_a$, and the remaining occurrences of $\mathbf{R}_a$ and $\mathbf{R}_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, eight occurrences of $\mathbf{R}_a$ and $\mathbf{R}_b$ are $\mathbf{R}_a$, and the remaining occurrences of $\mathbf{R}_a$ and $\mathbf{R}_b$ are as defined above for formula (4). In some variations of formula (4) described in the paragraphs above, ten occurrences of $\mathbf{R}_a$ and $\mathbf{R}_b$ are $\mathbf{R}_a$.

[134] In some variations of formula (4) described in the paragraphs above, $\mathbf{D}_1$ is safranin-O. In some variations of formula (4) described in the paragraphs above, $\mathbf{D}_2$ is safranin-O. In some variations of formula (4) described in the paragraphs above, $\mathbf{D}_1$ and $\mathbf{D}_2$ are safranin-O.

[135] In some variations of formula (4) described in the paragraph above, the pendant phenyl ring of $\mathbf{D}_1$ is unsubstituted. In some variations of formula (4) described in the paragraph above, the pendant phenyl ring of $\mathbf{D}_1$ is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of $\mathbf{D}_1$ is substituted, the substituents are selected independently from $-\mathbf{NH}_2$, $-\mathbf{NHR}$, $-\mathbf{NR}_2$, $-\mathbf{OH}$, $-\mathbf{O}^-$, $-\mathbf{NHCOR}$, $-\mathbf{OCH}_3$, $-\mathbf{OR}$, $-\mathbf{C}_2\mathbf{H}_4$, $-\mathbf{R}$, and $-\mathbf{C}_6\mathbf{H}_5$, wherein $\mathbf{R}$ is $\mathbf{C}_1-\mathbf{C}_6$ linear or branched alkyl (e.g., $\mathbf{C}_1\mathbf{-C}_6$, $\mathbf{C}_1\mathbf{-C}_5$, $\mathbf{C}_1\mathbf{-C}_4$, $\mathbf{C}_1\mathbf{-C}_3$, $\mathbf{C}_1\mathbf{-C}_2$, $\mathbf{C}_1$, $\mathbf{C}_2\mathbf{-C}_6$, $\mathbf{C}_2\mathbf{-C}_5$, $\mathbf{C}_2\mathbf{-C}_4$, $\mathbf{C}_2\mathbf{-C}_3$, $\mathbf{C}_2$, $\mathbf{C}_3\mathbf{-C}_6$, $\mathbf{C}_3\mathbf{-C}_5$, $\mathbf{C}_3\mathbf{-C}_4$, $\mathbf{C}_3$, $\mathbf{C}_4\mathbf{-C}_6$, $\mathbf{C}_4\mathbf{-C}_5$, $\mathbf{C}_4$, $\mathbf{C}_5\mathbf{-C}_6$, $\mathbf{C}_5$, or $\mathbf{C}_6$ linear or branched alkyl). In some embodiments in which the pendant phenyl ring of $\mathbf{D}_1$ is substituted, the substituents are selected independently from $-\mathbf{N}_0\mathbf{H}_2$, $-\mathbf{N}_0\mathbf{R}_3^+$, halo (e.g., $\mathbf{F}$, $\mathbf{Br}$, $\mathbf{Cl}$, $\mathbf{I}$), trihalide (e.g., $-\mathbf{CF}_3$, $-\mathbf{CCI}_3$, $-\mathbf{CBr}_3$, $-\mathbf{Cl}_3$), $-\mathbf{CN}$, $-\mathbf{S}_2\mathbf{H}_2$, $-\mathbf{COOH}$, $-\mathbf{COOR}$, $-\mathbf{CHO}$, and $-\mathbf{COR}$, wherein $\mathbf{R}$ is $\mathbf{C}_1-\mathbf{C}_6$ linear or branched alkyl (e.g., $\mathbf{C}_1\mathbf{-C}_6$, $\mathbf{C}_1\mathbf{-C}_5$, $\mathbf{C}_1\mathbf{-C}_4$, $\mathbf{C}_1\mathbf{-C}_3$, $\mathbf{C}_1\mathbf{-C}_2$, $\mathbf{C}_1$, $\mathbf{C}_2\mathbf{-C}_6$, $\mathbf{C}_2\mathbf{-C}_5$, $\mathbf{C}_2\mathbf{-C}_4$, $\mathbf{C}_2\mathbf{-C}_3$, $\mathbf{C}_2$, $\mathbf{C}_3\mathbf{-C}_6$, $\mathbf{C}_3\mathbf{-C}_5$, $\mathbf{C}_3\mathbf{-C}_4$, $\mathbf{C}_3$, $\mathbf{C}_4\mathbf{-C}_6$, $\mathbf{C}_4\mathbf{-C}_5$, $\mathbf{C}_4$, $\mathbf{C}_5\mathbf{-C}_6$, $\mathbf{C}_5$, or $\mathbf{C}_6$ linear or branched alkyl).
In some variations of formula (4) described in the paragraph above, the pendant phenyl ring of D2 is unsubstituted. In some variations of formula (4) described in the paragraph above, the pendant phenyl ring of D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —N0₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —S0₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

In some of the variations of formula (4) described above, D1 and D2 are safranin-0 moieties, as shown in formula (4a):

![Diagram](image)

(4a) in which k, Rₐ, and Rₐ are as described in the paragraphs above, Ri, R₂, R₃, R₄, R₅, and R₆ independently are absent or independently are selected from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, —C₆H₅, —N0₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —S0₂H, —COOH, —COOR, —CHO, and —COR), and R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

In some of the variations of formula (4a), k is 2-10, each Rₐ and Rₐ is H, and Ri to R₆ are as described above for formula (4). In some of these variations, n is 6 or 8, each Rₐ and Rₐ is H,
and each of $R_i$ to $R_6$ independently is absent or is a halo. In particular variations, $\lambda$ is 6 or 8, each $R_a$ and $R_b$ is H, and $R_i$ to $R_6$ are all absent.

[139] In some of the variations of formula (4a), $k$ is 2-10, $R_a$ and $R_b$ are either H or $\begin{array}{c} \text{O} \\ \text{N} \end{array}$, and $R_i$ to $R_6$ are as described above for formula (4). In some of these variations, $\lambda$ is 6 or 8, $R_a$ and $R_b$ are either H or $\begin{array}{c} \text{O} \\ \text{N} \end{array}$, and each of $R_1$ to $R_6$ independently is absent or is a halo. In particular variations, $\lambda$ is 6 or 8, $R_a$ and $R_b$ are either H or $\begin{array}{c} \text{O} \\ \text{N} \end{array}$, and $R_i$ to $R_6$ are all absent.

[140] In some of the variations of formula (a4), $k$ is 2-10, $R_a$ and $R_b$ are either H or $\begin{array}{c} \text{O} \\ \text{N} \end{array}$, and $R_i$ to $R_6$ are as described above for formula (4). In some of these variations, $\lambda$ is 6 or 8, $R_a$ and $R_b$ are either H or $\begin{array}{c} \text{O} \\ \text{N} \end{array}$, and each of $R_i$ to $R_6$ independently is absent or is a halo. In particular variations, $\lambda$ is 6 or 8, $R_a$ and $R_b$ are either H or $\begin{array}{c} \text{O} \\ \text{N} \end{array}$, and $R_i$ to $R_6$ are all absent.

[141] In some of the variations of formula (4a), $k$ is 2-10, each $R_a$ and $R_b$ is H or two of $\text{CR}_a\text{R}_b$ are $\begin{array}{c} \text{V} \\ \text{V} \end{array}$, and $R_i$ to $R_6$ are as described above for formula (4). In some of these variations, $k$ is 6 or 8, each $R_a$ and $R_b$ is H or two of $\text{CR}_a\text{R}_b$ are $\begin{array}{c} \text{V} \\ \text{V} \end{array}$, and each of $R_1$ to $R_6$ independently is absent or is a halo. In particular variations, $\lambda$ is 6 or 8, each $R_a$ and $R_b$ is H or two of $\text{CR}_a\text{R}_b$ are $\begin{array}{c} \text{V} \\ \text{V} \end{array}$, and $R_i$ to $R_6$ are all absent.

[142] One of skill in the art can readily visualize and prepare other cationic multimers falling within formula (4) in which other cationic dye moieties are used in place of one or both of the safranin-0 moieties.

[143] Some cationic dye dimers fall within formula (5):

![Diagram](image)

(5)

, wherein each of $D_1$ and $D_2$ is a cationic dye moiety, $n$ is 0-6, and $\lambda$ is 1-4.
In some variations of formula (5), D₁ and D₂ are different cationic dye moieties. In other variations of formula (5), D₁ and D₂ are the same cationic dye moiety. In some variations of formula (5), D₁ and D₂ are independently selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

In some variations of formula (5) described in the paragraphs above, \( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

In some variations of formula (5) described in the paragraphs above, \( n_1 \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (5) described in the paragraphs above, D₁ is safranin-O. In some variations of formula (5) described in the paragraphs above, D₂ is safranin-O. In some variations of formula (5) described in the paragraphs above, D₁ and D₂ are safranin-O.

In some variations of formula (5) described in the paragraph above, the pendant phenyl ring of D₁ is unsubstituted. In some variations of formula (5) described in the paragraph above, the pendant phenyl ring of D₁ is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D₁ is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₆H₅, —R, and —C₆H₅, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D₁ is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl).

In some variations of formula (5) described in the paragraph above, the pendant phenyl ring of D₂ is unsubstituted. In some variations of formula (5) described in the paragraph above, the pendant phenyl ring of D₂ is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D₂ is substituted, the
substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D₂ is substituted, the substituents are selected independently from —NO₂, —NR₂⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₂), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Ci, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

Some cationic dye dimers fall within formula (6):

![Diagram of formula (6)](image)

wherein each of D₁ and D₂ is a cationic dye moiety, n₁ is 0-5, and ¾ is 1-5.

In some variations of formula (6), D₁ and D₂ are different cationic dye moieties. In other variations of formula (6), D₁ and D₂ are the same cationic dye moiety. In some variations of formula (6), D₁ and D₂ are independently selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

In some variations of formula (6) described in the paragraphs above, n₁ is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (6) described in the paragraphs above, n₂ is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (6) described in the paragraphs above, D₁ is safranin-O. In some variations of formula (6) described in the paragraphs above, D₂ is safranin-O. In some variations of formula (6) described in the paragraphs above, D₁ and D₂ are safranin-O.

In some variations of formula (6) described in the paragraph above, the pendant phenyl ring of D₁ is unsubstituted. In some variations of formula (6) described in the paragraph above, the pendant phenyl ring of D₁ is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating
or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOC₂H₅, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅ wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D₁ is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl).

[156] In some variations of formula (6) described in the paragraph above, the pendant phenyl ring of D₂ is unsubstituted. In some variations of formula (6) described in the paragraph above, the pendant phenyl ring of D₂ is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D₂ is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOC₂H₅, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅ wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D₂ is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl).
Some cationic dye dimers fall within formula (7):

![Diagram of formula (7)](image)

(7), in which each of \( D_1 \) and \( D_2 \) is a cationic dye moiety, \( n_1 \) is 0-5, and \( \frac{3}{4} \) is 1-5.

In some variations of formula (7), \( D_1 \) and \( D_2 \) are different cationic dye moieties. In other variations of formula (7), \( D_1 \) and \( D_2 \) are the same cationic dye moiety. In some variations of formula (7), \( D_1 \) and \( D_2 \) are independently selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

In some variations of formula (7) described in the paragraphs above, \( n_1 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (7) described in the paragraphs above, \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (7) described in the paragraphs above, \( D_1 \) is safranin-O. In some variations of formula (7) described in the paragraphs above, \( D_2 \) is safranin-O. In some variations of formula (7) described in the paragraphs above, \( D_1 \) and \( D_2 \) are safranin-O.

In some variations of formula (7) described in the paragraph above, the pendant phenyl ring of \( D_1 \) is unsubstituted. In some variations of formula (7) described in the paragraph above, the pendant phenyl ring of \( D_1 \) is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of \( D_1 \) is substituted, the substituents are selected independently from —NH\(_2\), —NHR, —NR\(_2\), —OH, —O\(^-\), —NHCOCH\(_3\), —NHCOR, —OCH\(_3\), —OR, —C\(_2\)H\(_5\), —R, and —C\(_6\)H\(_5\), wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of \( D_1 \) is substituted, the substituents are selected independently from —N0\(_2\), —NR\(_3^+\), halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF\(_3\), —CCl\(_3\), —CBr\(_3\), —Cl\(_3\)), —CN, —SO\(_2\)H, —COOH, —COOR, —CHO, and...
—COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[163] In some variations of formula (7) described in the paragraph above, the pendant phenyl ring of D2 is unsubstituted. In some variations of formula (7) described in the paragraph above, the pendant phenyl ring of D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1-2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[164] Some cationic dye dimers fall within formula (8):

\[
\text{D1} \quad \text{D2}
\]

, in which each of D1 and D2 is a cationic dye moiety, \( n \) is 0-5, and \( \frac{3}{4} \) is 1-5.

[165] In some variations of formula (8), D1 and D2 are different cationic dye moieties. In other variations of formula (8), D1 and D2 are the same cationic dye moiety. In some variations of formula (8), D1 and D2 are independently selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

[166] In some variations of formula (8) described in the paragraphs above, \( n \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.
In some variations of formula (8) described in the paragraphs above, \( n \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (8) described in the paragraphs above, \( D_1 \) is safranin-O. In some variations of formula (8) described in the paragraphs above, \( D_2 \) is safranin-O. In some variations of formula (8) described in the paragraphs above, \( D_1 \) and \( D_2 \) are safranin-O.

In some variations of formula (8) described in the paragraph above, the pendant phenyl ring of \( D_1 \) is unsubstituted. In some variations of formula (8) described in the paragraph above, the pendant phenyl ring of \( D_1 \) is substituted with 1-3 (e.g., 1-3, 1-2, 1-2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of \( D_1 \) is substituted, the substituents are selected independently from \(-\text{NH}_2, -\text{NHR}, -\text{NR}_2, -\text{OH}, -\text{O}, -\text{OH}, -\text{C}_6\text{H}_5, -\text{Cl}, -\text{Br}, -\text{CN}, -\text{S}_\text{O}_\text{2}\text{H}, -\text{COOH}, -\text{COOR}, -\text{CHO}, \) and \(-\text{COR}, \) wherein \( R \) is \( C_1\text{-C6} \) linear or branched alkyl (e.g., \( C_1\text{-C6}, C_1\text{-C5}, C_1\text{-C4}, C_1\text{-C3}, C_1\text{-C2}, C_1\text{-C2}, C_1\text{-C2}, C_2\text{-C6}, C_2\text{-C5}, C_2\text{-C4}, C_2\text{-C3}, C_2\text{-C3}, C_2\text{-C2}, C_3\text{-C6}, C_3\text{-C5}, C_3\text{-C4}, C_3\text{-C3}, C_3\text{-C2}, C_4\text{-C6}, C_4\text{-C5}, C_4\text{-C4}, C_5\text{-C6}, C_5\text{-C5}, C_5\text{-C4}, C_5\text{-C3}, C_5\text{-C2}, \) or \( C_6 \) linear or branched alkyl).

In some variations of formula (8) described in the paragraph above, the pendant phenyl ring of \( D_2 \) is unsubstituted. In some variations of formula (8) described in the paragraph above, the pendant phenyl ring of \( D_2 \) is substituted with 1-3 (e.g., 1-3, 1-2, 1-2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of \( D_2 \) is substituted, the substituents are selected independently from \(-\text{NH}_2, -\text{NHR}, -\text{NR}_2, -\text{OH}, -\text{O}, -\text{OH}, -\text{C}_6\text{H}_5, -\text{Cl}, -\text{Br}, -\text{CN}, -\text{S}_\text{O}_\text{2}\text{H}, -\text{COOH}, -\text{COOR}, -\text{CHO}, \) and \(-\text{COR}, \) wherein \( R \) is \( C_1\text{-C6} \) linear or branched alkyl (e.g., \( C_1\text{-C6}, C_1\text{-C5}, C_1\text{-C4}, C_1\text{-C3}, C_1\text{-C2}, C_1\text{-C2}, C_1\text{-C2}, C_2\text{-C6}, C_2\text{-C5}, C_2\text{-C4}, C_2\text{-C3}, C_2\text{-C3}, C_2\text{-C2}, C_3\text{-C6}, C_3\text{-C5}, C_3\text{-C4}, C_3\text{-C3}, C_3\text{-C2}, C_4\text{-C6}, C_4\text{-C5}, C_4\text{-C4}, C_5\text{-C6}, C_5\text{-C5}, C_5\text{-C4}, C_5\text{-C3}, C_5\text{-C2}, \) or \( C_6 \) linear or branched alkyl).
C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

In some embodiments in which the pendant phenyl ring of D1 is substituted, the substitutions are selected independently from —NH2, —NHR, —NR2, —OH, —O’, —NHCOC1H3, —NHCOR, —OCH3, —OR, —C2H5, —R, and —C6H5, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

Some cationic dye dimers fall within formula (9):

\[
\text{D1} \text{HNN} \text{O} \text{D2} \\
\text{(9)} \quad n_1 \quad n_2
\]

, in which each of D1 and D2 is a cationic dye moiety and \(n_1\) and \(n_2\) independently are 1-5.

In some variations of formula (9), D1 and D2 are different cationic dye moieties. In other variations of formula (9), D1 and D2 are the same cationic dye moiety. In some variations of formula (9), D1 and D2 are independently selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

In some variations of formula (9) described in the paragraphs above, \(n_1\) is 1-5, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (9) described in the paragraphs above, \(n_2\) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (9) described in the paragraphs above, D1 is safranin-O. In some variations of formula (9) described in the paragraphs above, D2 is safranin-O. In some variations of formula (9) described in the paragraphs above, D1 and D2 are safranin-O.

In some variations of formula (9) described in the paragraph above, the pendant phenyl ring of D1 is unsubstituted. In some variations of formula (9) described in the paragraph above, the pendant phenyl ring of D1 is substituted with 1-3 (e.g., 1-3, 1-2, 1-2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NH2, —NHR, —NR2, —OH, —O’, —NHCOC1H3, —NHCOR, —OCH3, —OR, —C2H5, —R, and —C6H5, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D1 is substituted, the
substituents are selected independently from —N0₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CC₁₃, —CBr₃, —Cl₃), —CN, —S0₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl).

[177] In some variations of formula (9) described in the paragraph above, the pendant phenyl ring of D₂ is unsubstituted. In some variations of formula (9) described in the paragraph above, the pendant phenyl ring of D₂ is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D₂ is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, Cl, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D₂ is substituted, the substituents are selected independently from —N0₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CC₁₃, —CBr₃, —Cl₃), —CN, —S0₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, Cl, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl).

[178] Some cationic dye multimers fall within formula (10):

\[ \text{[178]} \quad \begin{array}{c}
\text{D1} \\
\begin{array}{c}
\text{HN} \\
\text{O} \\
\text{NH}_2 \\
\text{H}_2\text{N}
\end{array}
\end{array}
\]

\[ \begin{array}{c}
\text{D2} \\
\begin{array}{c}
\text{HN} \\
\text{O} \\
\text{NH} \\
\text{NH}_2 \\
\text{n}
\end{array}
\end{array}
\]

\[ \text{[10]} \quad , \text{wherein each of D1 and D2 is a cationic dye moiety and } n \text{ is } 1-6. \]

[179] In some variations of formula (10), D₁ and D₂ are different cationic dye moieties. In some variations of formula (10), D₁ and D₂ are the same cationic dye moiety. In some variations
of formula (10), D1 and D2 independently are selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

[180] In some variations of formula (32) described above, n is 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 12-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 1, 2, 3, 4, 5, or 6.

[181] In some variations of formula (10) described in the paragraphs above, D1 is safranin-O. In some variations of formula (10) described in the paragraphs above, D2 is safranin-O. In some variations of formula (10) described in the paragraphs above, D1 and D2 are safranin-O.

[182] In some variations of formula (10) described in the paragraph above, the pendant phenyl ring of D1 is unsubstituted. In some variations of formula (10) described in the paragraph above, the pendant phenyl ring of D1 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NH2, —NHR, —NR2, —OH, —O’, —NHCOCH3, —NHCOR, —OCH3, —OR, —C2H5, —R, and —C6H5, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NO2, —NR3+, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF3, —CCl3, —CBr3, —Cl3), —CN, —SO2H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[183] In some variations of formula (10) described in the paragraph above, the pendant phenyl ring of D2 is unsubstituted. In some variations of formula (10) described in the paragraph above, the pendant phenyl ring of D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NH2, —NHR, —NR2, —OH, —O’, —NHCOCH3, —NHCOR, —OCH3, —OR, —C2H5, —R, and —C6H5, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the
substituents are selected independently from —N\(_2\),—NR\(_3^+\), halo (e.g. F, Br, CI, I), trihalide (e.g. —CF\(_3\), —CCl\(_3\), —CBr\(_3\), —CI\(_3\)), —CN, —S\(_2\)H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g. C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[184] In some of the variations of formula (10) described above, D1 and D2 are safranin-0 moieties, as shown in formula (10a):

![Formula](image)

in which \(n\) is 1-6, R\(_1\), R\(_2\), R\(_3\), R\(_4\), R\(_5\), and R\(_6\) independently are absent or independently are selected from —NH\(_2\), —NHR, —NR\(_2\), —OH, —O, —NHCOCH\(_3\), —NHCOR, —OCH\(_3\), —OR, —C\(_2\)H\(_5\), —R, —C\(_6\)H\(_5\), —N\(_2\), —NR\(_3^+\), halo (e.g. F, Br, CI, I), trihalide (e.g. —CF\(_3\), —CCl\(_3\), —CBr\(_3\), —CI\(_3\)), —CN, —S\(_2\)H, —COOH, —COOR, —CHO, and —COR), and R is C1-C6 linear or branched alkyl (e.g. C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[185] In some variations of formula (10a), \(n\) is 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 1, 2, 3, 4, 5, or 6.

[186] One of skill in the art can readily visualize and prepare other cationic multimers falling within formula (10) in which other cationic dye moieties are used in place of one or both of the safranin-0 moieties.
Some cationic dye dimers fall within formula (11):

\[
\text{(11)} \quad D_1 \quad \text{D2}
\]

, in which each of \( D_1 \) and \( D_2 \) is a cationic dye moiety; \( I_1 \) and \( I_2 \) independently are 1-4; \( n \) is 1-4; \( \text{ring} \) \( A \) is aryl, heteroaryl, cycloalkyl, or heterocyclyl; for each independent instance of \( R_{a1} \) and \( R_{b1} \), \( R_{a1} \) and \( R_{b1} \) (1) independently are H or CH₃, or (2) \( R_{a1} \) and \( R_{b1} \) are \( \text{or} \), or (3) two of \( CR_{a1}R_{b1} \) are \( \text{or} \); and, for each independent instance of \( R_{a2} \) and \( R_{b2} \), \( R_{a2} \) and \( R_{b2} \) (1) independently are H or CH₃, or (2) \( R_{a2} \) and \( R_{b2} \) are \( \text{or} \), or (3) two of \( CR_{a2}R_{b2} \) are \( \text{or} \\

[188] In some variations of formula (11), \( D_1 \) and \( D_2 \) are different cationic dye moieties. In other variations of formula (11), \( D_1 \) and \( D_2 \) are the same cationic dye moiety. In some variations of formula (11), \( D_1 \) and \( D_2 \) are independently selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

[189] In some variations of formula (11), \( I_1 \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[190] In some variations of formula (11) described in the paragraphs above, \( I_2 \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[191] In some variations of formula (11) described in the paragraphs above in which \( I_1 \) is 1, \( R_{a1} \) and \( R_{b1} \) are both H. In some variations of formula (11) described in the paragraphs above in which \( I_1 \) is 1, \( R_{a1} \) is H and \( R_{b1} \) is CH₃. In some variations of formula (11) described in the paragraphs above in which \( I_1 \) is 1, \( R_{a1} \) and \( R_{b1} \) are both CH₃. In some variations of formula (11) described in the paragraphs above in which \( I_1 \) is 1, \( R_{a1} \) and \( R_{b1} \) are \( \text{or} \). In some variations of formula (11) described in the paragraphs above in which \( I_1 \) is 1, \( R_{a1} \) and \( R_{b1} \) are \( \text{or} \).
In variations of formula (11) described in the paragraphs above in which \( I_f \) is 2, the two instances of \( R_a \) and \( \frac{3}{4} \), are indicated as \( R_{a_1} \) and \( R_{a_2} \) and \( R_{b_1} \) and \( R_{b_2} \), respectively. In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 2, each of \( R_{a_1} \) and \( R_{b_1} \) and \( R_{a_2} \) and \( R_{b_2} \) is \( H \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 2, each of \( R_{a_1} \) and \( R_{b_1} \) and \( R_{a_2} \) and \( R_{b_2} \) is \( \text{CH}_3 \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 2, each of \( R_{a_1} \) and \( R_{a_2} \) is \( \text{H} \) and each of \( R_{b_1} \) and \( R_{b_2} \) is \( \text{CH}_3 \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 2, each of \( R_{a_1} \), \( R_{a_2} \), and \( R_{b_1} \) is \( \text{H} \) and \( R_{b_2} \) is \( \text{CH}_3 \).

In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 2, each of \( R_{a_1} \) and \( R_{b_1} \) is \( \text{H} \) and \( R_{a_2} \) and \( R_{b_2} \) are \( \text{H} \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 2, each of \( R_{a_1} \) and \( R_{b_1} \) is \( \text{CH}_3 \) and \( R_{a_2} \) and \( R_{b_2} \) are \( \text{H} \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 2, each of \( R_{a_1} \) and \( R_{b_1} \) is \( \text{CH}_3 \) and \( R_{a_2} \) and \( R_{b_2} \) are \( \text{H} \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 2, \( R_{a_1} \) is \( \text{H} \), \( R_{b_1} \) is \( \text{CH}_3 \), and \( R_{a_2} \) and \( R_{b_2} \) are \( \text{H} \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 2, \( R_{a_1} \) is \( \text{H} \), \( R_{b_1} \) is \( \text{CH}_3 \), and \( R_{a_2} \) and \( R_{b_2} \) are \( \text{H} \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 2, \( R_{a_1} \) is \( \text{H} \), \( R_{b_1} \) is \( \text{CH}_3 \), and \( R_{a_2} \) and \( R_{b_2} \) together are \( \text{H} \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 2, \( R_{a_1} \) and \( R_{b_1} \) are \( \text{H} \) and \( R_{a_2} \) and \( R_{b_2} \) are \( \text{H} \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 2, \( R_{a_1} \) and \( R_{b_1} \) are \( \text{H} \) and \( R_{a_2} \) and \( R_{b_2} \) are \( \text{H} \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 2, \( R_{a_1} \) and \( R_{b_1} \) are \( \text{H} \) and \( R_{a_2} \) and \( R_{b_2} \) are \( \text{H} \).
In variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, the three instances of \( R_a \) and \( 3/4 \) are indicated as \( R_{a1} \) and \( R_{a1}' \); \( R_{a2} \) and \( R_{a2}' \); and \( R_{a3} \) and \( R_{a3}' \), respectively. In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, each of \( R_{a1} \), \( R_{a1}' \), \( R_{a2} \), \( R_{a2}' \), \( R_{a3} \), and \( R_{a3}' \) is \( H \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, each of \( R_{a1} \), \( R_{a1}' \), \( R_{a2} \), \( R_{a2}' \), \( R_{b1} \), and \( R_{b1}' \) is \( CH_3 \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, each of \( R_{a1} \), \( R_{a1}' \), \( R_{a2} \), and \( R_{b1} \) is \( H \) and each of \( R_{a3} \) and \( R_{b1} \) is \( CH_3 \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, each of \( R_{a1} \), \( R_{a1}' \), \( R_{a2} \), and \( R_{b1} \) is \( H \) and each of \( R_{a3} \) and \( R_{b1} \) is \( CH_3 \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, each of \( R_{a1} \), \( R_{a1}' \), \( R_{a2} \), and \( R_{b1} \) is \( H \) and each of \( R_{a3} \) and \( R_{b1} \) is \( CH_3 \).

In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, each of \( R_{a1} \), \( R_{a1}' \), \( R_{a2} \), and \( R_{b2} \) is \( H \) and each of \( R_{a3} \) and \( R_{b2} \) is \( CH_3 \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, each of \( R_{a1} \), \( R_{a1}' \), \( R_{a2} \), and \( R_{b2} \) is \( H \) and each of \( R_{a3} \) and \( R_{b2} \) is \( CH_3 \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, each of \( R_{a1} \), \( R_{a1}' \), \( R_{a2} \), and \( R_{b2} \) is \( H \) and each of \( R_{a3} \) and \( R_{b2} \) is \( CH_3 \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, each of \( R_{a1} \), \( R_{a1}' \), \( R_{a2} \), and \( R_{b2} \) is \( H \) and each of \( R_{a3} \) and \( R_{b2} \) is \( CH_3 \).
variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, each of \( R_{a1} \) and \( R_{a2} \) is H and each of \( R_{b1} \) and \( R_{b2} \) is \( CH_3 \), and \( R_{a3} \) and \( R_{b3} \) are

[197] In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \overset{\scriptsize{\text{\textbullet}}}{\text{\textbullet}} \), \( R_{a2} \) and \( R_{b2} \) are \( \overset{\scriptsize{\text{\textbullet}}}{\text{\textbullet}} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \overset{\scriptsize{\text{\textbullet}}}{\text{\textbullet}} \), \( R_{a2} \) and \( R_{b2} \) are \( \overset{\scriptsize{\text{\textbullet}}}{\text{\textbullet}} \), and each of \( R_{a3} \) and \( R_{b3} \) is \( CH_3 \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \overset{\scriptsize{\text{\textbullet}}}{\text{\textbullet}} \), \( R_{a2} \) and \( R_{b2} \) are \( \overset{\scriptsize{\text{\textbullet}}}{\text{\textbullet}} \), and each of \( R_{a3} \) and \( R_{b3} \) is \( CH_3 \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \overset{\scriptsize{\text{\textbullet}}}{\text{\textbullet}} \), \( R_{a2} \) and \( R_{b2} \) are \( \overset{\scriptsize{\text{\textbullet}}}{\text{\textbullet}} \), and each of \( R_{a3} \) and \( R_{b3} \) is \( CH_3 \).

[198] In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \overset{\scriptsize{\text{\textbullet}}}{\text{\textbullet}} \), \( R_{a2} \) and \( R_{b2} \) are \( \overset{\scriptsize{\text{\textbullet}}}{\text{\textbullet}} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \overset{\scriptsize{\text{\textbullet}}}{\text{\textbullet}} \), \( R_{a2} \) and \( R_{b2} \) are \( \overset{\scriptsize{\text{\textbullet}}}{\text{\textbullet}} \), and each of \( R_{a3} \) and \( R_{b3} \) is \( CH_3 \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \overset{\scriptsize{\text{\textbullet}}}{\text{\textbullet}} \), \( R_{a2} \) and \( R_{b2} \) are \( \overset{\scriptsize{\text{\textbullet}}}{\text{\textbullet}} \), and each of \( R_{a3} \) and \( R_{b3} \) is \( CH_3 \). In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 3, \( R_{a1} \) and \( R_{b1} \) are

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R_{a2} and R_{b2} are \( R \), and each of R_{a3} and R_{b3} is CH_{3}. In some variations of formula (11) described in the paragraphs above in which \( I_{f} = 3 \), R_{a} and R_{b} are \( R \), and each of R_{a3} and R_{b3} is CH_{3}.

[199] In some variations of formula (11) described in the paragraphs above in which \( I_{f} = 3 \), R_{a} and R_{b} are \( R \), and each of R_{a3} and R_{b3} is H. In some variations of

formula (11) described in the paragraphs above in which \( I_{f} = 3 \), R_{a} and R_{b} are \( R \), and each of R_{a3} and R_{b3} is CH_{3}. In some variations of formula (11) described in the paragraphs above in which \( I_{f} = 3 \), R_{a} and R_{b} are \( R \), and each of R_{a3} and R_{b3} is H. In some variations of

formula (11) described in the paragraphs above in which \( I_{f} = 3 \), R_{a} and R_{b} are \( R \), and each of R_{a3} and R_{b3} is CH_{3}. In some variations of formula (11) described in the paragraphs above in which \( I_{f} = 3 \), R_{a} and R_{b} are \( R \), and each of R_{a3} and R_{b3} is H. In some variations of

formula (11) described in the paragraphs above in which \( I_{f} = 3 \), R_{a} and R_{b} are \( R \), and each of R_{a3} and R_{b3} is CH_{3}. In some variations of formula (11) described in the paragraphs above in which \( I_{f} = 3 \), R_{a} and R_{b} are \( R \), and each of R_{a3} and R_{b3} is H. In some variations of
and \( R_{b3} \) are \( \text{H} \). In some variations of formula (11) described in the paragraphs above in
which \( I_i \) is 3, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \text{H} \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \). In some variations of formula (11) described in the paragraphs above in which \( I_i \) is 4, each of \( R_{a1} \), \( R_{b1} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), \( R_{b3} \), \( R_{a4} \), and \( R_{b4} \) is \( \text{H} \). In some variations of formula (11) described in the paragraphs above in which \( I_i \) is 4, each of \( R_{a1} \), \( R_{b1} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), \( R_{b3} \), \( R_{a4} \), and \( R_{b4} \) is \( \text{CH}_3 \). In some variations of formula (11) described in the paragraphs above in which \( I_i \) is 4, each of \( R_{a1} \), \( R_{b1} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), \( R_{b3} \), \( R_{a4} \), and \( R_{b4} \) is \( \text{H} \). In some variations of formula (11) described in the paragraphs above in which \( I_i \) is 4, each of \( R_{a1} \), \( R_{b1} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), \( R_{b3} \), \( R_{a4} \), and \( R_{b4} \) is \( \text{CH}_3 \). In some variations of formula (11) described in the paragraphs above in which \( I_i \) is 4, each of \( R_{a1} \), \( R_{b1} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), \( R_{b3} \), \( R_{a4} \), and \( R_{b4} \) is \( \text{H} \). In some variations of formula (11) described in the paragraphs above in which \( I_i \) is 4, each of \( R_{a1} \), \( R_{b1} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), \( R_{b3} \), \( R_{a4} \), and \( R_{b4} \) is \( \text{CH}_3 \).
described in the paragraphs above in which \( I \) is 4, \( R^a_i \) and \( R^b_i \) are \( \text{CH}_3 \), \( R^a_2 \) and \( R^b_2 \) are \( \text{CH}_3 \), \( R_{a3} \) and \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \).

[204] In some variations of formula (11) described in the paragraphs above in which \( I \) is 4, \( R^a_i \) and \( R^b_i \) are \( \text{H} \), \( R^a_2 \) and \( R^b_2 \) are \( \text{H} \), \( R^a_3 \) and \( R^b_3 \) are \( \text{CH}_3 \), \( R^a_4 \) and \( R^b_4 \) are \( \text{CH}_3 \). In some variations of formula (11) described in the paragraphs above in which \( I \) is 4, \( R^a_1 \) and \( R^b_1 \) are \( \text{H} \), \( R^a_2 \) and \( R^b_2 \) are \( \text{CH}_3 \), \( R^a_3 \) and \( R^b_3 \) are \( \text{CH}_3 \), \( R^a_4 \) and \( R^b_4 \) are \( \text{CH}_3 \). In some variations of formula (11) described in the paragraphs above in which \( I \) is 4, \( R^a_i \) is \( \text{H} \), \( R^b_i \) is \( \text{CH}_3 \), \( R^a_2 \) and \( R^b_2 \) are \( \text{CH}_3 \), \( R^a_3 \) and \( R^b_3 \) are \( \text{CH}_3 \), \( R^a_4 \) and \( R^b_4 \) are \( \text{CH}_3 \). In some variations of formula (11) described in the paragraphs above in which \( I \) is 4, \( R^a_i \) is \( \text{H} \), \( R^b_i \) is \( \text{CH}_3 \), \( R^a_2 \) is \( \text{H} \), \( R^b_2 \) is \( \text{CH}_3 \), \( R^a_3 \) and \( R^b_3 \) are \( \text{CH}_3 \), \( R^a_4 \) and \( R^b_4 \) are \( \text{CH}_3 \).
\[ R_{a2} \text{ and } R_{b2} \text{ are } H, \ R_{a3} \text{ and } R_{b3} \text{ are } CH_3, \text{ and } R_{a4} \text{ and } R_{b4} \text{ are } \cdot \cdot \cdot \]

In some variations of formula (11) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \cdot \cdot \cdot \). In some variations of formula (11) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \cdot \cdot \cdot \).

\[ R_{a3} \text{ and } R_{b3} \text{ are } CH_3, \text{ and } R_{a4} \text{ and } R_{b4} \text{ are } \cdot \cdot \cdot . \]

[207] In some variations of formula (11) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( H \), \( R_{a3} \) and \( R_{b3} \) are \( \cdot \cdot \cdot \), and \( R_{a4} \) and \( R_{b4} \) are \( \cdot \cdot \cdot \). In some variations of formula (11) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \cdot \cdot \cdot \), and \( R_{a4} \) and \( R_{b4} \) are \( \cdot \cdot \cdot \). In some variations of formula (11) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) is \( H \), \( R_{b1} \) is \( CH_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \cdot \cdot \cdot \), \( R_{a3} \) and \( R_{b3} \) are \( \cdot \cdot \cdot \), and \( R_{a4} \) and \( R_{b4} \) are \( \cdot \cdot \cdot \). In some variations of formula (11) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) is \( H \), \( R_{b1} \) is \( CH_3 \), \( R_{a2} \) is \( H \), \( R_{b2} \) is \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \cdot \cdot \cdot \), and \( R_{a4} \) and \( R_{b4} \) are \( \cdot \cdot \cdot \).

[208] In some variations of formula (11) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( \cdot \cdot \cdot \), \( R_{a3} \) and \( R_{b3} \) are \( \cdot \cdot \cdot \), and \( R_{a4} \) and \( R_{b4} \) are \( \cdot \cdot \cdot \). In some variations of formula (11) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \cdot \cdot \cdot \), \( R_{a2} \) and \( R_{b2} \) are \( \cdot \cdot \cdot \), \( R_{a3} \) and \( R_{b3} \) are \( \cdot \cdot \cdot \), and \( R_{a4} \) and \( R_{b4} \) are \( \cdot \cdot \cdot \). In some variations of formula (11) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) is \( H \), \( R_{b1} \) is \( CH_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \cdot \cdot \cdot \), \( R_{a3} \) and \( R_{b3} \) are \( \cdot \cdot \cdot \), and \( R_{a4} \) and \( R_{b4} \) are \( \cdot \cdot \cdot \). In some variations of formula
(11) described in the paragraphs above in which $l_I$ is 4, $R_{a1}$ and $R_{b1}$ are $\text{CH}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, $R_{a3}$ and $R_{b3}$ are $\text{CH}_3$, and $R_{a4}$ and $R_{b4}$ are $\text{CH}_3$.

[209] In some variations of formula (11) described in the paragraphs above in which $l_I$ is 4, $R_{a1}$ and $R_{b1}$ are $\text{CH}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, $R_{a3}$ and $R_{b3}$ are $\text{CH}_3$, and $R_{a4}$ and $R_{b4}$ are $\text{CH}_3$.

[210] In some variations of formula (11) described in the paragraphs above in which $l_I$ is 4, $R_{a1}$ and $R_{b1}$ are $\text{CH}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, $R_{a3}$ and $R_{b3}$ are $\text{CH}_3$, and $R_{a4}$ and $R_{b4}$ are $\text{CH}_3$.

[211] In some variations of formula (11) described in the paragraphs above in which $l_I$ is 4, $R_{a1}$ and $R_{b1}$ are $\text{CH}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, $R_{a3}$ and $R_{b3}$ are $\text{CH}_3$, and $R_{a4}$ and $R_{b4}$ are $\text{CH}_3$.

[212] In some variations of formula (11) described in the paragraphs above in which $l_I$ is 4, $R_{a1}$ and $R_{b1}$ are $\text{CH}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, $R_{a3}$ and $R_{b3}$ are $\text{CH}_3$, and $R_{a4}$ and $R_{b4}$ are $\text{CH}_3$. In some
variations of formula (11) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are 
\[
\begin{align*}
\text{R}_{a2} \quad \text{and} \quad \text{R}_{b2} \quad &\text{are} \quad \gamma, \\
\text{R}_{a3} \quad \text{and} \quad \text{R}_{b3} \quad &\text{are} \quad \text{CH}_3, \quad \text{and} \quad \text{R}_{a4} \quad \text{and} \quad \text{R}_{b4} \quad &\text{are} \quad \gamma.
\end{align*}
\]
In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are 
\[
\begin{align*}
\text{R}_{a2} \quad \text{and} \quad \text{R}_{b2} \quad &\text{are} \quad \gamma, \\
\text{R}_{a3} \quad \text{and} \quad \text{R}_{b3} \quad &\text{are} \quad \text{CH}_3, \quad \text{and} \quad \text{R}_{a4} \quad \text{and} \quad \text{R}_{b4} \quad &\text{are} \quad \gamma.
\end{align*}
\]
In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are 
\[
\begin{align*}
\text{R}_{a2} \quad \text{and} \quad \text{R}_{b2} \quad &\text{are} \quad \gamma, \\
\text{R}_{a3} \quad \text{and} \quad \text{R}_{b3} \quad &\text{are} \quad \text{H}, \quad \text{and} \quad \text{R}_{a4} \quad \text{and} \quad \text{R}_{b4} \quad &\text{are} \quad \gamma.
\end{align*}
\]

[213] In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are 
\[
\begin{align*}
\text{R}_{a2} \quad \text{and} \quad \text{R}_{b2} \quad &\text{are} \quad \frac{\sqrt{3}}{4}, \\
\text{R}_{a3} \quad \text{and} \quad \text{R}_{b3} \quad &\text{are} \quad \frac{\sqrt{3}}{4}, \quad \text{and} \quad \text{R}_{a4} \quad \text{and} \quad \text{R}_{b4} \quad &\text{are} \quad \frac{\sqrt{3}}{4}.
\end{align*}
\]

[214] In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are 
\[
\begin{align*}
\text{R}_{a2} \quad \text{and} \quad \text{R}_{b2} \quad &\text{are} \quad \frac{\sqrt{3}}{4}, \\
\text{R}_{a3} \quad \text{and} \quad \text{R}_{b3} \quad &\text{are} \quad \text{H}, \quad \text{and} \quad \text{R}_{a4} \quad \text{and} \quad \text{R}_{b4} \quad &\text{are} \quad \frac{\sqrt{3}}{4}.
\end{align*}
\]
In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are 
\[
\begin{align*}
\text{R}_{a2} \quad \text{and} \quad \text{R}_{b2} \quad &\text{are} \quad \frac{\sqrt{3}}{4}, \\
\text{R}_{a3} \quad \text{and} \quad \text{R}_{b3} \quad &\text{are} \quad \text{CH}_3, \quad \text{and} \quad \text{R}_{a4} \quad \text{and} \quad \text{R}_{b4} \quad &\text{are} \quad \frac{\sqrt{3}}{4}.
\end{align*}
\]
In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are 
\[
\begin{align*}
\text{R}_{a2} \quad \text{and} \quad \text{R}_{b2} \quad &\text{are} \quad \frac{\sqrt{3}}{4}, \\
\text{R}_{a3} \quad \text{and} \quad \text{R}_{b3} \quad &\text{are} \quad \text{H}, \quad \text{and} \quad \text{R}_{a4} \quad \text{and} \quad \text{R}_{b4} \quad &\text{are} \quad \frac{\sqrt{3}}{4}.
\end{align*}
\]

[215] In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are 
\[
\begin{align*}
\text{R}_{a2} \quad \text{and} \quad \text{R}_{b2} \quad &\text{are} \quad \frac{\sqrt{3}}{4}, \\
\text{R}_{a3} \quad \text{and} \quad \text{R}_{b3} \quad &\text{are} \quad \text{H}, \quad \text{and} \quad \text{R}_{a4} \quad \text{and} \quad \text{R}_{b4} \quad &\text{are} \quad \frac{\sqrt{3}}{4}.
\end{align*}
\]

[216] In some variations of formula (11) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are 
\[
\begin{align*}
\text{R}_{a2} \quad \text{and} \quad \text{R}_{b2} \quad &\text{are} \quad \text{H}, \quad \text{R}_{a3} \quad \text{and} \quad \text{R}_{b3} \quad \text{and} \quad \text{R}_{a4} \quad \text{and} \quad \text{R}_{b4} \quad \text{together are} \quad \frac{\sqrt{3}}{4}.
\end{align*}
\]
are H, R_{a2} and R_{b2} are CH₃, and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are \(\text{CH}_3\)·. In some variations of formula (11) described in the paragraphs above in which \(I_i\) is 4, R_{a1} and R_{a2} are H, R_{b1} and R_{b2} are CH₃, and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are \(\text{CH}_3\)·. In some variations of formula (11) described in the paragraphs above in which \(I_i\) is 4, R_{a1} and R_{b1} are H, R_{a2} and R_{b2} are \(\text{CH}_3\)·, and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are \(\text{CH}_3\)·. In some variations of formula (11) described in the paragraphs above in which \(I_i\) is 4, R_{a1} is H, R_{b1} is CH₃, R_{a2} and R_{b2} are \(\text{CH}_3\)·, and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are \(\text{CH}_3\)·. In some variations of formula (11) described in the paragraphs above in which \(I_i\) is 4, R_{a1} is H, R_{b1} is CH₃, R_{a2} and R_{b2} are \(\text{CH}_3\)·, and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are \(\text{CH}_3\)·. In some variations of formula (11) described in the paragraphs above in which \(I_i\) is 4, R_{a1} and R_{b1} are \(\text{CH}_3\)·, and R_{a2} and R_{b2} are \(\text{CH}_3\)·, and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are \(\text{CH}_3\)·. In some variations of formula (11) described in the paragraphs above in which \(I_i\) is 4, R_{a1} and R_{b1} are \(\text{CH}_3\)·, and R_{a2} and R_{b2} are \(\text{CH}_3\)·, and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are \(\text{CH}_3\)·.
In some variations of formula (11) described in the paragraphs above in which $I_f$ is 4, $R_o$ and $R_{a1}$ and $R_{a3}$ and $R_{b1}$ and $R_{a4}$ and $R_{b1}$ together are.

In some variations of formula (11) described in the paragraphs above in which $I_f$ is 4, $R_{a1}$ and $R_{b1}$ and $R_{b3}$ and $R_{a4}$ and $R_{b1}$ together are.

In some variations of formula (11) described in the paragraphs above in which $I_f$ is 1, $R_{a1}$ and $R_{b1}$ are both H. In some variations of formula (11) described in the paragraphs above in which $I_f$ is 1, $R_{a1}$ is H and $R_{b1}$ is CH$_3$. In some variations of formula (11) described in the paragraphs above in which $I_f$ is 1, $R_{a1}$ and $R_{b1}$ are both CH$_3$. In some variations of formula (11) described in the paragraphs above in which $I_f$ is 1, $R_{a1}$ and $R_{b1}$ are.

In some variations of formula (11) described in the paragraphs above in which $I_f$ is 1, $R_{a1}$ and $R_{b1}$ are.

In variations of formula (11) described in the paragraphs above in which $I_f$ is 2, the two instances of $R_a$ and $R_b$ are indicated as $R_{a1}$ and $R_{b1}$ and $R_{a2}$ and $R_{b2}$, respectively. In some variations of formula (11) described in the paragraphs above in which $I_f$ is 2, each of $R_{a1}$ and $R_{b1}$ and $R_{a2}$ and $R_{b2}$ is H. In some variations of formula (11) described in the paragraphs above in which $I_f$ is 2, each of $R_{a1}$ and $R_{b1}$ and $R_{a2}$ and $R_{b2}$ is CH$_3$. In some variations of formula (11) described in the paragraphs above in which $I_f$ is 2, each of $R_{a1}$ and $R_{b1}$ is H and each of $R_{b1}$ is CH$_3$. In some variations of formula (11) described in the paragraphs above in which $I_f$ is 2, each of $R_{a1}, R_{a2},$ and $R_{b1}$ is H and $R_{b2}$ is CH$_3$.

In some variations of formula (11) described in the paragraphs above in which $I_f$ is 2, each of $R_{a1}$ and $R_{b1}$ is H and $R_{a2}$ and $R_{b2}$ are.

In some variations of formula (11) described in the paragraphs above in which $I_f$ is 2, each of $R_{a1}$ and $R_{b1}$ is H and $R_{a2}$ and $R_{b2}$ are.

In some variations of formula (11) described in the paragraphs above in which $I_f$ is 2, each
of \(R_{a1}\) and \(R_{b1}\) is \(CH_3\) and \(R_{a2}\) and \(R_{b2}\) are \(\text{Me}\). In some variations of formula (11) described in the paragraphs above in which \(I_2\) is 2, each of \(R_{a1}\) and \(R_{b1}\) is \(CH_3\) and \(R_{a2}\) and \(R_{b2}\) are \(\text{Me}\). In some variations of formula (11) described in the paragraphs above in which \(I_2\) is 2, \(R_{a1}\) is \(H\), \(R_{b1}\) is \(CH_3\), and \(R_{a2}\) and \(R_{b2}\) are \(\text{Me}\). In some variations of formula (11) described in the paragraphs above in which \(I_2\) is 2, \(R_{a1}\) is \(H\), \(R_{b1}\) is \(CH_3\), and \(R_{a2}\) and \(R_{b2}\) are \(\text{Me}\). In some variations of formula (11) described in the paragraphs above in which \(I_2\) is 2, \(R_{a1}\) and \(R_{b1}\) are \(\text{Me}\), \(R_{a2}\) and \(R_{b2}\) are \(\text{Me}\). In some variations of formula (11) described in the paragraphs above in which \(I_2\) is 2, \(R_{a1}\) and \(R_{b1}\) are \(\text{Me}\), \(R_{a2}\) and \(R_{b2}\) are \(\text{Me}\). In some variations of formula (11) described in the paragraphs above in which \(I_2\) is 2, \(R_{a1}\) and \(R_{b1}\) are \(\text{Me}\), \(R_{a2}\) and \(R_{b2}\) are \(\text{Me}\). In some variations of formula (11) described in the paragraphs above in which \(I_2\) is 2, \(R_{a1}\) and \(R_{b1}\) are \(\text{Me}\), \(R_{a2}\) and \(R_{b2}\) are \(\text{Me}\). In some variations of formula (11) described in the paragraphs above in which \(I_2\) is 2, \(R_{a1}\) and \(R_{b1}\) are \(\text{Me}\), \(R_{a2}\) and \(R_{b2}\) are \(\text{Me}\). In some variations of formula (11) described in the paragraphs above in which \(I_2\) is 2, \(R_{a1}\) and \(R_{b1}\) are \(\text{Me}\), \(R_{a2}\) and \(R_{b2}\) are \(\text{Me}\). In some variations of formula (11) described in the paragraphs above in which \(I_2\) is 3, the three instances of \(R_{a}\) and \(R_{b}\) are indicated as \(R_{a1}\) and \(R_{b1}\); \(R_{a2}\) and \(R_{b2}\); and \(R_{a3}\) and \(R_{b3}\), respectively. In some variations of formula (11) described in the paragraphs above in which \(\frac{3}{4}\) is 3, In some variations of formula (11) described in the paragraphs above in which \(I_2\) is 3, each of \(R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3},\) and \(R_{b3}\) is \(H\). In some variations of formula (11) described in the paragraphs above in which \(I_2\) is 3, each of \(R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3},\) and \(R_{b3}\) is \(CH_3\). In some variations of formula (11) described in the paragraphs above in which \(\frac{3}{4}\) is 3, each of \(R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3},\) and \(R_{b3}\) is \(H\) and each of \(R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3},\) and \(R_{b3}\) is \(CH_3\). In some variations of formula (11) described in the paragraphs above in which \(I_2\) is 3, each of \(R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3},\) and \(R_{b3}\) is \(H\) and each of \(R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3},\) and \(R_{b3}\) is \(CH_3\). In some variations of formula (11) described in the paragraphs above in which \(I_2\) is 3, each of \(R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3},\) and \(R_{b3}\) is \(H\) and each of \(R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3},\) and \(R_{b3}\) is \(CH_3\).
In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{ai}, R_{bi}, R_{a2}, \) and \( R_{b2} \) is \( H \) and \( R_{a3} \) and \( R_{b3} \) are \( \text{as shown} \). In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{ai}, R_{bi}, R_{a2}, \) and \( R_{b2} \) is \( \text{CH}_3 \) and \( R_{a3} \) and \( R_{b3} \) are \( \text{as shown} \). In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, \( R_{ai} \) is \( H \) and each of \( R_{a2}, R_{bi}, \) and \( R_{b2} \) is \( \text{CH}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{as shown} \). In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{a1} \) and \( R_{a2} \) is \( H \) and each of \( R_{bi} \) and \( R_{b2} \) is \( \text{CH}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{as shown} \).

In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{ai}, R_{bi}, R_{a2}, \) and \( R_{b2} \) is \( H \) and \( R_{a3} \) and \( R_{b3} \) are \( \text{as shown} \). In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{ai}, R_{bi}, R_{a2}, \) and \( R_{b2} \) is \( \text{CH}_3 \) and \( R_{a3} \) and \( R_{b3} \) are \( \text{as shown} \). In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, \( R_{ai} \) is \( H \) and each of \( R_{a2}, R_{bi}, \) and \( R_{b2} \) is \( \text{CH}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{as shown} \). In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{a1} \) and \( R_{a2} \) is \( H \) and each of \( R_{bi} \) and \( R_{b2} \) is \( \text{CH}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{as shown} \).

In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \text{as shown} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{as shown} \), and each of \( R_{a3} \) and \( R_{b3} \) is \( H \). In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \text{as shown} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{as shown} \), \( R_{a3} \) is \( H \), and \( R_{b3} \) is \( \text{CH}_3 \). In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \text{as shown} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{as shown} \), and each of \( R_{a3} \) and \( R_{b3} \) is \( H \). In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \text{as shown} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{as shown} \), and each of \( R_{a3} \) and \( R_{b3} \) is \( H \). In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are
R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is CH₃. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, Rᵢ and Rᵢ are \( \text{CH}_3 \), R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is H. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, Rᵢ and Rᵢ are \( \text{CH}_3 \), R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is H. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, Rᵢ and Rᵢ are \( \text{CH}_3 \), R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is H. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, Rᵢ and Rᵢ are \( \text{CH}_3 \), R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is H. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, Rᵢ and Rᵢ are \( \text{CH}_3 \), R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is H. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, Rᵢ and Rᵢ are \( \text{CH}_3 \), R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is H. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, Rᵢ and Rᵢ are \( \text{CH}_3 \), R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is H. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, Rᵢ and Rᵢ are \( \text{CH}_3 \), R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is H. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, Rᵢ and Rᵢ are \( \text{CH}_3 \), R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is H. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, Rᵢ and Rᵢ are \( \text{CH}_3 \), R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is H. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, Rᵢ and Rᵢ are \( \text{CH}_3 \), R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is H. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, Rᵢ and Rᵢ are \( \text{CH}_3 \), R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is H. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, Rᵢ and Rᵢ are \( \text{CH}_3 \), R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is H. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, Rᵢ and Rᵢ are \( \text{CH}_3 \), R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is H. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, Rᵢ and Rᵢ are \( \text{CH}_3 \), R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is H. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, Rᵢ and Rᵢ are \( \text{CH}_3 \), R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is H. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3, Rᵢ and Rᵢ are \( \text{CH}_3 \), R₂ and R₃ are \( \text{CH}_3 \), and each of R₃ and R₅ is H. In some variations of formula (11) described in the paragraphs above in which \( I_2 \) is 3,
\( R_{ai} \) and \( R_{bi} \) are \( \circ \), \( R_{a2} \) and \( R_{b2} \) are \( \circ \), and each of \( R_{a3} \) and \( R_{b3} \) is \( \mathrm{H} \). In some variations of formula (11) described in the paragraphs above in which \( \ell_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \circ \), \( R_{a2} \) and \( R_{b2} \) are \( \circ \), and each of \( R_{a3} \) and \( R_{b3} \) is \( \mathrm{CH}_3 \). In some variations of formula (11) described in the paragraphs above in which \( \ell_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \circ \), \( R_{a2} \) and \( R_{b2} \) are \( \circ \), \( R_{a3} \) is \( \mathrm{H} \), and \( R_{b3} \) is \( \mathrm{CH}_3 \).

[231] In some variations of formula (11) described in the paragraphs above in which \( \ell_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \circ \), and each of \( R_{a3} \) and \( R_{b3} \) is \( \mathrm{H} \). In some variations of formula (11) described in the paragraphs above in which \( \ell_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \circ \), and each of \( R_{a3} \) and \( R_{b3} \) is \( \mathrm{CH}_3 \). In some variations of formula (11) described in the paragraphs above in which \( \ell_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) and \( R_{a3} \) and \( R_{b2} \) together are \( \circ \), and \( R_{a3} \) and \( R_{b3} \) are \( \circ \). In some variations of formula (11) described in the paragraphs above in which \( \ell_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \circ \), and \( R_{a3} \) and \( R_{b3} \) are \( \circ \).

[232] In variations of formula (11) described in the paragraphs above in which \( \ell_2 \) is 4, the three instances of \( R_{a} \) and \( R_{b} \) are indicated as \( R_{ai} \) and \( R_{bi} \); \( R_{a2} \) and \( R_{b2} \); \( R_{a3} \) and \( R_{b3} \); and \( R_{a4} \) and \( R_{b4} \), respectively. In some variations of formula (11) described in the paragraphs above in which \( \ell_2 \) is 4, in some variations of formula (11) described in the paragraphs above in which \( \ell_2 \) is 4, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), \( R_{b3} \), \( R_{a4} \), \( R_{b4} \), and \( R_{b4} \) is \( \mathrm{H} \). In some variations of formula (11) described in the paragraphs above in which \( \ell_2 \) is 4, each of \( R_{a1} \), \( R_{b1} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), \( R_{b3} \), \( R_{a4} \), and \( R_{b4} \) is \( \mathrm{CH}_3 \). In some variations of formula (11) described in the paragraphs above in which \( \ell_2 \) is 4, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), and \( R_{b3} \) is \( \mathrm{CH}_3 \) and each of \( R_{a4} \) and \( R_{b4} \) is \( \mathrm{H} \).
In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, each of \( R_{a1}, R_{a2}, \) and \( R_{a3} \) is H and each of \( R_{b1}, R_{b2}, \) and \( R_{b3} \) is \( \text{CH}_3 \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) is H, \( R_{a2} \) is \( \text{CH}_3 \), and each of \( R_{a3} \), \( R_{b1} \), \( R_{b2} \), and \( R_{b3} \) is H. In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, each of \( R_{a1} \) and \( R_{a2} \) is H, each of \( R_{b1} \) and \( R_{b2} \) is \( \text{CH}_3 \), and each of \( R_{a3} \) and \( R_{b3} \) is \( \text{CH}_3 \).

In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are H, \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) is H, \( R_{a2} \) is \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) is H, \( R_{a2} \) is \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \).
In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{\sqrt{3}}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{\sqrt{3}}{4} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \frac{3}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{\sqrt{3}}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{\sqrt{3}}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{\sqrt{3}}{4} \).

In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{\sqrt{3}}{4} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{\sqrt{3}}{4} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \frac{3}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{\sqrt{3}}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{\sqrt{3}}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{\sqrt{3}}{4} \).

In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{\sqrt{3}}{4} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{\sqrt{3}}{4} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) is H, \( R_{b1} \) is \( CH_3 \), \( R_{a2} \) and \( R_{b2} \) are THF.

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CH₃, Rₐ₃ and Rₜ₃ are \( O \), and Rₐ₄ and Rₜ₄ are \( O \). In some variations of formula (11) described in the paragraphs above in which \( l₂ \) is 4, Rₐ is H, Rₜ is CH₃, Rₐ₂ is H, Rₜ₂ is CH₃, Rₐ₃ and Rₜ₃ are \( O \), and Rₐ₄ and Rₜ₄ are \( O \). In some variations of formula (11) described in the paragraphs above in which \( l₂ \) is 4, Rₐ is H, Rₜ is CH₃, Rₐ₂ is H, Rₜ₂ is CH₃, Rₐ₃ and Rₜ₃ are \( O \), and Rₐ₄ and Rₜ₄ are \( O \). In some variations of formula (11) described in the paragraphs above in which \( l₂ \) is 4, Rₐ is H, Rₜ is CH₃, Rₐ₂ is H, Rₜ₂ is CH₃, Rₐ₃ and Rₜ₃ are \( O \), and Rₐ₄ and Rₜ₄ are \( O \). In some variations of formula (11) described in the paragraphs above in which \( l₂ \) is 4, Rₐ is H, Rₜ is CH₃, Rₐ₂ is H, Rₜ₂ is CH₃, Rₐ₃ and Rₜ₃ are \( O \), and Rₐ₄ and Rₜ₄ are \( O \). In some variations of formula (11) described in the paragraphs above in which \( l₂ \) is 4, Rₐ is H, Rₜ is CH₃, Rₐ₂ is H, Rₜ₂ is CH₃, Rₐ₃ and Rₜ₃ are \( O \), and Rₐ₄ and Rₜ₄ are \( O \). In some variations of formula (11) described in the paragraphs above in which \( l₂ \) is 4, Rₐ is H, Rₜ is CH₃, Rₐ₂ is H, Rₜ₂ is CH₃, Rₐ₃ and Rₜ₃ are \( O \), and Rₐ₄ and Rₜ₄ are \( O \). In some variations of formula (11) described in the paragraphs above in which \( l₂ \) is 4, Rₐ is H, Rₜ is CH₃, Rₐ₂ is H, Rₜ₂ is CH₃, Rₐ₃ and Rₜ₃ are \( O \), and Rₐ₄ and Rₜ₄ are \( O \).
are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{a4} \) are \( \text{CH}_3 \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are 

In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are 

In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are 

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In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are 

In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are 

In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are 

In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are 

In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are 

In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are
of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{\text{a}1} \) and \( R_{\text{b}1} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}2} \)
and \( R_{\text{b}2} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}3} \) and \( R_{\text{b}3} \) are \( \text{CH}_3 \), and \( R_{\text{a}4} \) and \( R_{\text{b}4} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \). In some variations of
formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{\text{a}1} \) and \( R_{\text{b}1} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}2} \) and \( R_{\text{b}2} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}3} \) and \( R_{\text{b}3} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), and \( R_{\text{a}4} \) and \( R_{\text{b}4} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \).

[246] In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{\text{a}1} \) and \( R_{\text{b}1} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}2} \) and \( R_{\text{b}2} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}3} \) and \( R_{\text{b}3} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), and \( R_{\text{a}4} \) and \( R_{\text{b}4} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{\text{a}1} \) and \( R_{\text{b}1} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}2} \) and \( R_{\text{b}2} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}3} \) and \( R_{\text{b}3} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), and \( R_{\text{a}4} \) and \( R_{\text{b}4} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{\text{a}1} \) and \( R_{\text{b}1} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}2} \) and \( R_{\text{b}2} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}3} \) and \( R_{\text{b}3} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), and \( R_{\text{a}4} \) and \( R_{\text{b}4} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{\text{a}1} \) and \( R_{\text{b}1} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}2} \) and \( R_{\text{b}2} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}3} \) and \( R_{\text{b}3} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), and \( R_{\text{a}4} \) and \( R_{\text{b}4} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{\text{a}1} \) and \( R_{\text{b}1} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}2} \) and \( R_{\text{b}2} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}3} \) and \( R_{\text{b}3} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), and \( R_{\text{a}4} \) and \( R_{\text{b}4} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{\text{a}1} \) and \( R_{\text{b}1} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}2} \) and \( R_{\text{b}2} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}3} \) and \( R_{\text{b}3} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), and \( R_{\text{a}4} \) and \( R_{\text{b}4} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{\text{a}1} \) and \( R_{\text{b}1} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}2} \) and \( R_{\text{b}2} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}3} \) and \( R_{\text{b}3} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), and \( R_{\text{a}4} \) and \( R_{\text{b}4} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \). In some variations of formula (11) described in the paragraphs above in which \( l_2 \) is 4, \( R_{\text{a}1} \) and \( R_{\text{b}1} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}2} \) and \( R_{\text{b}2} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), \( R_{\text{a}3} \) and \( R_{\text{b}3} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \), and \( R_{\text{a}4} \) and \( R_{\text{b}4} \) are \( \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\circ}}}} \).
variations of formula (11) described in the paragraphs above in which $l_2$ is 4, $R_{a1}$ is H, $R_{b1}$ is CH$_3$, $R_{a2}$ and $R_{b2}$ are $\text{O} \quad \text{O}$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{O} \quad \text{O}$.

[250] In some variations of formula (11) described in the paragraphs above in which $l_2$ is 4, $R_{a1}$ and $R_{b1}$ are $\text{O} \quad \text{O}$, $R_{a2}$ and $R_{b2}$ are $\text{O} \quad \text{O}$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{O} \quad \text{O}$.

In some variations of formula (11) described in the paragraphs above in which $l_2$ is 4, $R_{a1}$ and $R_{b1}$ are $\text{O} \quad \text{O}$, $R_{a2}$ and $R_{b2}$ are $\text{O} \quad \text{O}$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{O} \quad \text{O}$.

[251] In some variations of formula (11) described in the paragraphs above in which $l_2$ is 4, $R_{a1}$ and $R_{b1}$ are $\text{O} \quad \text{O}$, $R_{a2}$ and $R_{b2}$ are $\text{O} \quad \text{O}$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{O} \quad \text{O}$.

[252] In some variations of formula (11) described in the paragraphs above in which $l_2$ is 4, $R_{a1}$ and $R_{b1}$ and $R_{a2}$ and $R_{b2}$ together are $\text{O} \quad \text{O}$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{O} \quad \text{O}$.

[253] In some variations of formula (11) described in the paragraphs above **ring** A is

(a) $\text{O} \quad \text{O}$, $\text{O} \quad \text{O}$, $\text{O} \quad \text{O}$, or $\text{O} \quad \text{O}$, optionally substituted with halo or C1-C6 linear or branched alkyl;

(b) $\text{O} \quad \text{O}$, $\text{O} \quad \text{O}$, $\text{O} \quad \text{O}$, $\text{O} \quad \text{O}$, $\text{O} \quad \text{O}$, or $\text{O} \quad \text{O}$, optionally substituted with halo or C1-C6 linear or branched alkyl; or
optionally substituted with halo or C1-C6 linear or branched alkyl.

[254] In some variations of formula (11) described in the paragraphs above, \( n \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[255] In some variations of formula (11) described in the paragraphs above, **ring** A is substituted with halo. In some variations, the halo is F, Br, I, or Cl.

[256] In some variations of formula (11) described in the paragraphs above, **ring** A is substituted with C1-C6 linear or branched alkyl (*e.g.*, C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[257] In some variations of formula (11) described in the paragraphs above, D1 is safranin-O. In some variations of formula (11) described in the paragraphs above, D2 is safranin-O. In some variations of formula (11) described in the paragraphs above, D1 and D2 are safranin-O.

[258] In some variations of formula (11) described in the paragraph above, the pendant phenyl ring of D1 is unsubstituted. In some variations of formula (11) described in the paragraph above, the pendant phenyl ring of D1 is substituted with 1-3 (*e.g.*, 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O', —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (*e.g.*, C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (*e.g.*, F, Br, Cl, I), trihalide (*e.g.*, —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (*e.g.*, C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).
In some variations of formula (11) described in the paragraph above, the pendant phenyl ring of D2 is unsubstituted. In some variations of formula (11) described in the paragraph above, the pendant phenyl ring of D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O³ −, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —N₂O, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₂, —CCl₃, —CBr₂, —Cl₂), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl).

In some of the variations of formula (11) described above, D₁ and D₂ are safranin-0 moieties, as shown in formula (11a):

![Diagram](image_url)

(11a)

in which I₁, I₂, n, ring A, Rₐ₁, Rbi Ra₂, and Rb₂ are as described in the paragraphs above, R₁, R₂, R₃, R₄, R₅, and R₆ independently are absent or independently are selected from —NH₂, —NHR, —NR₂, —OH, —O³ −, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, —C₆H₅, —N₂O, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₂, —CCl₃, —CBr₂, —Cl₂), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR), and R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl).

One of skill in the art can readily visualize and prepare other cationic multimers falling within formula (11) in which other cationic dye moieties are used in place of one or both of the safranin-0 moieties.
Some cationic dye dimers fall within formula (12):

\[
\begin{align*}
\text{D1} & \quad \text{NH} \quad \text{D2} \\
R_{a1} & \quad R_{d1} \\
R_{a1} & \quad R_{d1} \\
R_{a2} & \quad R_{d2} \\
R_{a2} & \quad R_{d2}
\end{align*}
\]

(12), in which each of D1 and D2 is a cationic dye moiety; \( I_1, \frac{3}{4}, n, \alpha i, \) and \( \theta_2 \) independently are 1-4; ring A is aryl, heteroaryl, cycloalkyl, or heterocyclyl; for each independent instance of \( R_{a1} \) and \( R_{b1} \), \( R_{a1} \) and \( R_{b1} \) (1) independently are H or CH\(_3\), or (2) \( R_{a1} \) and \( R_{b1} \) are \( \gamma \) or \( \gamma \), or (3) two of \( CR_{a1}R_{b1} \) are \( \gamma \) or \( \gamma \); for each independent instance of \( R_{a2} \) and \( R_{b2} \), \( R_{a2} \) and \( R_{b2} \) (1) independently are H or CH\(_3\), or (2) \( R_{a2} \) and \( R_{b2} \) are \( \gamma \) or \( \gamma \), or (3) two of \( CR_{a2}R_{b2} \) are \( \gamma \) or \( \gamma \); for each independent instance of \( R_{c1} \) and \( R_{d1} \), \( R_{c1} \) and \( R_{d1} \) (1) independently are H or CH\(_3\), or (2) \( R_{c1} \) and \( R_{d1} \) are \( \gamma \) or \( \gamma \), or (3) two of \( CR_{c1}R_{d1} \) are \( \gamma \) or \( \gamma \); for each independent instance of \( R_{c2} \) and \( R_{d2} \), \( R_{c2} \) and \( R_{d2} \) (1) independently are H or CH\(_3\), or (2) \( R_{c2} \) and \( R_{d2} \) are \( \gamma \) or \( \gamma \), or (3) two of \( CR_{c2}R_{d2} \) are \( \gamma \) or \( \gamma \).

In some variations of formula (12), the cationic dye moiety is selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue. In some variations of formula (12), D1 and D2 are different cationic dye moieties. In other variations of formula (12), D1 and D2 are the same cationic dye moiety.

In some variations of formula (12) described in the paragraphs above, \( I_1 \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (12) described in the paragraphs above, \( I_2 \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some previous variations of formula (12) described in the paragraphs above, \( \alpha i \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.
In some previous variations of formula (12) described in the paragraphs above, \( R_a^i \) and \( R_b^i \) are both H. In some variations of formula (12) described in the paragraphs above in which \( i \) is 1, \( R_a^i \) is H and \( R_b^i \) is CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( i \) is 1, \( R_a^i \) and \( R_b^i \) are both CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( i \) is 1, \( R_a^i \) and \( R_b^i \) are \( \frac{3}{4} \). In some variations of formula (12) described in the paragraphs above in which \( i \) is 1, \( R_a^i \) and \( R_b^i \) are \( \frac{3}{4} \).

In some variations of formula (12) described in the paragraphs above in which \( i \) is 2, the two instances of \( R_a^i \) and \( R_b^i \) are indicated as \( R_a^i \) and \( R_{a2}^i \) and \( R_{b2}^i \), respectively. In some variations of formula (12) described in the paragraphs above in which \( i \) is 2, each of \( R_a^i \) and \( R_b^i \) and \( R_{a2}^i \) and \( R_{b2}^i \) is H. In some variations of formula (12) described in the paragraphs above in which \( i \) is 2, each of \( R_a^i \) and \( R_b^i \) and \( R_{a2}^i \) and \( R_{b2}^i \) is CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( i \) is 2, each of \( R_a^i \) and \( R_{b2}^i \) is H and each of \( R_{a2}^i \) and \( R_b^i \) is CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( i \) is 2, each of \( R_a^i \), \( R_{a2}^i \), and \( R_b^i \) is H and \( R_{b2}^i \) is CH\(_3\).
variations of formula (12) described in the paragraphs above in which \( I_i \) is 2, \( R_{ai} \) and \( R_{bi} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \text{\textbullet}\text{\textbullet}\text{\textbullet}\text{\textbullet}\), some variations of formula (12) described in the paragraphs above in which \( I_i \) is 2, \( R_{ai} \) and \( R_{bi} \) are \( \text{\textbullet}\text{\textbullet}\text{\textbullet}\text{\textbullet}\), \( R_{a2} \) and \( R_{b2} \) are \( \text{\textbullet}\text{\textbullet}\text{\textbullet}\text{\textbullet}\). In some variations of formula (12) described in the paragraphs above in which \( I_i \) is 2, \( R_{ai} \) and \( R_{bi} \) are \( \text{\textbullet}\text{\textbullet}\text{\textbullet}\text{\textbullet}\), \( R_{a2} \) and \( R_{b2} \) are \( \text{\textbullet}\text{\textbullet}\text{\textbullet}\text{\textbullet}\). In some variations of formula (12) described in the paragraphs above in which \( I_i \) is 2, \( R_{ai} \) and \( R_{bi} \) are \( \text{\textbullet}\text{\textbullet}\text{\textbullet}\text{\textbullet}\), \( R_{a2} \) and \( R_{b2} \) are \( \text{\textbullet}\text{\textbullet}\text{\textbullet}\text{\textbullet}\).

[271] In variations of formula (12) described in the paragraphs above in which \( I_i \) is 3, the three instances of \( R_a \) and \( R_b \) are indicated as \( R_{ai} \) and \( R_{bi} \); \( R_{a2} \) and \( R_{b2} \); and \( R_{a3} \) and \( R_{b3} \), respectively. In some variations of formula (12) described in the paragraphs above in which \( I_i \) is 3, In some variations of formula (12) described in the paragraphs above in which \( I_i \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), and \( R_{b3} \) is \( \text{H} \). In some variations of formula (12) described in the paragraphs above in which \( I_i \) is 3, each of \( R_{ai} \), \( R_{b1} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), and \( R_{b3} \) is \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which \( I_i \) is 3, each of \( R_{ai} \), \( R_{b1} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), and \( R_{b3} \) is \( \text{H} \). In some variations of formula (12) described in the paragraphs above in which \( I_i \) is 3, each of \( R_{ai} \), \( R_{b1} \), \( R_{a2} \), and \( R_{b2} \) is \( \text{CH}_3 \) and each of \( R_{a3} \) and \( R_{b3} \) is \( \text{H} \). In some variations of formula (12) described in the paragraphs above in which \( I_i \) is 3, each of \( R_{ai} \), \( R_{b1} \), \( R_{a2} \), and \( R_{b2} \) is \( \text{H} \) and each of \( R_{a3} \) and \( R_{b3} \) is \( \text{CH}_3 \).

[272] In some variations of formula (12) described in the paragraphs above in which \( I_i \) is 3, each of \( R_{ai} \), \( R_{b1} \), \( R_{a2} \), and \( R_{b2} \) is \( \text{H} \) and each of \( R_{a3} \) and \( R_{b3} \) are \( \text{\textbullet}\text{\textbullet}\text{\textbullet}\text{\textbullet}\). In some variations of formula (12) described in the paragraphs above in which \( I_i \) is 3, each of \( R_{ai} \), \( R_{b1} \), \( R_{a2} \), and \( R_{b2} \) is \( \text{CH}_3 \) and \( R_{a3} \) and \( R_{b3} \) are \( \text{\textbullet}\text{\textbullet}\text{\textbullet}\text{\textbullet}\). In some variations of formula (12) described in the paragraphs above in which \( I_i \) is 3, each of \( R_{ai} \) and \( R_{a2} \) is \( \text{H} \) and each of \( R_{b1} \) and \( R_{b2} \) is \( \text{CH}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{\textbullet}\text{\textbullet}\text{\textbullet}\text{\textbullet}\).
In some variations of formula (12) described in the paragraphs above in which \( I_1 \) is 3, each of \( R_{a1}, R_{b1}, R_{a2}, \) and \( R_{b2} \) is H and \( R_{a3} \) and \( R_{b3} \) are H. In some variations of formula (12) described in the paragraphs above in which \( I_1 \) is 3, each of \( R_{a1}, R_{b1}, R_{a2}, \) and \( R_{b2} \) is CH\(_3\) and \( R_{a3} \) and \( R_{b3} \) are H. In some variations of formula (12) described in the paragraphs above in which \( I_1 \) is 3, \( R_{a1} \) is H and each of \( R_{a2}, R_{b1}, \) and \( R_{b2} \) is CH\(_3\), and \( R_{a3} \) and \( R_{b3} \) are H. In some variations of formula (12) described in the paragraphs above in which \( I_1 \) is 3, each of \( R_{a1} \) and \( R_{a2} \) is H and each of \( R_{b1} \) and \( R_{b2} \) is CH\(_3\), and \( R_{a3} \) and \( R_{b3} \) are H. In some variations of formula (12) described in the paragraphs above in which \( I_1 \) is 3, \( R_{a1} \) and \( R_{b1} \) are O\(\text{CH}_3\), \( R_{a2} \) and \( R_{b2} \) are O\(\text{CH}_3\), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (12) described in the paragraphs above in which \( I_1 \) is 3, \( R_{a1} \) and \( R_{b1} \) are O\(\text{CH}_3\), \( R_{a2} \) and \( R_{b2} \) are O\(\text{CH}_3\), \( R_{a3} \) is H, and \( R_{b3} \) is CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( I_1 \) is 3, \( R_{a1} \) and \( R_{b1} \) are O\(\text{CH}_3\), \( R_{a2} \) and \( R_{b2} \) are O\(\text{CH}_3\), \( R_{a3} \) is H, and \( R_{b3} \) is CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( I_1 \) is 3, \( R_{a1} \) and \( R_{b1} \) are O\(\text{CH}_3\), \( R_{a2} \) and \( R_{b2} \) are O\(\text{CH}_3\), \( R_{a3} \) is H, and \( R_{b3} \) is CH\(_3\).
\( R_{b2} \) are \( O \ \text{and} \ \text{each of } R_{a3} \ \text{and} \ R_{b3} \ \text{is} \ CH_3 \). In some variations of formula (12) described in the paragraphs above in which \( I_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( O \), \( R_{a2} \) and \( R_{b2} \) are \( O \), \( R_{a3} \) is \( H \), and \( R_{b3} \) is \( CH_3 \). In some variations of formula (12) described in the paragraphs above in which \( I_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( O \), \( R_{a2} \) and \( R_{b2} \) are \( O \), and each of \( R_{a3} \) and \( R_{b3} \) is \( H \). In some variations of formula (12) described in the paragraphs above in which \( I_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( O \), \( R_{a2} \) and \( R_{b2} \) are \( O \), \( R_{a3} \) is \( H \), and \( R_{b3} \) is \( CH_3 \).

[276] In some variations of formula (12) described in the paragraphs above in which \( I_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( O \), \( R_{a2} \) and \( R_{b2} \) are \( O \), and each of \( R_{a3} \) and \( R_{b3} \) is \( H \). In some variations of formula (12) described in the paragraphs above in which \( I_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( O \), \( R_{a2} \) and \( R_{b2} \) are \( O \), \( R_{a3} \) is \( H \), and \( R_{b3} \) is \( CH_3 \). In some variations of formula (12) described in the paragraphs above in which \( I_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( O \), \( R_{a2} \) and \( R_{b2} \) are \( O \), and each of \( R_{a3} \) and \( R_{b3} \) is \( H \). In some variations of formula (12) described in the paragraphs above in which \( I_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( O \), \( R_{a2} \) and \( R_{b2} \) are \( O \), \( R_{a3} \) is \( H \), and \( R_{b3} \) is \( CH_3 \). In some variations of formula (12) described in the paragraphs above in which \( I_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( O \), \( R_{a2} \) and \( R_{b2} \) are \( O \), \( R_{a3} \) is \( H \), and \( R_{b3} \) is \( CH_3 \).
In some variations of formula (12) described in the paragraphs above in which $I_f$ is 3, $R_{ai}$ and $R_{bi}$ and $R_{b2}$ together are $\text{H}$, and each of $R_{a3}$ and $R_{b3}$ is $\text{H}$. In some variations of formula (12) described in the paragraphs above in which $I_f$ is 3, $R_{ai}$ and $R_{bi}$ and $R_{a2}$ and $R_{b2}$ together are $\text{H}$, and each of $R_{a3}$ and $R_{b3}$ is $\text{CH}_3$. In some variations of formula (12) described in the paragraphs above in which $I_f$ is 3, $R_{ai}$ and $R_{bi}$ and $R_{a2}$ and $R_{b2}$ together are $\text{H}$, and each of $R_{a3}$ and $R_{b3}$ is $\text{CH}_3$. In some variations of formula (12) described in the paragraphs above in which $I_f$ is 3, $R_{a2}$, $R_{a3}$, $R_{a4}$, and $R_{b4}$ is $\text{H}$. In some variations of formula (12) described in the paragraphs above in which $I_f$ is 3, $R_{b2}$ and $R_{b3}$ is $\text{CH}_3$. In some variations of formula (12) described in the paragraphs above in which $I_f$ is 4, each of $R_{a2}$, $R_{a3}$, and $R_{b3}$ is $\text{H}$, and each of $R_{a4}$ and $R_{b4}$ is $\text{CH}_3$. In some variations of formula (12) described in the paragraphs above in which $I_f$ is 3, $R_{a2}$, $R_{a3}$, and $R_{b3}$ is $\text{H}$, and each of $R_{a4}$ and $R_{b4}$ is $\text{CH}_3$.
In some variations of formula (12) described in the paragraphs above in which \( I_I = 4 \), \( R_i \) and \( R_{n} \) are H, \( R_{a_1} \) and \( R_{b_1} \) are H, \( R_{a_2} \) and \( R_{b_2} \) are H, \( R_{a_3} \) and \( R_{b_3} \) are \( CH_3 \), and \( R_{a_4} \) and \( R_{b_4} \) are \( CH_3 \).

In some variations of formula (12) described in the paragraphs above in which \( I_I = 4 \), \( R_i \) and \( R_{n} \) are H, \( R_{a_1} \) and \( R_{b_1} \) are H, \( R_{a_2} \) and \( R_{b_2} \) are \( CH_3 \), \( R_{a_3} \) and \( R_{b_3} \) are \( CH_3 \), and \( R_{a_4} \) and \( R_{b_4} \) are \( CH_3 \).

In some variations of formula (12) described in the paragraphs above in which \( I_I = 4 \), \( R_i \) and \( R_{n} \) are H, \( R_{a_1} \) and \( R_{b_1} \) are H, \( R_{a_2} \) and \( R_{b_2} \) are \( CH_3 \), \( R_{a_3} \) and \( R_{b_3} \) are \( CH_3 \), and \( R_{a_4} \) and \( R_{b_4} \) are \( CH_3 \).

In some variations of formula (12) described in the paragraphs above in which \( I_I = 4 \), \( R_i \) and \( R_{n} \) are H, \( R_{a_1} \) and \( R_{b_1} \) are H, \( R_{a_2} \) and \( R_{b_2} \) are \( CH_3 \), \( R_{a_3} \) and \( R_{b_3} \) are \( CH_3 \), and \( R_{a_4} \) and \( R_{b_4} \) are \( CH_3 \).

In some variations of formula (12) described in the paragraphs above in which \( I_I = 4 \), \( R_i \) and \( R_{n} \) are H, \( R_{a_1} \) and \( R_{b_1} \) are H, \( R_{a_2} \) and \( R_{b_2} \) are \( CH_3 \), \( R_{a_3} \) and \( R_{b_3} \) are \( CH_3 \), and \( R_{a_4} \) and \( R_{b_4} \) are \( CH_3 \).

In some variations of formula (12) described in the paragraphs above in which \( I_I = 4 \), \( R_i \) and \( R_{n} \) are H, \( R_{a_1} \) and \( R_{b_1} \) are H, \( R_{a_2} \) and \( R_{b_2} \) are \( CH_3 \), \( R_{a_3} \) and \( R_{b_3} \) are \( CH_3 \), and \( R_{a_4} \) and \( R_{b_4} \) are \( CH_3 \).

In some variations of formula (12) described in the paragraphs above in which \( I_I = 4 \), \( R_i \) and \( R_{n} \) are H, \( R_{a_1} \) and \( R_{b_1} \) are H, \( R_{a_2} \) and \( R_{b_2} \) are \( CH_3 \), \( R_{a_3} \) and \( R_{b_3} \) are \( CH_3 \), and \( R_{a_4} \) and \( R_{b_4} \) are \( CH_3 \).
variations of formula (12) described in the paragraphs above in which $I_4$ is 4, $R_{ai}$ and $R_{bi}$ are
\[
\frac{3}{4}, \quad R_{a2} \text{ and } R_{b2} \text{ are } \frac{3}{4}, \quad R_{a3} \text{ and } R_{b3} \text{ are } \frac{3}{4}, \quad \text{and } R_{a4} \text{ and } R_{b4} \text{ are } \frac{3}{4}.
\]

[283] In some variations of formula (12) described in the paragraphs above in which $I_4$ is 4, $R_{ai}$ and $R_{bi}$ are H, $R_{a2}$ and $R_{b2}$ are H, $R_{a3}$ and $R_{b3}$ are H, and $R_{a4}$ and $R_{b4}$ are some
\[
\frac{3}{4}, \quad R_{a3} \text{ and } R_{b3} \text{ are } CH_3, \quad R_{a4} \text{ and } R_{b4} \text{ are } \frac{3}{4}. \quad \text{In some variations of formula (12) described in the paragraphs above in which } I_4 \text{ is } 4, \quad R_{ai} \text{ and } R_{bi} \text{ are H,}
\]
\[
R_{a2} \text{ and } R_{b2} \text{ are CH}_3, \quad R_{a3} \text{ and } R_{b3} \text{ are CH}_3, \quad \text{and } R_{a4} \text{ and } R_{b4} \text{ are } \frac{3}{4}. \quad \text{In some variations of formula (12) described in the paragraphs above in which } I_4 \text{ is } 4, \quad R_{ai} \text{ and } R_{bi} \text{ are CH}_3, \quad R_{a2} \text{ and } R_{b2} \text{ are CH}_3, \quad R_{a3} \text{ and } R_{b3} \text{ are CH}_3, \quad \text{and } R_{a4} \text{ and } R_{b4} \text{ are } \frac{3}{4}.
\]

[284] In some variations of formula (12) described in the paragraphs above in which $I_4$ is 4, $R_{ai}$ and $R_{bi}$ are H, $R_{a2}$ and $R_{b2}$ are H, $R_{a3}$ and $R_{b3}$ are some, and $R_{a4}$ and $R_{b4}$ are $\nu$. In some variations of formula (12) described in the paragraphs above in which $I_4$ is 4, $R_{ai}$ and $R_{bi}$ are H, $R_{a2}$ and $R_{b2}$ are CH$_3$, $R_{a3}$ and $R_{b3}$ are CH$_3$, and $R_{a4}$ and $R_{b4}$ are CH$_3$. In some variations of formula (12) described in the paragraphs above in which $I_4$ is 4, $R_{ai}$ and $R_{bi}$ are H, $R_{a2}$ and $R_{b2}$ are CH$_3$, $R_{a3}$ and $R_{b3}$ are CH$_3$, and $R_{a4}$ and $R_{b4}$ are CH$_3$. In some variations of formula (12) described in the paragraphs above in which $I_4$ is 4, $R_{ai}$ is H, $R_{bi}$ is CH$_3$, $R_{a2}$ and $R_{b2}$ are CH$_3$, $R_{a3}$ and $R_{b3}$ are CH$_3$, and $R_{a4}$ and $R_{b4}$ are CH$_3$. In some variations of formula (12) described in the paragraphs above in which $I_4$ is 4, $R_{ai}$ is H, $R_{bi}$ is CH$_3$, $R_{a2}$ is H, $R_{b2}$ is CH$_3$, $R_{a3}$ and $R_{b3}$ are CH$_3$, and $R_{a4}$ and $R_{b4}$ are CH$_3$. In some

[285] In some variations of formula (12) described in the paragraphs above in which $I_4$ is 4, $R_{ai}$ and $R_{bi}$ are H, $R_{a2}$ and $R_{b2}$ are some, $R_{a3}$ and $R_{b3}$ are some, and $R_{a4}$ and $R_{b4}$ are some. In some
variations of formula (12) described in the paragraphs above in which \( I_f \) is 4, \( R_i \) and \( R_{ji} \) are 

\[ \text{CH}_3, R_{a2} \text{ and } R_{b2} \text{ are } \cdot \text{O} \cdot \cdot \cdot, R_{a3} \text{ and } R_{b3} \text{ are } \cdot \cdot \cdot \cdot \cdot, \text{and } R_{a4} \text{ and } R_{b4} \text{ are } \cdot \cdot \cdot \cdot \cdot. \]  

In some variations of formula (12) described in the paragraphs above in which \( I_f \) is 4, \( R_i \) and \( R_{ji} \) are 

\[ R_{b2} \text{ are } \cdot \cdot \cdot \cdot \cdot, R_{a3} \text{ and } R_{b3} \text{ are } \cdot \cdot \cdot \cdot \cdot, \text{and } R_{a4} \text{ and } R_{b4} \text{ are } \cdot \cdot \cdot \cdot \cdot. \]  

In some variations of formula (12) described in the paragraphs above in which \( I_f \) is 4, \( R_i \) and \( R_{ji} \) are 

\[ \text{C} \text{H}_3, R_{a2} \text{ and } R_{b2} \text{ are } H, R_{a3} \text{ and } R_{b3} \text{ are } H, \text{and } R_{a4} \text{ and } R_{b4} \text{ are } \cdot \cdot \cdot \cdot \cdot. \]  

In some variations of formula (12) described in the paragraphs above in which \( I_f \) is 4, \( R_i \) and \( R_{ji} \) are 

\[ \text{C} \text{H}_3, R_{a2} \text{ and } R_{b2} \text{ are } \cdot \cdot \cdot \cdot \cdot, R_{a3} \text{ and } R_{b3} \text{ are } \cdot \cdot \cdot \cdot \cdot, \text{and } R_{a4} \text{ and } R_{b4} \text{ are } \cdot \cdot \cdot \cdot \cdot. \]  

In some variations of formula (12) described in the paragraphs above in which \( I_f \) is 4, \( R_i \) and \( R_{ji} \) are 

\[ \text{H}, R_{a2} \text{ and } R_{b2} \text{ are } \cdot \cdot \cdot \cdot \cdot, \text{and } R_{a3} \text{ and } R_{b3} \text{ are } \cdot \cdot \cdot \cdot \cdot. \]  

In some variations of formula (12) described in the paragraphs above in which \( I_f \) is 4, \( R_i \) and \( R_{ji} \) are 

\[ \text{H}, R_{a3} \text{ and } R_{b3} \text{ are } \cdot \cdot \cdot \cdot \cdot, \text{and } R_{a4} \text{ and } R_{b4} \text{ are } \cdot \cdot \cdot \cdot \cdot. \]  

In some variations of formula (12) described in the paragraphs above in which \( I_f \) is 4, \( R_i \) and \( R_{ji} \) are 

\[ \text{H}, \text{and } R_{a4} \text{ and } R_{b4} \text{ are } \cdot \cdot \cdot \cdot \cdot. \]  

In some variations of formula (12) described in the paragraphs above in which \( I_f \) is 4, \( R_i \) and \( R_{ji} \) are 

\[ \text{H}, \text{and } R_{a4} \text{ and } R_{b4} \text{ are } \cdot \cdot \cdot \cdot \cdot. \]  

In some variations of formula (12) described in the paragraphs above in which \( I_f \) is 4, \( R_i \) and \( R_{ji} \) are 

\[ \text{H}, \text{and } R_{a4} \text{ and } R_{b4} \text{ are } \cdot \cdot \cdot \cdot \cdot. \]
In some variations of formula (12) described in the paragraphs above in which \( I_1 \) is 4, \( R_a \) and \( R_i \) are \( \frac{1}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{1}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{1}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{1}{4} \).

In some variations of formula (12) described in the paragraphs above in which \( I_1 \) is 4, \( R_a \) and \( R_i \) are \( \frac{1}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{1}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{1}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{1}{4} \).

In some variations of formula (12) described in the paragraphs above in which \( I_1 \) is 4, \( R_a \) and \( R_i \) are \( \frac{1}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{1}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{1}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{1}{4} \).

In some variations of formula (12) described in the paragraphs above in which \( I_1 \) is 4, \( R_a \) and \( R_i \) are \( \frac{1}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{1}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{1}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{1}{4} \).

In some variations of formula (12) described in the paragraphs above in which \( I_1 \) is 4, \( R_a \) and \( R_i \) are \( \frac{1}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{1}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{1}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{1}{4} \).
In some variations of formula (12) described in the paragraphs above in which I_1 is 4, R^a_i and R^b_i are \( \text{CH}_3 \). R^a_2 and R^b_2 are \( \text{CH}_3 \), and R^a_3 and R^b_3 together are \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which I_1 is 4, R^a_i and R^b_i are \( \text{CH}_3 \). R^a_2 and R^b_2 are \( \text{CH}_3 \), and R^a_3 and R^b_3 together are \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which I_1 is 4, R^a_i and R^b_i are \( \text{CH}_3 \). R^a_2 and R^b_2 are \( \text{CH}_3 \), and R^a_3 and R^b_3 together are \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which I_1 is 4, R^a_i and R^b_i are \( \text{CH}_3 \). R^a_2 and R^b_2 are \( \text{CH}_3 \), and R^a_3 and R^b_3 together are \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which I_1 is 4, R^a_i and R^b_i are \( \text{CH}_3 \). R^a_2 and R^b_2 are \( \text{CH}_3 \), and R^a_3 and R^b_3 together are \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which I_1 is 4, R^a_i and R^b_i are \( \text{CH}_3 \). R^a_2 and R^b_2 are \( \text{CH}_3 \), and R^a_3 and R^b_3 together are \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which I_1 is 4, R^a_i and R^b_i are \( \text{CH}_3 \). R^a_2 and R^b_2 are \( \text{CH}_3 \), and R^a_3 and R^b_3 together are \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which I_1 is 4, R^a_i and R^b_i are \( \text{CH}_3 \). R^a_2 and R^b_2 are \( \text{CH}_3 \), and R^a_3 and R^b_3 together are \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which I_1 is 4, R^a_i and R^b_i are \( \text{CH}_3 \). R^a_2 and R^b_2 are \( \text{CH}_3 \), and R^a_3 and R^b_3 together are \( \text{CH}_3 \).
R_{a1} and R_{a2} and R_{b1} and R_{b2} are \( \cdot \), and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are \( \cdot \). In some variations of formula (12) described in the paragraphs above in which \( I_1 \) is 4, R_{a1} and R_{b1} are \( \cdot \), R_{a2} and R_{b2} are \( \cdot \), and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are \( \cdot \).

[297] In some variations of formula (12) described in the paragraphs above in which \( I_1 \) is 4, R_{a1} and R_{b1} are \( \cdot \), R_{a2} and R_{b2} are \( \cdot \), and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are \( \cdot \).

[298] In some variations of formula (12) described in the paragraphs above in which \( I_1 \) is 4, R_{a1} and R_{b1} and R_{a2} and R_{b2} together are \( \cdot \), and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are \( \cdot \).

[299] In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 1, R_{a1} and R_{b1} are both H. In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 1, R_{a1} is H and R_{b1} is CH₃. In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 1, R_{a1} and R_{b1} are both CH₃. In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 1, R_{a1} and R_{b1} are \( \cdot \). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 1, R_{a1} and R_{b1} are \( \cdot \).

[300] In variations of formula (12) described in the paragraphs above in which \( I_2 \) is 2, the two instances of R_{a} and R_{b} are indicated as R_{a1} and R_{b1} and R_{a2} and R_{b2}, respectively. In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 2, each of R_{a1} and R_{b1} and R_{a2} and R_{b2} is H. In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 2, each of R_{a1} and R_{b1} and R_{a2} and R_{b2} is CH₃. In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 2, each of R_{a1} and R_{a2} is H and each of R_{b1} and R_{b2} is CH₃. In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 2, each of R_{a1}, R_{a2}, and R_{b1} is H and R_{b2} is CH₃.

[301] In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 2, each of R_{a1} and R_{b1} is H and R_{a2} and R_{b2} are \( \cdot \). In some variations of formula (12)
described in the paragraphs above in which \( I_2 \) is 2, each of \( R_{ai} \) and \( R_{bi} \) is H and \( R_{a2} \) and \( R_{b2} \) are \( 3^3 \). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 2, each of \( R_{ai} \) and \( R_{bi} \) is CH\(_3\) and \( R_{a2} \) and \( R_{b2} \) are \( 3^3 \). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 2, each of \( R_{ai} \) and \( R_{bi} \) is CH\(_3\) and \( R_{a2} \) and \( R_{b2} \) are \( 3^3 \).

In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 2, \( R_{ai} \) is H, \( R_{bi} \) is CH\(_3\), and \( R_{a2} \) and \( R_{b2} \) are \( 3^4 \). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 2, \( R_{ai} \) is H, \( R_{bi} \) is CH\(_3\), and \( R_{a2} \) and \( R_{b2} \) are \( 3^3 \). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 2, \( R_{ai} \) and \( R_{bi} \) are \( 3^3 \), \( R_{a2} \) and \( R_{b2} \) are \( 3^3 \). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 2, \( R_{ai} \) and \( R_{bi} \) are \( 3^3 \), \( R_{a2} \) and \( R_{b2} \) are \( 3^3 \). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 2, \( R_{ai} \) and \( R_{bi} \) are \( 3^2 \), \( R_{a2} \) and \( R_{b2} \) are \( 3^2 \).

[302] In variations of formula (12) described in the paragraphs above in which \( I_2 \) is 3, the three instances of \( R_a \) and \( R_b \) are indicated as \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), and \( R_{b3} \), respectively. In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 3, \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), and \( R_{b3} \) is CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), and \( R_{b3} \) is CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), and \( R_{b3} \) is CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), and \( R_{b3} \) is CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), and \( R_{b3} \) is CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), and \( R_{b3} \) is CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), and \( R_{b3} \) is CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), and \( R_{b3} \) is CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), and \( R_{b3} \) is CH\(_3\).
CH$_3$. In some variations of formula (12) described in the paragraphs above in which $l_2$ is 3, each of Ra$_i$, Ra$_{a2}$, and Ra$_{a3}$ is H and each of Rbi, R$_{b2}$, and R$_{b3}$ is CH$_3$.

[303] In some variations of formula (12) described in the paragraphs above in which $l_2$ is 3, each of Ra$_i$, Ra$_{a2}$, and R$_{b2}$ is H and Ra$_{a3}$ and R$_{b3}$ are $\gamma_3 R_3$. In some variations of formula (12) described in the paragraphs above in which $l_2$ is 3, each of Ra$_i$, Ra$_{a2}$, and R$_{b2}$ is CH$_3$ and Ra$_{a3}$ and R$_{b3}$ are $\gamma_3 R_3$. In some variations of formula (12) described in the paragraphs above in which $l_2$ is 3, R$_{a1}$ is H and each of Ra$_{a2}$, R$_{b1}$, and R$_{b2}$ is CH$_3$, and Ra$_{a3}$ and R$_{b3}$ are $\gamma_3 R_3$.

[304] In some variations of formula (12) described in the paragraphs above in which $l_2$ is 3, each of Ra$_i$, Ra$_{a2}$, and R$_{b2}$ is H and Ra$_{a3}$ and R$_{b3}$ are $\gamma_3 R_3$. In some variations of formula (12) described in the paragraphs above in which $l_2$ is 3, each of Ra$_i$, Ra$_{a2}$, and R$_{b2}$ is CH$_3$ and Ra$_{a3}$ and R$_{b3}$ are $\gamma_3 R_3$. In some variations of formula (12) described in the paragraphs above in which $l_2$ is 3, each of Ra$_{a1}$ and Ra$_{a2}$ is H and each of R$_{b1}$ and R$_{b2}$ is CH$_3$, and Ra$_{a3}$ and R$_{b3}$ are $\gamma_3 R_3$.

[305] In some variations of formula (12) described in the paragraphs above in which $l_2$ is 3, Ra$_i$ and R$_{b1}$ are $\gamma_3 R_3$, Ra$_{a2}$ and R$_{b2}$ are $\gamma_3 R_3$, and each of Ra$_{a3}$ and R$_{b3}$ is H. In some variations of formula (12) described in the paragraphs above in which $l_2$ is 3, Ra$_i$ and R$_{b1}$ are $\gamma_3 R_3$, Ra$_{a2}$ and R$_{b2}$ are $\gamma_3 R_3$, Ra$_{a3}$ is H, R$_{b3}$ is CH$_3$. In some variations of formula (12) described in the paragraphs above in which $l_2$ is 3,
$R_{ai}$ and $R_{bi}$ are $\frac{3}{4}$, $R_{a2}$ and $R_{h2}$ are $\frac{3}{4}$, and each of $R_{a3}$ and $R_{h3}$ is H. In some variations of formula (12) described in the paragraphs above in which $I_2$ is 3, $R_{ai}$ and $R_{bi}$ are $\frac{3}{4}$, $R_{a2}$ and $R_{h2}$ are $\frac{3}{4}$, and each of $R_{a3}$ and $R_{h3}$ is CH$_3$. In some variations of formula (12) described in the paragraphs above in which $I_2$ is 3, $R_{ai}$ and $R_{bi}$ are $\frac{3}{4}$, $R_{a2}$ and $R_{h2}$ are $\frac{3}{4}$, $R_{a3}$ is H, $R_{h3}$ is CH$_3$.

[306] In some variations of formula (12) described in the paragraphs above in which $I_2$ is 3, $R_{ai}$ and $R_{bi}$ are $\frac{3}{4}$, $R_{a2}$ and $R_{h2}$ are $\frac{3}{4}$, and each of $R_{a3}$ and $R_{h3}$ is H. In some variations of formula (12) described in the paragraphs above in which $\frac{3}{4}$ is 3, $R_{ai}$ and $R_{bi}$ are $\frac{3}{4}$, $R_{a2}$ and $R_{h2}$ are $\frac{3}{4}$, $R_{a3}$ is H, and $R_{h3}$ is CH$_3$. In some variations of formula (12) described in the paragraphs above in which $I_2$ is 3, $R_{ai}$ and $R_{bi}$ are $\frac{3}{4}$, $R_{a2}$ and $R_{h2}$ are $\frac{3}{4}$, and each of $R_{a3}$ and $R_{h3}$ is H. In some variations of formula (12) described in the paragraphs above in which $\frac{3}{4}$ is 3, $R_{ai}$ and $R_{bi}$ are $\frac{3}{4}$, $R_{a2}$ and $R_{h2}$ are $\frac{3}{4}$, $R_{a3}$ is H, and $R_{h3}$ is CH$_3$.

[307] In some variations of formula (12) described in the paragraphs above in which $I_2$ is 3, $R_{ai}$ and $R_{bi}$ are $\frac{3}{4}$, $R_{a2}$ and $R_{h2}$ are $\frac{3}{4}$, and each of $R_{a3}$ and $R_{h3}$ is H. In some variations of formula (12) described in the paragraphs above in which $I_2$ is 3, $R_{ai}$ and $R_{bi}$ are $\frac{3}{4}$, $R_{a2}$ and $R_{h2}$ are $\frac{3}{4}$, $R_{a3}$ is H, and $R_{h3}$ is CH$_3$. In some variations of formula (12) described in
the paragraphs above in which \( I_2 \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( R_{a2} \) and \( R_{b2} \) are \( R_{a3} \) is H, and \( R_{b3} \) is CH₃. In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( R_{a2} \) and \( R_{b2} \) are \( R_{a3} \) is H, and \( R_{b3} \) is CH₃. In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{a1} \), \( R_{b1} \), \( R_{a2} \), and \( R_{b2} \) is H and \( R_{b3} \) is CH₃. In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( R_{a2} \) and \( R_{b2} \) are \( R_{a3} \) is H, and \( R_{b3} \) is CH₃.

\[ \text{[308]} \] In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( R_{a2} \) and \( R_{b2} \) together are \( R_{a3} \) is H, and \( R_{b3} \) is CH₃. In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 3, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are \( R_{a3} \) and \( R_{b3} \) are \( R_{a3} \) and \( R_{b3} \) are \( R_{a3} \) and \( R_{b3} \) are \( R_{a3} \) and \( R_{b3} \) are.

\[ \text{[309]} \] In variations of formula (12) described in the paragraphs above in which \( I_2 \) is 4, the three instances of \( R_{a} \) and \( R_{b} \) are indicated as \( R_{a1} \) and \( R_{b1} \); \( R_{a2} \) and \( R_{b2} \); \( R_{a3} \) and \( R_{b3} \); and \( R_{a4} \) and \( R_{b4} \), respectively. In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 4, In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 4, each of \( R_{a1} \), \( R_{b1} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), \( R_{b3} \), \( R_{a4} \), and \( R_{b4} \) is H. In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3}, R_{b3}, R_{a4}, \) and \( R_{b4} \) is CH₃. In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3}, R_{b3}, R_{a4}, \) and \( R_{b4} \) is CH₃. In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3}, R_{b3}, R_{a4}, \) and \( R_{b4} \) is H and
each of \( R_{a3}, R_{b3}, R_{a4}, \) and \( R_{b4} \) is \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which \( I_2 = 4 \), each of \( R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3}, \) and \( R_{b3} \) is \( \text{CH}_3 \) and each of \( R_{a4} \) and \( R_{b4} \) is \( H \).

[310] In some variations of formula (12) described in the paragraphs above in which \( \frac{3}{4} \) is 4, each of \( R_{a1}, R_{a2}, \) and \( R_{a3} \) is \( H \) and each of \( R_{b1}, R_{b2}, \) and \( R_{b3} \) is \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which \( I_2 = 4 \), \( R_{a1} \) is \( H \), \( R_{b1} \) is \( \text{CH}_3 \), and each of \( R_{a2}, R_{b2}, R_{a3}, \) and \( R_{b3} \) is \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which \( \frac{3}{4} \) is 4, \( R_{a1} \) is \( H \), \( R_{b1} \) is \( \text{CH}_3 \), and each of \( R_{a2}, R_{b2}, R_{a3}, \) and \( R_{b3} \) is \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which \( I_2 = 4 \), each of \( R_{a1} \) and \( R_{a2} \) is \( \text{H} \), each of \( R_{b1} \) and \( R_{b2} \) is \( \text{CH}_3 \), and each of \( R_{a3} \) and \( R_{b3} \) is \( \text{CH}_3 \).

[311] In some variations of formula (12) described in the paragraphs above in which \( I_2 = 4 \), \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which \( I_2 = 4 \), \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which \( I_2 = 4 \), \( R_{a1} \) and \( R_{b1} \) are \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which \( I_2 = 4 \), \( R_{a1} \) and \( R_{b1} \) are \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which \( I_2 = 4 \), \( R_{a1} \) is \( \text{H} \), \( R_{b1} \) is \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \).
CH₃, Rₐ₃ and Rₜ₃ are \( \frac{3}{12} \cdot \frac{1}{4} \cdot \frac{1}{4} \), and Rₐ₄ and Rₜ₄ are \( \frac{3}{4} \cdot \frac{1}{4} \cdot \frac{1}{2} \). In some variations of formula (12) described in the paragraphs above in which \( l₂ \) is 4, \( Rₐ₁ \) and \( Rₜ₁ \) are CH₃, \( Rₐ₂ \) is H, \( Rₜ₂ \) is CH₃, \( Rₐ₃ \) and \( Rₜ₃ \) are \( \frac{3}{4} \cdot \frac{1}{4} \cdot \frac{1}{12} \), and \( Rₐ₄ \) and \( Rₜ₄ \) are \( \frac{3}{4} \cdot \frac{1}{4} \cdot \frac{1}{4} \).

[313] In some variations of formula (12) described in the paragraphs above in which \( l₂ \) is 4, \( Rₐ₁ \) and \( Rₜ₁ \) are H, \( Rₐ₂ \) and \( Rₜ₂ \) are \( \frac{3}{4} \cdot \frac{1}{4} \cdot \frac{1}{4} \), \( Rₐ₃ \) and \( Rₜ₃ \) are \( \frac{3}{4} \cdot \frac{1}{4} \cdot \frac{1}{4} \), and \( Rₐ₄ \) and \( Rₜ₄ \) are \( \frac{3}{4} \cdot \frac{1}{4} \cdot \frac{1}{4} \). In some variations of formula (12) described in the paragraphs above in which \( l₂ \) is 4, \( Rₐ₁ \) and \( Rₜ₁ \) are CH₃, \( Rₐ₂ \) and \( Rₜ₂ \) are \( \frac{3}{4} \cdot \frac{1}{4} \cdot \frac{1}{4} \), \( Rₐ₃ \) and \( Rₜ₃ \) are \( \frac{3}{4} \cdot \frac{1}{4} \cdot \frac{1}{4} \), and \( Rₐ₄ \) and \( Rₜ₄ \) are \( \frac{3}{4} \cdot \frac{1}{4} \cdot \frac{1}{4} \).

[314] In some variations of formula (12) described in the paragraphs above in which \( l₂ \) is 4, \( Rₐ₁ \) and \( Rₜ₁ \) are H, \( Rₐ₂ \) and \( Rₜ₂ \) are H, \( Rₐ₃ \) and \( Rₜ₃ \) are CH₃, \( Rₐ₄ \) and \( Rₜ₄ \) are \( \frac{3}{4} \cdot \frac{1}{4} \cdot \frac{1}{4} \). In some variations of formula (12) described in the paragraphs above in which \( l₂ \) is 4, \( Rₐ₁ \) and \( Rₜ₁ \) are H, \( Rₐ₂ \) and \( Rₜ₂ \) are H, \( Rₐ₃ \) and \( Rₜ₃ \) are CH₃, \( Rₐ₄ \) and \( Rₜ₄ \) are \( \frac{3}{4} \cdot \frac{1}{4} \cdot \frac{1}{4} \). In some variations of formula (12) described in the paragraphs above in which \( l₂ \) is 4, \( Rₐ₁ \) and \( Rₜ₁ \) are H, \( Rₐ₂ \) and \( Rₜ₂ \) are H, \( Rₐ₃ \) and \( Rₜ₃ \) are CH₃, \( Rₐ₄ \) and \( Rₜ₄ \) are CH₃, \( Rₐ₅ \) and \( Rₜ₅ \) are \( \frac{3}{4} \cdot \frac{1}{4} \cdot \frac{1}{4} \).

[315] In some variations of formula (12) described in the paragraphs above in which \( l₂ \) is 4, \( Rₐ₁ \) and \( Rₜ₁ \) are H, \( Rₐ₂ \) and \( Rₜ₂ \) are H, \( Rₐ₃ \) and \( Rₜ₃ \) are \( \frac{3}{4} \cdot \frac{1}{4} \cdot \frac{1}{4} \), \( Rₐ₄ \) and \( Rₜ₄ \) are \( \frac{3}{4} \cdot \frac{1}{4} \cdot \frac{1}{4} \). In some variations of formula (12) described in the paragraphs above in which \( l₂ \) is 4, \( Rₐ₁ \) and \( Rₜ₁ \) are H,
\(R_{a2} \) and \(R_{b2} \) are CH\(_3\), \(R_{a3} \) and \(R_{b3} \) are \(\text{CH}_3\), \(R_{a4} \) and \(R_{b4} \) are \(\text{CH}_3\). In some variations of formula (12) described in the paragraphs above in which \(l_2 \) is 4, \(R_{a1} \) and \(R_{b1} \) are CH\(_3\), \(R_{a2} \) and \(R_{b2} \) are CH\(_3\), \(R_{a3} \) and \(R_{b3} \) are \(\text{CH}_3\), \(R_{a4} \) and \(R_{b4} \) are \(\text{CH}_3\). In some variations of formula (12) described in the paragraphs above in which \(l_2 \) is 4, \(R_{a1} \) is H, \(R_{b1} \) is CH\(_3\), \(R_{a2} \) and \(R_{b2} \) are CH\(_3\), \(R_{a3} \) and \(R_{b3} \) are \(\text{CH}_3\), \(R_{a4} \) and \(R_{b4} \) are \(\text{CH}_3\). In some variations of formula (12) described in the paragraphs above in which \(l_2 \) is 4, \(R_{a1} \) is H, \(R_{b1} \) is CH\(_3\), \(R_{a2} \) is H, \(R_{b2} \) is CH\(_3\), \(R_{a3} \) and \(R_{b3} \) are \(\text{CH}_3\), \(R_{a4} \) and \(R_{b4} \) are \(\text{CH}_3\).

[316] In some variations of formula (12) described in the paragraphs above in which \(l_2 \) is 4, \(R_{a1} \) and \(R_{b1} \) are H, \(R_{a2} \) and \(R_{b2} \) are \(\text{CH}_3\), \(R_{a3} \) and \(R_{b3} \) are \(\text{CH}_3\), \(R_{a4} \) and \(R_{b4} \) are \(\text{CH}_3\). In some variations of formula (12) described in the paragraphs above in which \(l_2 \) is 4, \(R_{a1} \) is H, \(R_{b1} \) is CH\(_3\), \(R_{a2} \) and \(R_{b2} \) are CH\(_3\), \(R_{a3} \) and \(R_{b3} \) are \(\text{CH}_3\), \(R_{a4} \) and \(R_{b4} \) are \(\text{CH}_3\). In some variations of formula (12) described in the paragraphs above in which \(l_2 \) is 4, \(R_{a1} \) and \(R_{b1} \) are \(\text{CH}_3\), \(R_{a2} \) and \(R_{b2} \) are \(\text{CH}_3\), \(R_{a3} \) and \(R_{b3} \) are \(\text{CH}_3\), \(R_{a4} \) and \(R_{b4} \) are \(\text{CH}_3\). In some variations of formula (12) described in the paragraphs above in which \(l_2 \) is 4, \(R_{a1} \) and \(R_{b1} \) are \(\text{CH}_3\), \(R_{a2} \) and \(R_{b2} \) are \(\text{CH}_3\), \(R_{a3} \) and \(R_{b3} \) are \(\text{CH}_3\), \(R_{a4} \) and \(R_{b4} \) are \(\text{CH}_3\).
In some variations of formula (12) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \frac{3}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( H \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (12) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \frac{3}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (12) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \frac{3}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( H \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \).

In some variations of formula (12) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \frac{3}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (12) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \frac{3}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( H \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \).
In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 4, \( R_a \) and \( R_i \) are \( \text{H} \), \( R_a \) and \( R_i \) are \( \text{CH}_3 \), and \( R_a \) and \( R_i \) are \( \text{H} \). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 4, \( R_a \) and \( R_i \) are \( \text{H} \), \( R_a \) and \( R_i \) are \( \text{CH}_3 \), and \( R_a \) and \( R_i \) are \( \text{H} \). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 4, \( R_a \) and \( R_i \) are \( \text{H} \), \( R_a \) and \( R_i \) are \( \text{CH}_3 \), and \( R_a \) and \( R_i \) are \( \text{H} \). In some variations of formula (12) described in the paragraphs above in which \( I_2 \) is 4, \( R_a \) and \( R_i \) are \( \text{H} \), \( R_a \) and \( R_i \) are \( \text{CH}_3 \), and \( R_a \) and \( R_i \) are \( \text{H} \).
[326] In some variations of formula (12) described in the paragraphs above in which $l_2$ is 4, $R_{ai}$ and $R_{bi}$ are H, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{CH}_3$. In some variations of formula (12) described in the paragraphs above in which $l_2$ is 4, $R_{ai}$ and $R_{bi}$ are $\text{CH}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{CH}_3$. In some variations of formula (12) described in the paragraphs above in which $l_2$ is 4, $R_{ai}$ is H, $R_{bi}$ is $\text{CH}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{CH}_3$.

[327] In some variations of formula (12) described in the paragraphs above in which $l_2$ is 4, $R_{ai}$ and $R_{bi}$ are $\text{CH}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{CH}_3$. In some variations of formula (12) described in the paragraphs above in which $l_2$ is 4, $R_{ai}$ and $R_{bi}$ are $\text{CH}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{CH}_3$.

[328] In some variations of formula (12) described in the paragraphs above in which $l_2$ is 4, $R_{ai}$ and $R_{bi}$ are $\text{CH}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{CH}_3$.

[329] In some variations of formula (12) described in the paragraphs above in which $l_2$ is 4, $R_{ai}$ and $R_{bi}$ and $R_{a2}$ and $R_{b2}$ together are $\text{CH}_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{CH}_3$.

[330] In some variations of formula (12) described in the paragraphs above in which $oi$ is 1, $R_{ai}$ and $R_{bi}$ are both H. In some variations of formula (12) described in the paragraphs above in which $oi$ is 1, $R_{ai}$ is H and $R_{bi}$ is $\text{CH}_3$. In some variations of formula (12) described in the paragraphs above in which $oi$ is 1, $R_{ai}$ and $R_{bi}$ are both $\text{CH}_3$. In some variations of formula (12)
described in the paragraphs above in which \( o_i \) is 1, \( R_{ai} \) and \( R_{bi} \) are \( O \rightarrow C \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 1, \( R_{ai} \) and \( R_{bi} \) are \( O \rightarrow C \).

[331] In variations of formula (12) described in the paragraphs above in which \( o_i \) is 2, the two instances of \( R_a \) and \( R_b \) are indicated as \( R_{ai} \) and \( R_{bi} \) and \( R_{a2} \) and \( R_{b2} \), respectively. In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 2, each of \( R_{ai} \) and \( R_{bi} \) and \( R_{a2} \) and \( R_{b2} \) is \( H \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 2, each of \( R_{ai} \) and \( R_{bi} \) and \( R_{a2} \) and \( R_{b2} \) is \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 2, each of \( R_{ai} \) and \( R_{a2} \) is \( H \) and each of \( R_{bi} \) and \( R_{b2} \) is \( \text{CH}_3 \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 2, each of \( R_{ai} \), \( R_{a2} \), and \( R_{bi} \) is \( H \) and \( R_{b2} \) is \( \text{CH}_3 \).

[332] In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 2, each of \( R_{ai} \) and \( R_{bi} \) is \( H \) and \( R_{a2} \) and \( R_{b2} \) are \( O \rightarrow C \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 2, each of \( R_{ai} \) and \( R_{bi} \) is \( H \) and \( R_{a2} \) and \( R_{b2} \) are \( O \rightarrow C \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 2, each of \( R_{ai} \) and \( R_{bi} \) is \( \text{CH}_3 \) and \( R_{a2} \) and \( R_{b2} \) are \( O \rightarrow C \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 2, each of \( R_{ai} \) and \( R_{bi} \) is \( \text{CH}_3 \) and \( R_{a2} \) and \( R_{b2} \) are \( O \rightarrow C \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 2, \( R_{a1} \) is \( H \), \( R_{b1} \) is \( \text{CH}_3 \), and \( R_{a2} \) and \( R_{b2} \) are \( O \rightarrow C \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 2, \( R_{a1} \) is \( H \), \( R_{b1} \) is \( \text{CH}_3 \), and \( R_{a2} \) and \( R_{b2} \) are \( O \rightarrow C \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 2, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are \( O \rightarrow C \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 2, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are \( O \rightarrow C \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 2, \( R_{ai} \) and \( R_{bi} \) are \( O \rightarrow C \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 2, \( R_{ai} \) and \( R_{bi} \) are \( O \rightarrow C \).
R_{b2} are \( O \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 2, \( R_{a1} \) and \( R_{b1} \) are \( O \), \( R_{a2} \) and \( R_{b2} \) are \( O \).

In variations of formula (12) described in the paragraphs above in which \( o_i \) is 3, the three instances of \( R_a \) and \( R_b \) are indicated as \( R_{ai} \) and \( R_{bi} \); \( R_{a2} \) and \( R_{b2} \); and \( R_{a3} \) and \( R_{b3} \), respectively.

In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 3, each of \( R_{a1}, R_{b1}, R_{a2}, \) and \( R_{b2} \) is \( C \) \( H \) \( 3 \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 3, each of \( R_{a1}, R_{b1}, R_{a2}, \) and \( R_{b2} \) is \( H \) and each of \( R_{a3} \) and \( R_{b3} \) is \( C \) \( H \) \( 3 \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 3, each of \( R_{a1}, R_{b1}, R_{a2}, \) and \( R_{b2} \) is \( C \) \( H \) \( 3 \) and each of \( R_{a3} \) and \( R_{b3} \) is \( H \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 3, \( R_{a1} \) is \( H \) and each of \( R_{a2}, R_{a3}, R_{b1}, R_{b2}, \) and \( R_{b3} \) is \( C \) \( H \) \( 3 \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 3, each of \( R_{a1} \) and \( R_{a2} \) is \( H \) and each of \( R_{a3}, R_{b1}, R_{b2}, \) and \( R_{b3} \) is \( C \) \( H \) \( 3 \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 3, each of \( R_{a1}, R_{a2}, \) and \( R_{a3} \) is \( H \) and each of \( R_{b1}, R_{b2}, \) and \( R_{b3} \) is \( C \) \( H \) \( 3 \).

In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 3, each of \( R_{a1}, R_{b1}, R_{a2}, \) and \( R_{b2} \), is \( H \) and \( R_{a3} \) and \( R_{b3} \) are \( O \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 3, each of \( R_{a1}, R_{b1}, R_{a2}, \) and \( R_{b2} \) is \( C \) \( H \) \( 3 \) and \( R_{a3} \) and \( R_{b3} \) are \( O \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 3, \( R_{a2} \) is \( H \) and each of \( R_{b1} \) and \( R_{b2} \) is \( C \) \( H \) \( 3 \), and \( R_{a3} \) and \( R_{b3} \) are \( O \).

In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 3, each of \( R_{a1}, R_{b1}, R_{a2}, \) and \( R_{b2} \) is \( C \) \( H \) \( 3 \) and \( R_{a3} \) and \( R_{b3} \) are \( O \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 3, each of \( R_{a1}, R_{b1}, R_{a2}, \) and \( R_{b2} \) is \( C \) \( H \) \( 3 \) and \( R_{a3} \) and \( R_{b3} \) are \( O \).
and $R_{b3}$ are $\text{C}_3\text{F}_3$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 3, $R_{a1}$ is $\text{H}$ and each of $R_{a2}$, $R_{b1}$, and $R_{b2}$ is $\text{CH}_3$, and $R_{a3}$ and $R_{b3}$ are $\text{C}_3\text{F}_3$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 3, each of $R_{a1}$ and $R_{b1}$ is $\text{H}$ and each of $R_{a2}$ and $R_{b2}$ is $\text{CH}_3$, and $R_{a3}$ and $R_{b3}$ are $\text{C}_3\text{F}_3$.

[336] In some variations of formula (12) described in the paragraphs above in which $o_1$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{C}_3\text{F}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and each of $R_{a3}$ and $R_{b3}$ is $\text{H}$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{C}_3\text{F}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, $R_{a3}$ is $\text{H}$, and $R_{b3}$ is $\text{CH}_3$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{C}_3\text{F}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and each of $R_{a3}$ and $R_{b3}$ is $\text{H}$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{C}_3\text{F}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, $R_{a3}$ is $\text{H}$, and $R_{b3}$ is $\text{CH}_3$.

[337] In some variations of formula (12) described in the paragraphs above in which $o_1$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{C}_3\text{F}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and each of $R_{a3}$ and $R_{b3}$ is $\text{H}$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{C}_3\text{F}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, $R_{a3}$ is $\text{H}$, and $R_{b3}$ is $\text{CH}_3$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{C}_3\text{F}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, $R_{a3}$ is $\text{H}$, and $R_{b3}$ is $\text{CH}_3$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{C}_3\text{F}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, $R_{a3}$ is $\text{H}$, and $R_{b3}$ is $\text{CH}_3$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{C}_3\text{F}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, $R_{a3}$ is $\text{H}$, and $R_{b3}$ is $\text{CH}_3$.
is 3, $R_{a,i}$ and $R_{b,i}$ are $\overset{\gamma}{\circ}$, $R_{a,2}$ and $R_{b,2}$ are $\overset{\gamma}{\circ}$, and each of $R_{a,3}$ and $R_{b,3}$ is H. In some variations of formula (12) described in the paragraphs above in which $oi$ is 3, $R_{a,i}$ and $R_{b,i}$ are $\overset{\gamma}{\circ}$, $R_{a,2}$ and $R_{b,2}$ are $\overset{\gamma}{\circ}$, and each of $R_{a,3}$ and $R_{b,3}$ is CH$_3$. In some variations of formula (12) described in the paragraphs above in which $oi$ is 3, $R_{a,i}$ and $R_{b,i}$ are $\overset{\gamma}{\circ}$, $R_{a,2}$ and $R_{b,2}$ are $\overset{\gamma}{\circ}$, $R_{a,3}$ is H, and $R_{b,3}$ is CH$_3$. 

[338] In some variations of formula (12) described in the paragraphs above in which $oi$ is 3, $R_{a,i}$ and $R_{b,i}$ are $\overset{\gamma}{\circ}$, $R_{a,2}$ and $R_{b,2}$ are $\overset{\gamma}{\circ}$, and each of $R_{a,3}$ and $R_{b,3}$ is H. In some variations of formula (12) described in the paragraphs above in which $oi$ is 3, $R_{a,i}$ and $R_{b,i}$ are $\overset{\gamma}{\circ}$, $R_{a,2}$ and $R_{b,2}$ are $\overset{\gamma}{\circ}$, $R_{a,3}$ is H, and $R_{b,3}$ is CH$_3$. In some variations of formula (12) described in the paragraphs above in which $oi$ is 3, $R_{a,i}$ and $R_{b,i}$ are $\overset{\gamma}{\circ}$, $R_{a,2}$ and $R_{b,2}$ are $\overset{\gamma}{\circ}$, and each of $R_{a,3}$ and $R_{b,3}$ is H. In some variations of formula (12) described in the paragraphs above in which $oi$ is 3, $R_{a,i}$ and $R_{b,i}$ are $\overset{\gamma}{\circ}$, $R_{a,2}$ and $R_{b,2}$ are $\overset{\gamma}{\circ}$, $R_{a,3}$ is H, and $R_{b,3}$ is CH$_3$. 

[339] In some variations of formula (12) described in the paragraphs above in which $oi$ is 3, $R_{a,i}$ and $R_{b,i}$ and $R_{a,2}$ and $R_{b,2}$ together are $\overset{\gamma}{\circ}$, and each of $R_{a,3}$ and $R_{b,3}$ is H. In some variations of formula (12) described in the paragraphs above in which $oi$ is 3, $R_{a,i}$ and $R_{b,i}$ and $R_{a,2}$ and $R_{b,2}$ together are $\overset{\gamma}{\circ}$, and each of $R_{a,3}$ and $R_{b,3}$ is CH$_3$. In some variations of formula (12) described in the paragraphs above in which $oi$ is 3, $R_{a,i}$ and $R_{b,i}$ and $R_{a,2}$ and $R_{b,2}$ together are $\overset{\gamma}{\circ}$, $R_{a,3}$ is H, and $R_{b,3}$ is CH$_3$. In some variations of formula (12) described in the
paragraphs above in which \( o_i \) is 3, \( R_a i \) and \( R_b i \) and \( R_a 2 \) and \( R_b 2 \) together are
\[ \frac{\text{\( R_a 3 \)}}{\text{\( R_b 3 \)}} \] and \( R_b 3 \) are
\[ \frac{\text{\( R_a 3 \)}}{\text{\( R_b 3 \)}} \]. In some variations of formula (12) described in the paragraphs above in
which \( o_i \) is 3, \( R_a i \) and \( R_b i \) and \( R_a 2 \) and \( R_b 2 \) together are
\[ \frac{\text{\( R_a 3 \)}}{\text{\( R_b 3 \)}} \] and \( R_b 3 \) are \[ \frac{\text{\( R_a 3 \)}}{\text{\( R_b 3 \)}} \].

[340] In variations of formula (12) described in the paragraphs above in which \( o_i \) is 4, the three instances of \( R_a \) and \( R_b \) are indicated as \( R_a i \) and \( R_b i \); \( R_a 2 \) and \( R_b 2 \); \( R_a 3 \) and \( R_b 3 \); and \( R_a 4 \) and \( R_b 4 \), respectively. In some variations of formula (12) described in the paragraphs above in which \( o_i \) is
4, In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 4, each of
\( R_a, R_b, R_{a 2}, R_{b 2}, R_{a 3}, R_{b 3}, R_{a 4}, \) and \( R_{b 4} \) is H. In some variations of formula (12) described in the
paragraphs above in which \( o_i \) is 4, each of \( R_a i, R_b i, R_a 2, R_b 2, R_a 3, R_b 3, R_a 4, \) and \( R_b 4 \) is \( CH_3 \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 4, each of \( R_a i, R_b i, R_a 2, R_b 2, R_a 3, R_b 3, \) and \( R_a 4, R_b 4 \) is \( CH_3 \) and each of
\( R_a 3, R_b 3, R_a 4, \) and \( R_b 4 \) is \( CH_3 \). In some variations of formula (12) described in the
paragraphs above in which \( o_i \) is 4, each of \( R_a i, R_b i, R_a 2, R_b 2, R_a 3, \) and \( R_b 3 \) is \( CH_3 \) and each of
\( R_a 3, R_b 3, \) is \( H \).

[341] In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 4, each of \( R_a i, R_a 2, \) and \( R_a 3 \) is H and each of \( R_b i, R_b 2, \) and \( R_b 3 \) is \( CH_3 \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 4, each of \( R_a i, R_b i, R_a 2, \) and \( R_b 2 \) is H and each of \( R_a 3, R_b 3, \) and \( R_a 4, \) and \( R_b 4 \) is \( CH_3 \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 4, each of \( R_a i, R_b i, R_a 2, R_b 2, \) and \( R_b 3 \) is \( CH_3 \) and each of
\( R_a 3, R_b 3, \) and \( R_a 4, \) and \( R_b 4 \) is \( H \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 4, each of \( R_a i, R_b i, R_a 2, \) and \( R_b 2 \) is H, each of \( R_a 3, R_b 3, \) and \( R_a 4, \) and \( R_b 4 \) is \( H \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 4, each of \( R_a i, R_b i, R_a 2, \) and \( R_b 2 \) is H, each of \( R_a 3, R_b 3, \) and \( R_a 4, \) and \( R_b 4 \) is \( H \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 4, each of \( R_a 2, R_b 2, \) and \( R_b 3 \) is \( CH_3 \) and each of \( R_a 3, R_b 3, \) and \( R_a 4, \) and \( R_b 4 \) is \( H \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 4, each of \( R_a i, \) and \( R_b i, R_a 2, \) and \( R_b 2 \) is H, each of \( R_a 3, R_b 3, \) and \( R_a 4, \) and \( R_b 4 \) is \( H \). In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 4, each of \( R_a i, R_b i, R_a 2, \) and \( R_b 2 \) is H, each of \( R_a 3, R_b 3, \) and \( R_a 4, \) and \( R_b 4 \) is \( H \).
are CH₃, Rₐ3 and Rₐ3 are CH₃, and Rₐ₄ and Rₐ₄ are \( \text{C}_3\text{H}_3 \). In some variations of formula (12) described in the paragraphs above in which \( \alpha_i \) is 4, Rₐi and Rₐi are CH₃, Rₐ₂ and Rₐ₂ are CH₃, Rₐ₃ and Rₐ₃ are CH₃, and Rₐ₄ and Rₐ₄ are CH₃.

[343] In some variations of formula (12) described in the paragraphs above in which \( \alpha_i \) is 4, Rₐi and Rₐi are H, Rₐ₂ and Rₐ₂ are H, Rₐ₃ and Rₐ₃ are \( \text{C}_3\text{H}_3 \), and Rₐ₄ and Rₐ₄ are \( \text{C}_3\text{H}_3 \). In some variations of formula (12) described in the paragraphs above in which \( \alpha_i \) is 4, Rₐi and Rₐi are H, Rₐ₂ and Rₐ₂ are CH₃, Rₐ₃ and Rₐ₃ are \( \text{C}_3\text{H}_3 \), and Rₐ₄ and Rₐ₄ are \( \text{C}_3\text{H}_3 \). In some variations of formula (12) described in the paragraphs above in which \( \alpha_i \) is 4, Rₐi and Rₐi are H, Rₐ₂ and Rₐ₂ are CH₃, Rₐ₃ and Rₐ₃ are \( \text{C}_3\text{H}_3 \), and Rₐ₄ and Rₐ₄ are \( \text{C}_3\text{H}_3 \). In some variations of formula (12) described in the paragraphs above in which \( \alpha_i \) is 4, Rₐi and Rₐi are H, Rₐ₂ and Rₐ₂ are CH₃, Rₐ₃ and Rₐ₃ are \( \text{C}_3\text{H}_3 \), and Rₐ₄ and Rₐ₄ are \( \text{C}_3\text{H}_3 \). In some variations of formula (12) described in the paragraphs above in which \( \alpha_i \) is 4, Rₐi and Rₐi are H, Rₐ₂ and Rₐ₂ are CH₃, Rₐ₃ and Rₐ₃ are \( \text{C}_3\text{H}_3 \), and Rₐ₄ and Rₐ₄ are \( \text{C}_3\text{H}_3 \).

[344] In some variations of formula (12) described in the paragraphs above in which \( \alpha_i \) is 4, Rₐi and Rₐi are H, Rₐ₂ and Rₐ₂ are \( \text{C}_3\text{H}_3 \), Rₐ₃ and Rₐ₃ are \( \text{C}_3\text{H}_3 \), and Rₐ₄ and Rₐ₄ are \( \text{C}_3\text{H}_3 \). In some variations of formula (12) described in the paragraphs above in which \( \alpha_i \) is 4, Rₐi and Rₐi are H, Rₐ₂ and Rₐ₂ are \( \text{C}_3\text{H}_3 \), Rₐ₃ and Rₐ₃ are \( \text{C}_3\text{H}_3 \), and Rₐ₄ and Rₐ₄ are \( \text{C}_3\text{H}_3 \). In some variations of formula (12) described in the paragraphs above in which \( \alpha_i \) is 4, Rₐi and Rₐi are H, Rₐ₂ and Rₐ₂ are \( \text{C}_3\text{H}_3 \), Rₐ₃ and Rₐ₃ are \( \text{C}_3\text{H}_3 \), and Rₐ₄ and Rₐ₄ are \( \text{C}_3\text{H}_3 \). In some variations of formula (12) described in the paragraphs above in which \( \alpha_i \) is 4, Rₐi and Rₐi are H, Rₐ₂ and Rₐ₂ are \( \text{C}_3\text{H}_3 \), Rₐ₃ and Rₐ₃ are \( \text{C}_3\text{H}_3 \), and Rₐ₄ and Rₐ₄ are \( \text{C}_3\text{H}_3 \).

[345] In some variations of formula (12) described in the paragraphs above in which \( \alpha_i \) is 4, Rₐi and Rₐi are H, Rₐ₂ and Rₐ₂ are H, Rₐ₃ and Rₐ₃ are H, and Rₐ₄ and Rₐ₄ are H. In some variations of formula (12) described in the paragraphs above in which \( \alpha_i \) is 4, Rₐi and Rₐi are H, Rₐ₂ and Rₐ₂ are H, Rₐ₃ and Rₐ₃ are H, and Rₐ₄ and Rₐ₄ are H.
$R_{a2}$ and $R_{b2}$ are H, $R_{a3}$ and $R_{b3}$ are CH$_3$, and $R_{a4}$ and $R_{b4}$ are $\text{O}$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 4, $R_{ai}$ and $R_{bi}$ are H, $R_{a2}$ and $R_{b2}$ are CH$_3$, $R_{a3}$ and $R_{b3}$ are CH$_3$, and $R_{a4}$ and $R_{b4}$ are $\text{O}$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 4, $R_{ai}$ and $R_{bi}$ are H, $R_{a2}$ and $R_{b2}$ are CH$_3$, $R_{a3}$ and $R_{b3}$ are CH$_3$, and $R_{a4}$ and $R_{b4}$ are $\text{O}$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 4, $R_{ai}$ and $R_{bi}$ are H, $R_{a2}$ and $R_{b2}$ are CH$_3$, $R_{a3}$ and $R_{b3}$ are CH$_3$, and $R_{a4}$ and $R_{b4}$ are $\text{O}$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 4, $R_{ai}$ and $R_{bi}$ are H, $R_{a2}$ and $R_{b2}$ are CH$_3$, $R_{a3}$ and $R_{b3}$ are CH$_3$, and $R_{a4}$ and $R_{b4}$ are $\text{O}$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 4, $R_{ai}$ and $R_{bi}$ are H, $R_{a2}$ and $R_{b2}$ are CH$_3$, $R_{a3}$ and $R_{b3}$ are CH$_3$, and $R_{a4}$ and $R_{b4}$ are $\text{O}$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 4, $R_{ai}$ and $R_{bi}$ are H, $R_{a2}$ and $R_{b2}$ are CH$_3$, $R_{a3}$ and $R_{b3}$ are CH$_3$, and $R_{a4}$ and $R_{b4}$ are $\text{O}$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 4, $R_{ai}$ and $R_{bi}$ are H, $R_{a2}$ and $R_{b2}$ are CH$_3$, $R_{a3}$ and $R_{b3}$ are CH$_3$, and $R_{a4}$ and $R_{b4}$ are $\text{O}$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 4, $R_{ai}$ and $R_{bi}$ are H, $R_{a2}$ and $R_{b2}$ are CH$_3$, $R_{a3}$ and $R_{b3}$ are CH$_3$, and $R_{a4}$ and $R_{b4}$ are $\text{O}$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 4, $R_{ai}$ and $R_{bi}$ are H, $R_{a2}$ and $R_{b2}$ are CH$_3$, $R_{a3}$ and $R_{b3}$ are CH$_3$, and $R_{a4}$ and $R_{b4}$ are $\text{O}$. In some variations of formula (12) described in the paragraphs above in which $o_1$ is 4, $R_{ai}$ and $R_{bi}$ are H, $R_{a2}$ and $R_{b2}$ are CH$_3$, $R_{a3}$ and $R_{b3}$ are CH$_3$, and $R_{a4}$ and $R_{b4}$ are $\text{O}$.
of formula (12) described in the paragraphs above in which \( \sigma \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{C}_3\text{H}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \). In some variations of formula (12) described in the paragraphs above in which \( \sigma \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{C}_3\text{H}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \). In some variations of formula (12) described in the paragraphs above in which \( \sigma \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{C}_3\text{H}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \). In some variations of formula (12) described in the paragraphs above in which \( \sigma \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{C}_3\text{H}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \). In some variations of formula (12) described in the paragraphs above in which \( \sigma \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{C}_3\text{H}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \). In some variations of formula (12) described in the paragraphs above in which \( \sigma \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{C}_3\text{H}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \). In some variations of formula (12) described in the paragraphs above in which \( \sigma \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{C}_3\text{H}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \).
In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 4, \( R_{ai} \) and \( R_{bi} \) are as described. In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 4, \( R_{ai} \) and \( R_{bi} \) are as described. In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 4, \( R_{ai} \) and \( R_{bi} \) are as described. In some variations of formula (12) described in the paragraphs above in which \( o_i \) is 4, \( R_{ai} \) and \( R_{bi} \) are as described.
In some variations of formula (12) described in the paragraphs above in which \( \alpha i \) is 4, \( R_{a1} \) and \( R_{bi} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( R_{a3} \) and \( R_{a4} \) and \( R_{a5} \) and \( R_{a6} \) together are \( \gamma_2 \). In some variations of formula (12) described in the paragraphs above in which \( \alpha i \) is 4, \( R_{a1} \) and \( R_{bi} \) are H, \( R_{a2} \) and \( R_{b2} \) are CH3, and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \gamma_2 \). In some variations of formula (12) described in the paragraphs above in which \( \alpha i \) is 4, \( R_{a1} \) and \( R_{bi} \) are CH3, \( R_{a2} \) and \( R_{b2} \) are \( \gamma_2 \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \gamma_2 \).

In some variations of formula (12) described in the paragraphs above in which \( \alpha i \) is 4, \( R_{a1} \) and \( R_{bi} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \gamma_2 \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \gamma_2 \). In some variations of formula (12) described in the paragraphs above in which \( \alpha i \) is 4, \( R_{a1} \) and \( R_{bi} \) are CH3, \( R_{a2} \) and \( R_{b2} \) are \( \gamma_2 \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \gamma_2 \).

In some variations of formula (12) described in the paragraphs above in which \( \alpha i \) is 4, \( R_{a1} \) and \( R_{bi} \) are \( \gamma_2 \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma_2 \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \gamma_2 \). In some variations of formula (12) described in the paragraphs above in which \( \alpha i \) is 4, \( R_{a1} \) and \( R_{bi} \) are \( \gamma_2 \), and \( R_{a2} \) and \( R_{b2} \) are \( \gamma_2 \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \gamma_2 \). In some variations of formula (12) described in the paragraphs above in which \( \alpha i \) is 4, \( R_{a1} \) and \( R_{bi} \) are \( \gamma_2 \), and \( R_{a2} \) and \( R_{b2} \) are \( \gamma_2 \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \gamma_2 \).
In some variations of formula (12) described in the paragraphs above in which \(\theta \) is 1,
\(R_{a1} \) and \(R_{b1} \) are both H. In some variations of formula (12) described in the paragraphs above in which \(\theta \) is 1, \(R_{a1} \) is H and \(R_{b1} \) is CH₃. In some variations of formula (12) described in the paragraphs above in which \(\theta \) is 1, \(R_{a1} \) and \(R_{b1} \) are both CH₃. In some variations of formula (12) described in the paragraphs above in which \(\theta \) is 1, \(R_{a1} \) and \(R_{b1} \) are \(3\). In some variations of formula (12) described in the paragraphs above in which \(\theta \) is 2,
\(R_{a1} \) and \(R_{b1} \) are \(3\). In some variations of formula (12) described in the paragraphs above in which \(\theta \) is 2, each of \(R_{a1} \) and \(R_{b1} \) and \(R_{a2} \) and \(R_{b2} \) is H. In some variations of formula (12) described in the paragraphs above in which \(\theta \) is 2, each of \(R_{a1} \) and \(R_{b1} \) and \(R_{a2} \) and \(R_{b2} \) is CH₃. In some variations of formula (12) described in the paragraphs above in which \(\theta \) is 2, each of \(R_{a1} \) and \(R_{a2} \) is H and each of \(R_{b1} \) and \(R_{b2} \) is CH₃. In some variations of formula (12) described in the paragraphs above in which \(\theta \) is 2, each of \(R_{a1} \), \(R_{a2} \), and \(R_{b1} \) is H and \(R_{b2} \) is CH₃. In some variations of formula (12) described in the paragraphs above in which \(\theta \) is 2, each of \(R_{a1} \) and \(R_{b1} \) is H and \(R_{a2} \) and \(R_{b2} \) are \(3\). In some variations of formula (12) described in the paragraphs above in which \(\theta \) is 2, each of \(R_{a1} \) and \(R_{b1} \) is H and \(R_{a2} \) and \(R_{b2} \) are \(3\).
In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 2, each of \( R_{a_1} \) and \( R_{b_1} \) is \( CH_3 \) and \( R_{a_2} \) and \( R_{b_2} \) are \( \text{ } ). 

In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a_1} \) and \( R_{b_1} \) is \( CH_3 \) and \( R_{a_2} \) and \( R_{b_2} \) are \( \text{ } ). 

In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 2, \( R_{a_i} \) is \( H \), \( R_{b_i} \) is \( CH_3 \), and \( R_{a_2} \) and \( R_{b_2} \) are \( \text{ } ). 

In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 2, \( R_{a_i} \) and \( R_{b_i} \) are \( \text{ } ). 

In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 2, \( R_{a_i} \) and \( R_{b_i} \) are \( \text{ } ). 

In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 2, \( R_{a_i} \) and \( R_{b_i} \) are \( \text{ } ). 

In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 2, \( R_{a_i} \) and \( R_{b_i} \) are \( \text{ } ). 

In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 2, \( R_{a_i} \) and \( R_{b_i} \) are \( \text{ } ). 

[364] In variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, the three instances of \( R_a \) and \( R_b \) are indicated as \( R_{a_1} \) and \( R_{b_1} \); \( R_{a_2} \) and \( R_{b_2} \); and \( R_{a_3} \) and \( R_{b_3} \), respectively. 

In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a_i} \), \( R_{b_i} \), \( R_{a_2} \), \( R_{b_2} \), \( R_{a_3} \), and \( R_{b_3} \) is \( CH_3 \). 

In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a_i} \), \( R_{i_2} \), and \( R_{b_2} \) is \( H \) and each of \( R_{a_3} \) and \( R_{b_3} \) is \( CH_3 \). 

In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a_i} \), \( R_{b_i} \), and \( R_{b_2} \) is \( CH_3 \) and each of \( R_{a_3} \) and \( R_{b_3} \) is \( H \). 

In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_{a_1} \) is \( H \) and each of \( R_{a_2} \), \( R_{a_3} \), \( R_{b_1} \), \( R_{b_2} \), and \( R_{b_3} \) is \( CH_3 \).
CH₃. In some variations of formula (12) described in the paragraphs above in which θ₂ is 3, each of Rₐ, R₂, and R₃ is H and each of R₂, R₃, and R₃ is CH₃.

[365] In some variations of formula (12) described in the paragraphs above in which θ₂ is 3, each of Rₐ, R₂, and R₃ is H and Rₐ and R₃ are \( \text{H} \) and R₂ is CH₃. In some variations of formula (12) described in the paragraphs above in which θ₂ is 3, each of Rₐ, R₂, and R₃ is CH₃ and Rₐ and R₃ are \( \text{H} \). In some variations of formula (12) described in the paragraphs above in which θ₂ is 3, each of Rₐ, R₂, and R₃ is CH₃ and Rₐ and R₃ are \( \text{H} \).

[366] In some variations of formula (12) described in the paragraphs above in which θ₂ is 3, each of Rₐ, R₂, and R₃ is H and Rₐ and R₃ are \( \text{H} \). In some variations of formula (12) described in the paragraphs above in which θ₂ is 3, each of Rₐ, R₂, and R₃ is CH₃ and Rₐ and R₃ are \( \text{H} \). In some variations of formula (12) described in the paragraphs above in which θ₂ is 3, each of Rₐ, R₂, and R₃ is CH₃ and Rₐ and R₃ are \( \text{H} \).

[367] In some variations of formula (12) described in the paragraphs above in which θ₂ is 3, Rₐ and R₃ are \( \text{H} \), and each of R₂, R₃, and R₃ is H. In some variations of formula (12) described in the paragraphs above in which θ₂ is 3, Rₐ and R₃ are \( \text{H} \), and each of R₂, R₃, and R₃ is H. In some variations of formula (12) described in the paragraphs above in which θ₂ is 3, Rₐ and R₃ are \( \text{H} \), and each of R₂, R₃, and R₃ is H. In some variations of formula (12) described in the paragraphs above in which θ₂ is 3, Rₐ and R₃ are \( \text{H} \), and each of R₂, R₃, and R₃ is H. In some variations of formula (12) described in the paragraphs above in which θ₂ is 3, Rₐ and R₃ are \( \text{H} \), and each of R₂, R₃, and R₃ is H.
is 3, \( R_a \) and \( R_b \) are \( \cdot H \), \( R_a^2 \) and \( R_b^2 \) are \( \cdot H \), and each of \( R_a^3 \) and \( R_b^3 \) is H. In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_a \) and \( R_b \) are \( \cdot H \), \( R_a^2 \) and \( R_b^2 \) are \( \cdot H \), and each of \( R_a^3 \) and \( R_b^3 \) is CH₃. In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_a \) and \( R_b \) are \( \cdot H \), \( R_a^2 \) and \( R_b^2 \) are \( \cdot H \), and each of \( R_a^3 \) and \( R_b^3 \) is CH₃.

[368] In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_a \) and \( R_b \) are \( \cdot H \), \( R_a^2 \) and \( R_b^2 \) are \( \cdot H \), and each of \( R_a^3 \) and \( R_b^3 \) is CH₃. In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_a \) and \( R_b \) are \( \cdot H \), \( R_a^2 \) and \( R_b^2 \) are \( \cdot H \), and each of \( R_a^3 \) and \( R_b^3 \) is CH₃.

[369] In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_a \) and \( R_b \) are \( \cdot H \), \( R_a^2 \) and \( R_b^2 \) are \( \cdot H \), and each of \( R_a^3 \) and \( R_b^3 \) is CH₃. In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_a \) and \( R_b \) are \( \cdot H \), \( R_a^2 \) and \( R_b^2 \) are \( \cdot H \), and each of \( R_a^3 \) and \( R_b^3 \) is CH₃.
the paragraphs above in which \( \theta_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \cdot \), \( R_{a2} \) and \( R_{b2} \) are \( \cdot \), \( R_{a3} \) is H, and \( R_{b3} \) is CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \cdot \), \( R_{a2} \) and \( R_{b2} \) are \( \cdot \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \cdot \), \( R_{a2} \) and \( R_{b2} \) are \( \cdot \), and each of \( R_{a3} \) and \( R_{b3} \) is CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \cdot \), \( R_{a2} \) and \( R_{b2} \) are \( \cdot \), \( R_{a3} \) is H, and \( R_{b3} \) is CH\(_3\).

[370] In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \cdot \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \cdot \), and each of \( R_{a3} \) and \( R_{b3} \) is CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \cdot \), and \( R_{a3} \) and \( R_{b3} \) are \( \cdot \). In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \cdot \), and \( R_{a3} \) and \( R_{b3} \) are \( \cdot \).

[371] In variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 4, the three instances of \( R_a \) and \( R_b \) are indicated as \( R_{ai} \) and \( R_{bi} \); \( R_{a2} \) and \( R_{b2} \); \( R_{a3} \) and \( R_{b3} \); and \( R_{a4} \) and \( R_{b4} \), respectively. In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 4, each of \( R_{ai}, R_{bi}, R_{a2}, R_{b2}, R_{a3}, R_{b3}, R_{a4}, \) and \( R_{b4} \) is H. In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 4, each of \( R_{ai}, R_{bi}, R_{a2}, R_{b2}, R_{a3}, R_{b3}, R_{a4}, \) and \( R_{b4} \) is CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( \theta_2 \) is 4, each of \( R_{ai}, R_{bi}, R_{a2}, \) and \( R_{b2} \) is H and each of \( R_{a3}, R_{b3}, R_{a4}, \) and \( R_{b4} \) is CH\(_3\). In some variations of formula (12) described in the
paragraphs above in which \( q_2 \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3}, \) and \( R_{b3} \) is CH3 and each of \( R_{a4} \) and \( R_{b4} \) is H.

[372] In some variations of formula (12) described in the paragraphs above in which \( q_2 \) is 4, each of \( R_{a1}, R_{a2}, R_{a3} \) and \( R_{b3} \) is H and each of \( R_{a4}, R_{b2}, \) and \( R_{b4} \) is CH3. In some variations of formula (12) described in the paragraphs above in which \( q_2 \) is 4, \( R_{a1}, R_{b1}, R_{a3}, \) and \( R_{b3} \) is CH3. In some variations of formula (12) described in the paragraphs above in which \( q_2 \) is 4, \( R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3}, \) and \( R_{b3} \) is H. In some variations of formula (12) described in the paragraphs above in which \( q_2 \) is 4, each of \( R_{a1} \) and \( R_{a2} \) are H, each of \( R_{b1} \) and \( R_{b2} \) is CH3, and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (12) described in the paragraphs above in which \( q_2 \) is 4, each of \( R_{a1} \) and \( R_{a2} \) are H, each of \( R_{b1} \) and \( R_{b2} \) is CH3, and each of \( R_{a3} \) and \( R_{b3} \) is CH3.

[373] In some variations of formula (12) described in the paragraphs above in which \( q_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are H, \( R_{a3} \) and \( R_{b3} \) are H, and \( R_{a4} \) and \( R_{b4} \) are CH3. In some variations of formula (12) described in the paragraphs above in which \( q_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are CH3, \( R_{a3} \) and \( R_{b3} \) are CH3, and \( R_{a4} \) and \( R_{b4} \) are CH3. In some variations of formula (12) described in the paragraphs above in which \( q_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are CH3, \( R_{a3} \) and \( R_{b3} \) are CH3, and \( R_{a4} \) and \( R_{b4} \) are CH3.

[374] In some variations of formula (12) described in the paragraphs above in which \( q_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are H, \( R_{a3} \) and \( R_{b3} \) are CH3, and \( R_{a4} \) and \( R_{b4} \) are CH3. In some variations of formula (12) described in the paragraphs above in which \( q_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are CH3, \( R_{a3} \) and \( R_{b3} \) are CH3, and \( R_{a4} \) and \( R_{b4} \) are CH3. In some variations of formula (12) described in the paragraphs above in which \( q_2 \) is 4, \( R_{a1} \) is H, \( R_{b1} \) is CH3, \( R_{a2} \) and \( R_{b2} \) are CH3, \( R_{a3} \) and \( R_{b3} \) are CH3, and \( R_{a4} \) and \( R_{b4} \) are CH3. In some variations of formula
(12) described in the paragraphs above in which \( \alpha_2 = 4 \), \( R_a^i \) is H, \( R_b^j \) is CH\(_3\), \( R_a^2 \) is H, \( R_b^2 \) is CH\(_3\), \( R_{a3} \) and \( R_{b3} \) are CH\(_3\), and \( R_{a4} \) and \( R_{b4} \) are CH\(_3\).

[375] In some variations of formula (12) described in the paragraphs above in which \( \alpha_2 = 4 \), \( R_a^i \) and \( R_b^j \) are H, \( R_a^2 \) and \( R_b^2 \) are CH\(_3\), \( R_{a3} \) and \( R_{b3} \) are CH\(_3\), and \( R_{a4} \) and \( R_{b4} \) are CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( \alpha_2 = 4 \), \( R_a^i \) and \( R_b^j \) are H, \( R_a^2 \) and \( R_b^2 \) are CH\(_3\), \( R_{a3} \) and \( R_{b3} \) are CH\(_3\), and \( R_{a4} \) and \( R_{b4} \) are CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( \alpha_2 = 4 \), \( R_a^i \) and \( R_b^j \) are H, \( R_a^2 \) and \( R_b^2 \) are CH\(_3\), \( R_{a3} \) and \( R_{b3} \) are CH\(_3\), and \( R_{a4} \) and \( R_{b4} \) are CH\(_3\).

[376] In some variations of formula (12) described in the paragraphs above in which \( \alpha_2 = 4 \), \( R_a^i \) and \( R_b^j \) are H, \( R_a^2 \) and \( R_b^2 \) are H, \( R_{a3} \) and \( R_{b3} \) are CH\(_3\), and \( R_{a4} \) and \( R_{b4} \) are CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( \alpha_2 = 4 \), \( R_a^i \) and \( R_b^j \) are H, \( R_a^2 \) and \( R_b^2 \) are CH\(_3\), \( R_{a3} \) and \( R_{b3} \) are CH\(_3\), and \( R_{a4} \) and \( R_{b4} \) are CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( \alpha_2 = 4 \), \( R_a^i \) and \( R_b^j \) are H, \( R_a^2 \) and \( R_b^2 \) are CH\(_3\), \( R_{a3} \) and \( R_{b3} \) are CH\(_3\), and \( R_{a4} \) and \( R_{b4} \) are CH\(_3\).

[377] In some variations of formula (12) described in the paragraphs above in which \( \alpha_2 = 4 \), \( R_a^i \) and \( R_b^j \) are H, \( R_a^2 \) and \( R_b^2 \) are CH\(_3\), \( R_{a3} \) and \( R_{b3} \) are CH\(_3\), and \( R_{a4} \) and \( R_{b4} \) are CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( \alpha_2 = 4 \), \( R_a^i \) and \( R_b^j \) are H, \( R_a^2 \) and \( R_b^2 \) are CH\(_3\), \( R_{a3} \) and \( R_{b3} \) are CH\(_3\), and \( R_{a4} \) and \( R_{b4} \) are CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( \alpha_2 = 4 \), \( R_a^i \) and \( R_b^j \) are CH\(_3\), \( R_a^2 \) and \( R_b^2 \) are CH\(_3\), \( R_{a3} \) and \( R_{b3} \) are CH\(_3\), and \( R_{a4} \) and \( R_{b4} \) are CH\(_3\). In some variations of formula (12) described in the paragraphs above in which \( \alpha_2 = 4 \), \( R_a^i \) and \( R_b^j \) are CH\(_3\), \( R_a^2 \) and \( R_b^2 \) are CH\(_3\), \( R_{a3} \) and \( R_{b3} \) are CH\(_3\), and \( R_{a4} \) and \( R_{b4} \) are CH\(_3\).
R_{b2} are CH₃, R_{a3} and R_{b3} are \( O \), and R_{a4} and R_{b4} are \( O \). In some variations of formula (12) described in the paragraphs above in which \( o2 \) is 4, R_{a1} is H, R_{b1} is CH₃, R_{a2} and R_{b2} are CH₃, R_{a3} and R_{b3} are \( O \), and R_{a4} and R_{b4} are \( O \). In some variations of formula (12) described in the paragraphs above in which \( o2 \) is 4, R_{a1} is H, R_{b1} is CH₃, R_{a2} is H, R_{b2} is CH₃, R_{a3} and R_{b3} are \( O \), and R_{a4} and R_{b4} are \( O \).

[378] In some variations of formula (12) described in the paragraphs above in which \( o2 \) is 4, R_{a1} and R_{b1} are H, R_{a2} and R_{b2} are \( O \), R_{a3} and R_{b3} are \( O \), and R_{a4} and R_{b4} are \( O \). In some variations of formula (12) described in the paragraphs above in which \( o2 \) is 4, R_{a1} is H, R_{b1} is CH₃, R_{a2} and R_{b2} are \( O \), R_{a3} and R_{b3} are \( O \), and R_{a4} and R_{b4} are \( O \). In some variations of formula (12) described in the paragraphs above in which \( o2 \) is 4, R_{a1} is H, R_{b1} is CH₃, R_{a2} and R_{b2} are \( O \), R_{a3} and R_{b3} are \( O \), and R_{a4} and R_{b4} are \( O \).

[379] In some variations of formula (12) described in the paragraphs above in which \( o2 \) is 4, R_{a1} and R_{b1} are \( O \), R_{a2} and R_{b2} are H, R_{a3} and R_{b3} are H, and R_{a4} and R_{b4} are \( O \). In some variations of formula (12) described in the paragraphs above in which \( o2 \) is 4, R_{a1} and R_{b1} are \( O \), R_{a2} and R_{b2} are CH₃, R_{a3} and R_{b3} are CH₃, and R_{a4} and R_{b4} are \( O \). In some variations of formula (12) described in the paragraphs above in which \( o2 \) is 4, R_{a1} and R_{b1} are \( O \), R_{a2} and R_{b2} are H, R_{a3} and R_{b3} are CH₃, and R_{a4} and R_{b4} are \( O \).
In some variations of formula (12) described in the paragraphs above in which \( \alpha \) is 4,

\[ R_a, R_{ai} \text{ and } R_{bi} \text{ are } ^{3}O, \quad R_a, R_{a2} \text{ and } R_{b2} \text{ are } ^{3}O, \quad R_{a3} \text{ and } R_{b3} \text{ are } H, \quad \text{and } R_{a4} \text{ and } R_{b4} \text{ are } ^{3}O. \]

In some variations of formula (12) described in the paragraphs above in which \( \alpha \) is 4, \( R_a, R_{ai} \text{ and } R_{bi} \) are \( ^{3}O \), \( R_{a2} \text{ and } R_{b2} \text{ are } ^{3}O, \quad R_{a3} \text{ and } R_{b3} \text{ are } CH_{3}, \quad \text{and } R_{a4} \text{ and } R_{b4} \text{ are } ^{3}O. \]

In some variations of formula (12) described in the paragraphs above in which \( \alpha \) is 4, \( R_a, R_{ai} \text{ and } R_{bi} \) are \( ^{3}O \), \( R_{a2} \text{ and } R_{b2} \text{ are } ^{3}O, \quad R_{a3} \text{ and } R_{b3} \text{ are } H, \quad \text{and } R_{a4} \text{ and } R_{b4} \text{ are } ^{3}O. \]

In some variations of formula (12) described in the paragraphs above in which \( \alpha \) is 4,

\[ R_a, R_{ai} \text{ and } R_{bi} \text{ are } \frac{3}{4}, \quad R_{a2} \text{ and } R_{b2} \text{ are } \frac{3}{4}, \quad R_{a3} \text{ and } R_{b3} \text{ are } \frac{3}{4}, \quad \text{and } R_{a4} \text{ and } R_{b4} \text{ are } \frac{3}{4}. \]
In some variations of formula (12) described in the paragraphs above in which $\phi$ is 4, $R_a$ and $R_b$ are $H$, and $R_a$ and $R_b$ together are $H$. In some variations of formula (12) described in the paragraphs above in which $\phi$ is 4, $R_a$ and $R_b$ are $H$, and $R_a$ and $R_b$ together are $H$. In some variations of formula (12) described in the paragraphs above in which $\phi$ is 4, $R_a$ and $R_b$ are $H$, and $R_a$ and $R_b$ together are $H$. In some variations of formula (12) described in the paragraphs above in which $\phi$ is 4, $R_a$ and $R_b$ are $H$, and $R_a$ and $R_b$ together are $H$. In some variations of formula (12) described in the paragraphs above in which $\phi$ is 4, $R_a$ and $R_b$ are $H$, and $R_a$ and $R_b$ together are $H$. In some variations of formula (12) described in the paragraphs above in which $\phi$ is 4, $R_a$ and $R_b$ are $H$, and $R_a$ and $R_b$ together are $H$. In some variations of formula (12) described in the paragraphs above in which $\phi$ is 4, $R_a$ and $R_b$ are $H$, and $R_a$ and $R_b$ together are $H$. In some variations of formula (12) described in the paragraphs above in which $\phi$ is 4, $R_a$ and $R_b$ are $H$, and $R_a$ and $R_b$ together are $H$. In some variations of formula (12) described in the paragraphs above in which $\phi$ is 4, $R_a$ and $R_b$ are $H$, and $R_a$ and $R_b$ together are $H$. In some variations of formula (12) described in the paragraphs above in which $\phi$ is 4, $R_a$ and $R_b$ are $H$, and $R_a$ and $R_b$ together are $H$. In some variations of formula (12) described in the paragraphs above in which $\phi$ is 4, $R_a$ and $R_b$ are $H$, and $R_a$ and $R_b$ together are $H$. In some variations of formula (12) described in the paragraphs above in which $\phi$ is 4, $R_a$ and $R_b$ are $H$, and $R_a$ and $R_b$ together are $H$.
In some variations of formula (12) described in the paragraphs above in which $O_2$ is 4, $R_{a1}$ and $R_{b1}$ are H, $R_{a2}$ and $R_{b2}$ are $\cdots$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\cdots$. In some variations of formula (12) described in the paragraphs above in which $O_2$ is 4, $R_{a1}$ and $R_{b1}$ are CH$_3$, and $R_{a2}$ and $R_{b2}$ are $\cdots$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\cdots$. In some variations of formula (12) described in the paragraphs above in which $O_2$ is 4, $R_{a1}$ is H, $R_{b1}$ is CH$_3$, $R_{a2}$ and $R_{b2}$ are $\cdots$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\cdots$.

In some variations of formula (12) described in the paragraphs above in which $O_2$ is 4, $R_{a1}$ and $R_{b1}$ are $\cdots$, and $R_{a2}$ and $R_{b2}$ are $\cdots$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\cdots$. In some variations of formula (12) described in the paragraphs above in which $O_2$ is 4, $R_{a1}$ and $R_{b1}$ are $\cdots$, and $R_{a2}$ and $R_{b2}$ are $\cdots$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\cdots$.

In some variations of formula (12) described in the paragraphs above in which $O_2$ is 4, $R_{a1}$ and $R_{b1}$ are $\cdots$, and $R_{a2}$ and $R_{b2}$ are $\cdots$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\cdots$.

In some variations of formula (12) described in the paragraphs above in which $O_2$ is 4, $R_{a1}$ and $R_{b1}$ and $R_{a2}$ and $R_{b2}$ together are $\cdots$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\cdots$.

In some variations of formula (12) described in the paragraphs above, ring A is:
(a) optionally substituted with halo or C1-C6 linear or branched alkyl;

(b) optionally substituted with halo or C1-C6 linear or branched alkyl; or

(c)
optionally substituted with halo or C1-C6 linear or branched alkyl.

[393] In some variations of formula (12) described in the paragraphs above, **ring** A is substituted with halo. In some variations, the halo is F, Br, I, or Cl.

[394] In some variations of formula (12) described in the paragraphs above, **ring** A is substituted with C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[395] In some variations of formula (12) described in the paragraphs above, *n* is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[396] In some variations of formula (12) described in the paragraphs above, **D1** is safranin-O. In some variations of formula (12) described in the paragraphs above, **D2** is safranin-O. In some variations of formula (12) described in the paragraphs above, **D1** and **D2** are safranin-O.

[397] In some variations of formula (12) described in the paragraph above, the pendant phenyl ring of **D1** is unsubstituted. In some variations of formula (12) described in the paragraph above, the pendant phenyl ring of **D1** is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of **D1** is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O⁻, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-
In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from \(-\text{NO}_2, -\text{NR}_2^+, \text{halo (e.g., F, Br, Cl, I)}, \text{trihalide (e.g., } -\text{CF}_3, -\text{CCl}_3, -\text{CBr}_3, -\text{Cl}_3), -\text{CN}, -\text{SO}_2\text{H}, -\text{COOH}, -\text{COOR}, -\text{CHO}, \text{and } -\text{COR}, \text{wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl)}.\) In some variations of formula (12) described in the paragraph above, the pendant phenyl ring of D2 is unsubstituted. In some variations of formula (12) described in the paragraph above, the pendant phenyl ring of D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from \(-\text{NH}_2, -\text{NHR}, -\text{NR}_2, -\text{OH}, -\text{O}^-, -\text{NHCOCH}_3, -\text{NHCOR}, -\text{OCH}_3, -\text{OR}, -\text{C}_2\text{H}_5, -\text{R}, \text{and } -\text{C}_6\text{H}_5, \text{wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl)}.\) In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from \(-\text{NO}_2, -\text{NR}_2^+, \text{halo (e.g., F, Br, Cl, I)}, \text{trihalide (e.g., } -\text{CF}_3, -\text{CCl}_3, -\text{CBr}_3, -\text{Cl}_3), -\text{CN}, -\text{SO}_2\text{H}, -\text{COOH}, -\text{COOR}, -\text{CHO}, \text{and } -\text{COR}, \text{wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl)}.\) In some of the variations of formula (12) described above, D1 and D2 are safranin-0 moieties, as shown in formula (12a):

![Diagram of D1 and D2](image)

in which \(I_1, I_2, n, o, i, o_2\) ring A, \(R_{\text{i1}}, R_{\text{i2}}, R_{\text{b1}}, R_{\text{b2}}, R_{\text{ci}}, R_{\text{di}}, R_{\text{c1}}, \text{and } R_{\text{d2}}\) are as described in the paragraphs above. \(R_i, R_2, R_3, R_4, R_5, \text{and } R_6\) independently are absent or independently are...
selected from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, 
—C₂H₅, —R, —C₆H₅, —N0₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, 
—CBr₃, —Cl₃), —CN, —SO₃H, —COOH, —COOR, —CHO, and —COR), and R is C₁-C₆ 
linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, Cl, C₂-C₆, C₂-C₅, C₂-
C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or 
branched alkyl).

[400] Some cationic dye dimers fall within formula (12b):

![Diagram](attachment:diagram.png)

(12b) in which each of D₁ and D₂ is a cationic dye moiety; ₘ, ₙ, independently are 1-4; ₙ₁ and ₙ₂ independently are 1-8; ring A is aryl, heteroaryl, cycloalkyl, or heterocyclyl; for each independent instance of Rₐ𝑖 and Rₐ𝑖, 
and Rₚ𝑖 (1) independently are H or CH₃, or (2) Rₚ𝑖 and Rₚ𝑖 are <chem>\begin{tikzpicture} % Diagram here</chem> or <chem>\begin{tikzpicture} % Diagram here</chem>, or (3) two of 
CRₐ𝑖Rₚ𝑖 are <chem>\begin{tikzpicture} % Diagram here</chem>; for each independent instance of R₂ and Rₐ ingress R₂ and Rₐ ingress (1) 
indipendently are H or CH₃, or (2) R₂ and Rₐ ingress are <chem>\begin{tikzpicture} % Diagram here</chem> or <chem>\begin{tikzpicture} % Diagram here</chem>, or (3) two of CR₂ ingress R₂ ingress are <chem>\begin{tikzpicture} % Diagram here</chem>; for each independent instance of R₂ ingress and R₂ ingress, R₂ ingress and R₂ ingress (1) independently are H or 
CH₃, or (2) R₂ ingress and R₂ ingress are <chem>\begin{tikzpicture} % Diagram here</chem> or <chem>\begin{tikzpicture} % Diagram here</chem>, or (3) two of CR₂ ingress R₂ ingress are <chem>\begin{tikzpicture} % Diagram here</chem>; for each independent instance of R₂ ingress and R₂ ingress, R₂ ingress and R₂ ingress (1) independently are H or CH₃, or (2) R₂ ingress and 
R₂ ingress are <chem>\begin{tikzpicture} % Diagram here</chem> or <chem>\begin{tikzpicture} % Diagram here</chem>, or (3) two of CR₂ ingress R₂ ingress are <chem>\begin{tikzpicture} % Diagram here</chem>. 

[401] In some variations of formula (12b), each of D₁ and D₂ is a cationic dye moiety; ring A 
is aryl, heteroaryl, cycloalkyl, or heterocyclyl; ₙ is 1-4; ₁ and ₂ are 1; or and ₂ 
indipendentely are 1-8; Rₐ𝑖 and Rₚ𝑖 are <chem>\begin{tikzpicture} % Diagram here</chem>; R₂ and Rₐ ingress are <chem>\begin{tikzpicture} % Diagram here</chem>; for each independent instance of R₂ ingress and R₂ ingress, R₂ ingress and R₂ ingress (1) independently are H or CH₃, or (2) R₂ ingress and R₂ ingress are <chem>\begin{tikzpicture} % Diagram here</chem>, or (3) two of CR₂ ingress R₂ ingress are <chem>\begin{tikzpicture} % Diagram here</chem>; for each independent instance of R₂ ingress and 

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\( \text{R}_d, \text{R}_e \) and \( \text{R}_d \) (1) independently are H or CH\(_3\), or (2) \( \text{R}_c \) and \( \text{R}_d \) are \( \text{O} \), or (3) two of \( \text{CR}_2 \text{R}_d \) are \( \text{C} \).

[402] In some variations of formula (12b), \( n \) is 2; \( I_1 \) and \( 3/4 \) are each 1; \( \text{R}_{a1} \) and \( \text{R}_{b1} \) are \( \text{O} \); \( \text{R}_{a2} \) and \( \text{R}_{b2} \) are \( \text{O} \); and each ring \( \text{A} \) independently is aryl, heteroaryl, cycloalkyl, or heterocycllyl, wherein the rings are joined together to form one of the regioisomeric moieties shown, where each ring \( \text{A} \) is exemplified as a phenyl ring:

In other similar variations of formula (12b), \( n \) is 3 or 4, each ring \( \text{A} \) independently is aryl, heteroaryl, cycloalkyl, or heterocycllyl and are linked together to form extended regioisomeric chains. In particular variations, ring \( \text{A} \) is aryl or heteroaryl.

[403] In some of the variations of formula (12b) described above, \( \text{D}_1 \) and \( \text{D}_2 \) are safranin-0 moieties, as shown in formula (12c):

in which \( /1, I_2, n, o_i, 0_2 \), ring \( \text{A} \), \( \text{R}_{ai} \), \( \text{R}_{bi} \), \( \text{R}_{a2} \), \( \text{R}_{b2} \), \( \text{R}_{ci} \), \( \text{R}_{di} \), \( \text{R}_{c2} \) and \( \text{R}_{d2} \) are as described for formula (12b), \( \text{R}_{i} \), \( \text{R}_{2} \), \( \text{R}_{3} \), \( \text{R}_{4} \), \( \text{R}_{5} \), and \( \text{R}_{6} \) independently are absent or independently are selected from \(-\text{NH}_2\), \(-\text{NHR}\), \(-\text{NR}_2\), \(-\text{OH}\), \(-\text{O}^\text{r}\), \(-\text{NHCOCH}_3\), \(-\text{NHCOR}\), \(-\text{OCH}_3\), \(-\text{OR}\), \(-\text{C}_2\text{H}_5\), \(-\text{R}\), \(-\text{C}_6\text{H}_5\), \(-\text{N0}_2\), \(-\text{NR}_3^+\), halo (e.g., \(-\text{F}\), \(-\text{Br}\), \(-\text{Cl}\), \(-\text{I}\)), trihalide (e.g., \(-\text{CF}_3\), \(-\text{CCl}_3\), \(-\text{CBr}_3\), \(-\text{Cl}_3\)), \(-\text{CN}\), \(-\text{SO}_2\text{H}\), \(-\text{COOH}\), \(-\text{COOR}\), \(-\text{CHO}\), and \(-\text{COR}\), and \( \text{R} \) is C1-C6 linear or branched alkyl (e.g., \(-\text{C}1\text{-C}6\), \(-\text{C}1\text{-C}5\), \(-\text{C}1\text{-C}4\), \(-\text{C}1\text{-C}3\), \(-\text{C}1\text{-C}2\), \(-\text{C}1\), \(-\text{C}2\text{-C}6\), \(-\text{C}2\text{-C}5\), \(-\text{C}2\text{-C}4\), \(-\text{C}2\text{-C}3\), \(-\text{C}2\), \(-\text{C}3\text{-C}6\), \(-\text{C}3\text{-C}5\), \(-\text{C}3\text{-C}4\), \(-\text{C}3\), \(-\text{C}4\text{-C}6\), \(-\text{C}4\text{-C}5\), \(-\text{C}4\), \(-\text{C}5\text{-C}6\), \(-\text{C}5\), or \(-\text{C}6\) linear or branched alkyl).
In some of the variations of formula (12c), each \( \sigma_1 \) and \( \sigma_2 \) is 1-8, each \( R_i, R_d, R_{c1} \) and \( R_{d2} \) is H, and \( R_i \) to \( R_8 \) are as described above for formula (12b). In some of these variations, \( \sigma_1 \) and \( \sigma_2 \) are 6 or 8, each \( R_a \) and \( R_b \) is H, and each of \( R_i \) to \( R_8 \) independently is absent or is a halo. In particular variations, \( \sigma_1 \) and \( \sigma_2 \) are 6 or 8, each \( R_a \) and \( R_b \) is H, and \( R_1 \) to \( R_6 \) are all absent.

In some of the variations of formula (12c), each \( \sigma_1 \) and \( \sigma_2 \) is 1-8, each \( R_i, R_d, R_{c1} \) and \( R_{d2} \) are either H or \( \text{halo} \), and \( R_i \) to \( R_6 \) are as described above for formula (12b). In some of these variations, \( \sigma_1 \) and \( \sigma_2 \) are 6 or 8, \( R_a \) and \( R_b \) are either H or \( \text{halo} \), and each of \( R_i \) to \( R_6 \) independently is absent or is a halo. In particular variations, \( \sigma_1 \) and \( \sigma_2 \) are 6 or 8, \( R_a \) and \( R_b \) are either H or \( \text{halo} \), and \( R_1 \) to \( R_6 \) are all absent.

In some of the variations of formula (12c), each \( \sigma_1 \) and \( \sigma_2 \) is 1-8, each \( R_{c1}, R_{d1}, R_{c2} \) and \( R_{d2} \) are either H or \( \text{halo} \), and \( R_1 \) to \( R_6 \) are as described above for formula (12b). In some of these variations, \( \sigma_1 \) and \( \sigma_2 \) are 6 or 8, \( R_a \) and \( R_b \) are either H or \( \text{halo} \), and each of \( R_i \) to \( R_6 \) independently is absent or is a halo. In particular variations, \( \sigma_1 \) and \( \sigma_2 \) are 6 or 8, \( R_a \) and \( R_b \) are either H or \( \text{halo} \), and \( R_1 \) to \( R_6 \) are all absent.

In some of the variations of formula (12c), each \( \sigma_1 \) and \( \sigma_2 \) is 1-8, each \( R_i, R_d, R_{c1} \) and \( R_{d2} \) are either H or two of \( \text{CR}_i \text{Rdi} \) and \( \text{CR}_{c2} \text{Rd2} \) are \( \text{halo} \), and \( R_i \) to \( R_6 \) are as described above for formula (12b). In some of these variations, \( \sigma_1 \) and \( \sigma_2 \) are 6 or 8, each \( R_i, R_d, R_{c1} \) and \( R_{d2} \) are either H or two of \( \text{CR}_i \text{Rdi} \) and \( \text{CR}_{c2} \text{Rd2} \) are \( \text{halo} \), and each of \( R_i \) to \( R_6 \) independently is absent or is a halo. In particular variations, \( \sigma_1 \) and \( \sigma_2 \) are 6 or 8, each \( R_i, R_d, R_{c1}, R_{c2} \) and \( R_{d2} \) are either H or two of \( \text{CR}_i \text{Rdi} \) and \( \text{CR}_{c2} \text{Rd2} \) are \( \text{halo} \), and \( R_i \) to \( R_6 \) are all absent.

One of skill in the art can readily visualize and prepare other cationic multimers falling within formulae (12) or (12b) in which other cationic dye moieties are used in place of one or both of the safranin-0 moieties.
Some cationic dye dimers fall within formula (13):

\[
\begin{array}{c}
\text{D1} \quad \text{N} \quad \text{N} \quad \text{D2} \\
\text{H} \quad \text{H} \quad \text{N} \\
\end{array}
\]

wherein each of \( \text{D1} \) and \( \text{D2} \) is a cationic dye moiety and \( n \) is 0-6, and \( m \) is 1-4.

In some variations of formula (13), \( \text{D1} \) and \( \text{D2} \) are different cationic dye moieties. In other variations of formula (13), \( \text{D1} \) and \( \text{D2} \) are the same cationic dye moiety. In some variations of formula (13), \( \text{D1} \) and \( \text{D2} \) are independently selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

In some variations of formula (13) described in the paragraphs above, \( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

In some variations of formula (13) described in the paragraphs above, \( m \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (13) described in the paragraphs above, \( \text{D1} \) is safranin-O. In some variations of formula (13) described in the paragraphs above, \( \text{D2} \) is safranin-O. In some variations of formula (13) described in the paragraphs above, \( \text{D1} \) and \( \text{D2} \) are safranin-O.

In some variations of formula (13) described in the paragraph above, the pendant phenyl ring of \( \text{D1} \) is unsubstituted. In some variations of formula (13) described in the paragraph above, the pendant phenyl ring of \( \text{D1} \) is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of \( \text{D1} \) is substituted, the substituents are selected independently from —NH\(_2\), —NHR, —NR\(_2\), —OH, —O\(^{-}\), —NHCOCH\(_3\), —NHCOR, —OCH\(_3\), —OR, —C\(_2\)H\(_5\), —R, and —C\(_6\)H\(_5\), wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of \( \text{D1} \) is substituted, the substituents are selected independently from —NO\(_2\), —NR\(_3^+\), halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF\(_3\), —CCl\(_3\), —CBr\(_3\), —Cl\(_3\)), —CN, —S0\(_3\)H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, Cl-
In some variations of formula (13) described in the paragraph above, the pendant phenyl ring of $D_2$ is unsubstituted. In some variations of formula (13) described in the paragraph above, the pendant phenyl ring of $D_2$ is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of $D_2$ is substituted, the substituents are selected independently from $-$NH$_2$, $-$NHR, $-$NR$_2$, $-$OH, $-$O$^-$, $-$NHC(O)CH$_3$, $-$NHCOR, $-$OCH$_3$, $-$OR, $-$C$_2$H$_5$, $-$R, and $-$C$_6$H$_5$, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of $D_2$ is substituted, the substituents are selected independently from $-$NO$_2$, $-$NR$_3^+$, halo (e.g., F, Br, Cl, I), trihalide (e.g., $-$CF$_3$, $-$CC1$_3$, $-$CBr$_3$, $-$Cl$_3$), $-$CN, $-$S$_2$H, $-$COOH, $-$COOR, $-$CHO, and $-$COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

**Examples of Cationic Dye Trimers and Other Multimers**

Some cationic dye trimers fall within formula (14):

\[
\begin{array}{c}
\text{D}_1 \\
\text{D}_2 \\
\text{D}_3
\end{array}
\]

(14)

In which each of $\text{D}_1$, $\text{D}_2$, and $\text{D}_3$ is a cationic dye moiety, $n$ is 0-6, $n_1$ is 1-4, $n_b$ is 0-6, and $n'\alpha$ is 0-6.

In some variations of formula (14), $\text{D}_1$, $\text{D}_2$, and $\text{D}_3$ are different cationic dye moieties. In some variations of formula (14), $\text{D}_1$, $\text{D}_2$, and $\text{D}_3$ are the same cationic dye moiety. In other variations of formula (14), $\text{D}_1$ and $\text{D}_2$ are the same cationic dye moiety and $\text{D}_3$ is a different cationic dye moiety. In other variations of formula (14), $\text{D}_1$ and $\text{D}_3$ are the same cationic dye moiety and $\text{D}_2$ is a different cationic dye moiety. In other variations of formula (14), $\text{D}_2$ and $\text{D}_3$ are the same cationic dye moiety and $\text{D}_1$ is a different cationic dye moiety. In some variations of formula (14), each of $\text{D}_1$, $\text{D}_2$, and $\text{D}_3$ independently is selected from the group consisting of
safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

[418] In some variations of formula (14) described in the paragraphs above, \( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

[419] In some variations of formula (14) described in the paragraphs above, \( n_1 \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[420] In some variations of formula (14) described in the paragraphs above, \( n_b \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

[421] In some variations of formula (14) described in the paragraphs above, \( n_{bl} \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[422] In some variations of formula (14) described in the paragraphs above, \( D_1 \) is safranin-O. In some variations of formula (14) described in the paragraphs above, \( D_2 \) is safranin-O. In some variations of formula (14) described in the paragraphs above, \( D_3 \) is safranin-O. In some variations of formula (14) described in the paragraphs above, \( D_1 \) and \( D_2 \) are safranin-O. In some variations of formula (14) described in the paragraphs above, \( D_1 \) and \( D_3 \) are safranin-O. In some variations of formula (14) described in the paragraphs above, \( D_2 \) and \( D_3 \) are safranin-O.

[423] In some variations of formula (14) described in the paragraph above, the pendant phenyl ring of \( D_1 \) is unsubstituted. In some variations of formula (14) described in the paragraph above, the pendant phenyl ring of \( D_1 \) is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of \( D_1 \) is substituted, the substituents are selected independently from \(-\text{NH}_2, -\text{NHR}, -\text{NR}_2, -\text{OH}, -\text{O}^-,\)

\(-\text{NHCOC}_3, -\text{NHCOR}, -\text{OCH}_3, -\text{OR}, -\text{C}_2\text{H}_5, -\text{R},\) and \(-\text{C}_6\text{H}_5\), wherein \( R \) is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, CI, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of \( D_1 \) is substituted, the substituents are selected independently from \(-\text{NO}_2, -\text{NR}_3^+,\) halo (e.g., F, Br, Cl, I), trihalide (e.g., \(-\text{CF}_3, -\text{CCl}_3, -\text{CBr}_3, -\text{Cl}_3),\) \(-\text{CN}, -\text{SO}_2\text{H}, -\text{COOH}, -\text{COOR}, -\text{CHO},\) and \(-\text{COR},\) wherein \( R \) is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1-C1, C1-C0).
C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[424] In some variations of formula (14) described in the two paragraphs above, the pendant phenyl ring of \textbf{D2} is unsubstituted. In some variations of formula (14) described in the paragraph above, the pendant phenyl ring of \textbf{D2} is substituted with 1-3 \textit{(e.g., 1-3, 1-2, 1, 2, or 3)} electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of \textbf{D2} is substituted, the substituents are selected independently from \(-\text{NH}_2, -\text{NHR}, -\text{NR}_2, -\text{OH}, -\text{O}^-, \)

\(-\text{NHCOC}_3, -\text{NHCOR}, -\text{OCH}_3, -\text{OR}, -\text{C}_2\text{H}_5, -\text{R}, \) and \(-\text{C}_6\text{H}_5, \) wherein \textit{R} is \textit{C}1-\textit{C}6 linear or branched alkyl \textit{(e.g., C}1-\textit{C}6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of \textbf{D2} is substituted, the substituents are selected independently from \(-\text{N}O_2, -\text{NR}_3^+, \) halo \textit{(e.g., F, Br, Cl, I)}, trihalide \textit{(e.g., -CF}_3, -CCl}_3, -CBr}_3, -Cl}_3), -CN, -S0}_2H, -COOH, -COOR, -CHO, and -COR, wherein \textit{R} is \textit{C}1-\textit{C}6 linear or branched alkyl \textit{(e.g., C}1-\textit{C}6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[425] In some variations of formula (14) described in the three paragraphs above, the pendant phenyl ring of \textbf{D3} is unsubstituted. In some variations of formula (14) described in the paragraph above, the pendant phenyl ring of \textbf{D3} is substituted with 1-3 \textit{(e.g., 1-3, 1-2, 1, 2, or 3)} electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of \textbf{D3} is substituted, the substituents are selected independently from \(-\text{NH}_2, -\text{NHR}, -\text{NR}_2, -\text{OH}, -\text{O}^-, \)

\(-\text{NHCOC}_3, -\text{NHCOR}, -\text{OCH}_3, -\text{OR}, -\text{C}_2\text{H}_5, -\text{R}, \) and \(-\text{C}_6\text{H}_5, \) wherein \textit{R} is \textit{C}1-\textit{C}6 linear or branched alkyl \textit{(e.g., C}1-\textit{C}6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of \textbf{D3} is substituted, the substituents are selected independently from \(-\text{N}O_2, -\text{NR}_3^+, \) halo \textit{(e.g., F, Br, Cl, I)}, trihalide \textit{(e.g., -CF}_3, -CCl}_3, -CBr}_3, -Cl}_3), -CN, -S0}_2H, -COOH, -COOR, -CHO, and -COR, wherein \textit{R} is \textit{C}1-\textit{C}6 linear or branched alkyl \textit{(e.g., C}1-\textit{C}6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[426] Some cationic dye trimers fall within formula (15):
In some variations of formula (15), Dl, D2, and D3 are different cationic dye moieties. In other variations of formula (15), Dl and D2 are the same cationic dye moiety and D3 is a different cationic dye moiety. In other variations of formula (15), Dl and D3 are the same cationic dye moiety and D2 is a different cationic dye moiety. In other variations of formula (15), D2 and D3 are the same cationic dye moiety and D1 is a different cationic dye moiety. In some variations of formula (15), each of Dl, D2, and D3 independently is selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

In some variations of formula (15) described in the paragraphs above, n is n is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

In some variations of formula (15) described in the paragraphs above, η₁ is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (15) described in the paragraphs above, η₂ is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

In some variations of formula (15) described in the paragraphs above, η₂ is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (15) described in the paragraphs above, Dl is safranin-O. In some variations of formula (15) described in the paragraphs above, D2 is safranin-O. In some variations of formula (15) described in the paragraphs above, D3 is safranin-O. In some variations of formula (15) described in the paragraphs above, Dl and D2 are safranin-O. In some variations of formula (15) described in the paragraphs above, Dl and D3 are safranin-O. In some variations of formula (15) described in the paragraphs above, D2 and D3 are safranin-O.
In some variations of formula (15) described in the paragraph above, the pendant phenyl ring of D1 is unsubstituted. In some variations of formula (15) described in the paragraph above, the pendant phenyl ring of D1 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₂), —CN, —S0₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

In some variations of formula (15) described in the two paragraphs above, the pendant phenyl ring of D2 is unsubstituted. In some variations of formula (15) described in the paragraph above, the pendant phenyl ring of D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₂), —CN, —S0₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

In some variations of formula (15) described in the three paragraphs above, the pendant phenyl ring of D3 is unsubstituted. In some variations of formula (15) described in the paragraph above, the pendant phenyl ring of D3 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant
In some embodiments in which the pendant phenyl ring of D 3 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O', —NHC(O)CH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁-C₂, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂-C₂, C₂-C₃, C₃-C₃, C₃-C₄, C₃-C₄, C₄-C₆, C₄-C₅, C₄-C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D 3 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —S₂O₃H, —COOH, —COOR, —CHO, and —COR, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₃, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl).

Some cationic dye trimers fall within formula (16):

\[
\text{D1} \quad \frac{R_{a1} R_{b1}}{n_1} \quad \text{D2} \quad \frac{R_{a2} R_{b2}}{n_2} \quad \text{D3}
\]

(16)

where each of D₁, D₂, and D₃ is a cationic dye moiety; \( n \) and \( n_2 \) independently are 0-6; \( n_1 \) and \( n_2 \) independently are 1-4; for each independent instance of \( R_{a1} \) and \( R_{b1} \), \( R_{a1} \) and \( R_{b1} \) (1) independently are H or CH₃, or (2) \( R_{a1} \) and \( R_{b1} \) are \( \mathcal{O} \) or \( \mathcal{O} \), or (3) two of CR₁Ra₂ are \( \mathcal{O} \); and, for each independent instance of \( R_{a2} \) and \( R_{b2} \), \( R_{a2} \) and \( R_{b2} \) (1) independently are H or CH₃, or (2) \( R_{a2} \) and \( R_{b2} \) are \( \mathcal{O} \) or \( \mathcal{O} \), or (3) two of CR₂Ra₂ are \( \mathcal{O} \).

In some variations of formula (16), D₁, D₂, and D₃ are different cationic dye moieties. In some variations of formula (16), D₁, D₂, and D₃ are the same cationic dye moiety. In other variations of formula (16), D₁ and D₂ are the same cationic dye moiety and D₃ is a different cationic dye moiety. In other variations of formula (16), D₁ and D₃ are the same cationic dye moiety and D₂ is a different cationic dye moiety. In other variations of formula (16), D₂ and D₃ are the same cationic dye moiety and D₁ is a different cationic dye moiety. In some variations of formula (16), each of D₁, D₂, and D₃ independently is selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.
In some variations of formula (16) described in the paragraphs above, \( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

In some variations of formula (16) described in the paragraphs above, \( n_1 \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (16) described in the paragraphs above, \( n_b \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

In some variations of formula (16) described in the paragraphs above, \( n_{b1} \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (16) described in the paragraphs above, \( R_{a1} \) is H and \( R_{b1} \) is H. In some variations of formula (16) described in the paragraphs above, \( R_{a1} \) is H and \( R_{b1} \) is CH₃. In some variations of formula (16) described in the paragraphs above, \( R_{a1} \) and \( R_{b1} \) are both CH₃. In some variations of formula (16) described in the paragraphs above, \( R_{a1} \) and \( R_{b1} \) are . In some variations of formula (16) described in the paragraphs above, two of \( \text{CR}_{a1}R_{b1} \) are .

In some variations of formula (16) described in the paragraphs above, \( R_{a2} \) is H and \( R_{b2} \) is H. In some variations of formula (16) described in the paragraphs above, \( R_{a2} \) is H and \( R_{b2} \) is CH₃. In some variations of formula (16) described in the paragraphs above, \( R_{a2} \) and \( R_{b2} \) are both CH₃. In some variations of formula (16) described in the paragraphs above, \( R_{a2} \) and \( R_{b2} \) are . In some variations of formula (16) described in the paragraphs above, two of \( \text{CR}_{a2}R_{b2} \) are .

In some variations of formula (16) described in the paragraphs above, \( D_{11} \) is safranin-O. In some variations of formula (16) described in the paragraphs above, \( D_{22} \) is safranin-O. In some
variations of formula (16) described in the paragraphs above, D3 is safranin-O. In some variations of formula (16) described in the paragraphs above, D1 and D2 are safranin-O. In some variations of formula (16) described in the paragraphs above, D1 and D3 are safranin-O. In some variations of formula (16) described in the paragraphs above, D2 and D3 are safranin-O.

[445] In some variations of formula (16) described in the paragraph above, the pendant phenyl ring of D1 is unsubstituted. In some variations of formula (16) described in the paragraph above, the pendant phenyl ring of D1 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, CI, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, CI, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, CI, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[446] In some variations of formula (16) described in the two paragraphs above, the pendant phenyl ring of D2 is unsubstituted. In some variations of formula (16) described in the paragraph above, the pendant phenyl ring of D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, CI, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, CI, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, CI, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).
In some variations of formula (16) described in the three paragraphs above, the pendant phenyl ring of D3 is unsubstituted. In some variations of formula (16) described in the paragraph above, the pendant phenyl ring of D3 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —NH2, —NHR, —NR2, —OH, —O’, —NHCOC1H3, —NHCOR, —OCH3, —OR, —C2H5, —R, and —C6H5, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, CI, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —NO2, —NR3+, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF3, —CCl3, —CBr3, —ClI), —CN, —S02H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, CI, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

Some cationic dye trimers fall within formula (17):

![Diagram](image)

(17) , in which each of D1, D2, and D3 is a cationic dye moiety; ki is 2-10; ¾ is 2-10; for each independent instance of Ra and Rb, Ra,i and Rb,i (1) independently are H or CH3, or (2) Ra,i and Rb,i are or ; and, for each independent instance of Ra and Rb, Ra,2 and Rb,2 (1) independently are H or CH3, or (2) Ra,2 and Rb,2 are or , or (3) two of CRa,Rb,2 are

In some variations of formula (17), D1, D2, and D3 are different cationic dye moieties. In some variations of formula (17), D1, D2, and D3 are the same cationic dye moiety. In other variations of formula (17), D1 and D2 are the same cationic dye moiety and D3 is a different cationic dye moiety. In other variations of formula (17), D1 and D3 are the same cationic dye moiety and D2 is a different cationic dye moiety. In other variations of formula (17), D2 and D3
are the same cationic dye moiety and \( \text{D1} \) is a different cationic dye moiety. In some variations of formula (17), each of \( \text{Dl, D2, and D3} \) independently is selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

[450] In some variations of formula (17) described in the paragraphs above, \( k_i \) is 2-10, 2-9, 2-8, 2-7, 2-6, 2-5, 2-4, 2-3, 3-10, 3-9, 3-8, 3-7, 3-6, 3-5, 3-4, 4-10, 4-9, 4-8, 4-7, 4-6, 4-5, 5-10, 5-9, 5-8, 5-7, 5-6, 6-10, 6-9, 6-8, 6-7, 7-10, 7-9, 7-8, 8-10, 8-9, 9-10, 2, 3, 4, 5, 6, 7, 8, 9, or 10.

[451] In some variations of formula (17) described in the paragraphs above, \( k_2 \) is 2-10, 2-9, 2-8, 2-7, 2-6, 2-5, 2-4, 2-3, 3-10, 3-9, 3-8, 3-7, 3-6, 3-5, 3-4, 4-10, 4-9, 4-8, 4-7, 4-6, 4-5, 5-10, 5-9, 5-8, 5-7, 5-6, 6-10, 6-9, 6-8, 6-7, 7-10, 7-9, 7-8, 8-10, 8-9, 9-10, 2, 3, 4, 5, 6, 7, 8, 9, or 10.

[452] In some variations of formula (17) described in the paragraphs above, each \( R_{a1} \) is H and each \( R_{b1} \) is H. In some variations of formula (17) described in the paragraphs above, each \( R_{a1} \) is H and each \( R_{b1} \) is CH₃. In some variations of formula (17) described in the paragraphs above, each \( R_{a1} \) and \( R_{b1} \) is \( \text{C} \). In some variations of formula (17) described in the paragraphs above, each \( R_{a1} \) and \( R_{b1} \) is \( \text{O} \). In some variations of formula (17) described in the paragraphs above, each two of \( \text{CR}_{a1} \text{R}_{b1} \) are \( \text{O} \).

[453] In some variations of formula (17) described in the paragraphs above, in a first occurrence of \( R_{a1} \) and \( R_{b1} \), each of \( R_{a1} \) and \( R_{b1} \) is H, and the remaining occurrences of \( R_{a1} \) and \( R_{b1} \) are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in a first occurrence of \( R_{a1} \) and \( R_{b1} \), each of \( R_{a1} \) and \( R_{b1} \) is CH₃, and the remaining occurrences of \( R_{a1} \) and \( R_{b1} \) are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in a first occurrence of \( R_{a1} \) and \( R_{b1} \), a first \( R_{a1} \) is H, a first \( R_{b1} \) is CH₃, and the remaining occurrences of \( R_{a1} \) and \( R_{b1} \) are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in a first occurrence of \( R_{a1} \) and \( R_{b1} \), \( R_{a1} \) and \( R_{b1} \) are \( \text{O} \), and the remaining occurrences of \( R_{a1} \) and \( R_{b1} \) are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in a first occurrence of \( R_{a1} \) and \( R_{b1} \), \( R_{a1} \) and \( R_{b1} \) are \( \text{C} \), and the remaining occurrences of \( R_{a1} \) and \( R_{b1} \) are as defined above for formula (17).
In some variations of formula (17) described in the paragraphs above, in two occurrences of \( R_{a_i} \) and \( R_{bi} \), each of \( R_{a_i} \) and \( R_{bi} \) is H, and the remaining occurrences of \( R_{a_i} \) and \( R_{bi} \) are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in two occurrences of \( R_{a_1} \) and \( R_{bi} \), each of \( R_{a_1} \) and \( R_{bi} \) is \( CH_3 \), and the remaining occurrences of \( R_{a_i} \) and \( R_{bi} \) are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in two occurrences of \( R_{a_i} \) and \( R_{bi} \), two of \( R_{a_i} \) are H, two of \( R_{bi} \) are \( CH_3 \), and the remaining occurrences of \( R_{a_i} \) and \( R_{bi} \) are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in two occurrences of \( R_{a_i} \) and \( R_{bi} \), four of \( R_{a_i} \) are H, and the remaining occurrences of \( R_{a_i} \) and \( R_{bi} \) are as defined above for formula (17).

In some variations of formula (17) described in the paragraphs above, in three occurrences of \( R_{a_i} \) and \( R_{bi} \), each of \( R_{a_i} \) and \( R_{bi} \) is H, and the remaining occurrences of \( R_{a_i} \) and \( R_{bi} \) are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in three occurrences of \( R_{a_i} \) and \( R_{bi} \), each of \( R_{a_i} \) and \( R_{bi} \) is \( CH_3 \), and the remaining occurrences of \( R_{a_i} \) and \( R_{bi} \) are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in three occurrences of \( R_{a_i} \) and \( R_{bi} \), three of \( R_{a_i} \) are H, three of \( R_{bi} \) are \( CH_3 \), and the remaining occurrences of \( R_{a_i} \) and \( R_{bi} \) are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in three occurrences of \( R_{a_i} \) and \( R_{bi} \), \( R_{a_1} \) and \( R_{bi} \) are H, and the remaining occurrences of \( R_{a_i} \) and \( R_{bi} \) are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in three occurrences of \( R_{a_i} \) and \( R_{bi} \), four of \( R_{a_i} \) are H, and the remaining occurrences of \( R_{a_i} \) and \( R_{bi} \) are as defined above for formula (17).
four of Rₙi are CH₃, and the remaining occurrences of Rₐi and Rₗi are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in four occurrences of Rₐi and Rbi, Rₐi and Rbi are \( \text{XXX} \), and the remaining occurrences of Rₐi and Rₗi are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in four occurrences of Rₐi and Rbi, Rₐi and Rbi are \( \text{XXX} \), and the remaining occurrences of Rₐi and Rₗi are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in four occurrences of Rₐi and Rbi, Rₐi and Rbi are as defined above for formula (17).

[457] In some variations of formula (17) described in the paragraphs above, in five occurrences of Rₐi and Rbi, each of Rₐi and Rbi is H, and the remaining occurrences of Rₐi and Rₗi are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in five occurrences of Rₐi and Rbi, each of Rₐi and Rbi is CH₃, and the remaining occurrences of Rₐi and Rbi are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in five occurrences of Rₐi and Rbi, each of Rₐi and Rbi is CH₃, and the remaining occurrences of Rₐi and Rbi are as defined above for formula (17).

[458] In some variations of formula (17) described in the paragraphs above, in six occurrences of Rₐi and Rbi, each of Rₐi and Rbi is H, and the remaining occurrences of Rₐi and Rₗi are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in six occurrences of Rₐi and Rbi, each of Rₐi and Rbi is CH₃, and the remaining occurrences of Rₐi and Rbi are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in six occurrences of Rₐi and Rbi, each of Rₐi and Rbi is CH₃, and the remaining occurrences of Rₐi and Rbi are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in six occurrences of Rₐi and Rbi, each of Rₐi and Rbi is CH₃, and the remaining occurrences of Rₐi and Rbi are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in six occurrences of Rₐi and Rbi, each of Rₐi and Rbi is CH₃, and the remaining occurrences of Rₐi and Rbi are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in six occurrences of Rₐi and Rbi, each of Rₐi and Rbi is CH₃, and the remaining occurrences of Rₐi and Rbi are as defined above for formula (17).
six occurrences of $R_{a1}$ and $R_{bi}$, $R_{ai}$ and $R_{bi}$ are $\text{O}$, and the remaining occurrences of $R_{a1}$ and $R_{bi}$ are as defined above for formula (17).

[459] In some variations of formula (17) described in the paragraphs above, in seven occurrences of $R_{ai}$ and $R_{bi}$, each of $R_{ai}$ and $R_{bi}$ is H, and the remaining occurrences of $R_{ai}$ and $R_{bi}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in seven occurrences of $R_{ai}$ and $R_{bi}$, each of $R_{ai}$ and $R_{bi}$ is CH$_3$, and the remaining occurrences of $R_{ai}$ and $R_{bi}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in seven occurrences of $R_{ai}$ and $R_{bi}$, seven of $R_{ai}$ are H, seven of $R_{bi}$ are CH$_3$, and the remaining occurrences of $R_{ai}$ and $R_{bi}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in seven occurrences of $R_{ai}$ and $R_{bi}$, each of $R_{ai}$ and $R_{bi}$ are $\text{O}$, and the remaining occurrences of $R_{ai}$ and $R_{bi}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in seven occurrences of $R_{ai}$ and $R_{bi}$, each of $R_{ai}$ and $R_{bi}$ are $\text{O}$, and the remaining occurrences of $R_{ai}$ and $R_{bi}$ are as defined above for formula (17).

[460] In some variations of formula (17) described in the paragraphs above, in eight occurrences of $R_{ai}$ and $R_{bi}$, each of $R_{ai}$ and $R_{bi}$ is H, and the remaining occurrences of $R_{ai}$ and $R_{bi}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in eight occurrences of $R_{ai}$ and $R_{bi}$, each of $R_{ai}$ and $R_{bi}$ is CH$_3$, and the remaining occurrences of $R_{ai}$ and $R_{bi}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in eight occurrences of $R_{ai}$ and $R_{bi}$, eight of $R_{ai}$ are H, eight of $R_{bi}$ are CH$_3$, and the remaining occurrences of $R_{ai}$ and $R_{bi}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in eight occurrences of $R_{ai}$ and $R_{bi}$, each of $R_{ai}$ and $R_{bi}$ are $\text{O}$, and the remaining occurrences of $R_{ai}$ and $R_{bi}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in eight occurrences of $R_{ai}$ and $R_{bi}$, each of $R_{ai}$ and $R_{bi}$ are $\text{O}$, and the remaining occurrences of $R_{ai}$ and $R_{bi}$ are as defined above for formula (17).

[461] In some variations of formula (17) described in the paragraphs above, in nine occurrences of $R_{ai}$ and $R_{bi}$, each of $R_{ai}$ and $R_{bi}$ is H, and the remaining occurrences of $R_{ai}$ and $R_{bi}$ are as
defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in nine occurrences of $R_{a_i}$ and $R_{b_i}$, each of $R_{a_i}$ and $R_{b_i}$ is CH$_3$, and the remaining occurrences of $R_{a_i}$ and $R_{b_i}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in nine occurrences of $R_{a_{i1}}$ and $R_{b_{i}}$, nine of $R_{a_{i1}}$ are H, nine of $R_{b_{i}}$ are CH$_3$, and the remaining occurrences of $R_{a_{i}}$ and $R_{b_{i}}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in nine occurrences of $R_{a_i}$ and $R_{b_i}$, $R_{a_i}$ and $R_{b_i}$ are defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in nine occurrences of $R_{a_{i1}}$ and $R_{b_{i1}}$, $R_{a_{i1}}$ and $R_{b_{i1}}$ are defined above for formula (17).

[462] In some variations of formula (17) described in the paragraphs above, in ten occurrences of $R_{a_i}$ and $R_{b_i}$, each of $R_{a_i}$ and $R_{b_i}$ is H, and the remaining occurrences of $R_{a_i}$ and $R_{b_i}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in ten occurrences of $R_{a_{i1}}$ and $R_{b_{i1}}$, each of $R_{a_{i1}}$ and $R_{b_{i1}}$ is CH$_3$, and the remaining occurrences of $R_{a_i}$ and $R_{b_i}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in ten occurrences of $R_{a_i}$ and $R_{b_i}$, ten of $R_{a_i}$ are H, ten of $R_{b_i}$ are CH$_3$, and the remaining occurrences of $R_{a_i}$ and $R_{b_i}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in ten occurrences of $R_{a_i}$ and $R_{b_i}$, $R_{a_i}$ and $R_{b_i}$ are defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in ten occurrences of $R_{a_i}$ and $R_{b_i}$, $R_{a_i}$ and $R_{b_i}$ are defined above for formula (17).
paragraphs above, eight occurrences of $R_{a1}$ and $R_{bi}$ are $\overset{\triangleright}{\overset{\triangleright}{\overset{\triangleright}}}$, and the remaining occurrences of $R_{ai}$ and $R_{bi}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, five occurrences of $R_{ai}$ and $R_{bi}$ are $\overset{\triangleright}{\overset{\triangleright}{\overset{\triangleright}}}$.

[464] In some variations of formula (17) described in the paragraphs above, each $R_{a2}$ is H and each $R_{b2}$ is H. In some variations of formula (17) described in the paragraphs above, each $R_{a2}$ is H and each $R_{b2}$ is CH$_3$. In some variations of formula (17) described in the paragraphs above, each $R_{a2}$ and $R_{b2}$ is $\overset{\triangleright}{\overset{\triangleright}{\overset{\triangleright}}}$.

[465] In some variations of formula (17) described in the paragraphs above, in a first occurrence of $R_{a2}$ and $R_{b2}$, each of $R_{a2}$ and $R_{b2}$ is H, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in a first occurrence of $R_{a2}$ and $R_{b2}$, each of $R_{a2}$ and $R_{b2}$ is CH$_3$, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in a first occurrence of $R_{a2}$ and $R_{b2}$, each of $R_{a2}$ and $R_{b2}$ is H, a first $R_{b2}$ is CH$_3$, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in a first occurrence of $R_{a2}$ and $R_{b2}$, $R_{a2}$ and $R_{b2}$ are $\overset{\triangleright}{\overset{\triangleright}{\overset{\triangleright}}}$, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in a first occurrence of $R_{a2}$ and $R_{b2}$, $R_{a2}$ and $R_{b2}$ are $\overset{\triangleright}{\overset{\triangleright}{\overset{\triangleright}}}$, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in two occurrences of $R_{a2}$ and $R_{b2}$, each of $R_{a2}$ and $R_{b2}$ is H, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in two occurrences of $R_{a2}$ and $R_{b2}$, each of $R_{a2}$ and $R_{b2}$ is CH$_3$, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in two occurrences of $R_{a2}$ and $R_{b2}$, two of $R_{a2}$ are H, two of $R_{b2}$ are CH$_3$, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17).
In some variations of formula (17) described in the paragraphs above, in two occurrences
of \( R_a \) and \( R_b \), \( R_a \) and \( R_b \) are \( \frac{\text{H}}{\text{H}} \), and the remaining occurrences of \( R_a \) and \( R_b \) are as defined
above for formula (17). In some variations of formula (17) described in the paragraphs above, in
two occurrences of \( R_a \) and \( R_b \), \( R_a \) and \( R_b \) are \( \frac{\text{H}}{\text{H}} \), and the remaining occurrences of \( R_a \) and \( R_b \) are as defined above for formula (17).

In some variations of formula (17) described in the paragraphs above, in three
occurrences of \( R_a \) and \( R_b \), each of \( R_a \) and \( R_b \) is H, and the remaining occurrences of \( R_a \) and \( R_b \) are as defined above for formula (17). In some variations of formula (17) described in
the paragraphs above, in three occurrences of \( R_a \) and \( R_b \), each of \( R_a \) and \( R_b \) is CH\(_3\), and the
remaining occurrences of \( R_a \) and \( R_b \) are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in
three occurrences of \( R_a \) and \( R_b \), \( R_a \) and \( R_b \) are \( \frac{\text{H}}{\text{H}} \), and the remaining occurrences of \( R_a \) and \( R_b \) are as defined above for formula (17).

In some variations of formula (17) described in the paragraphs above, in four occurrences
of \( R_a \) and \( R_b \), each of \( R_a \) and \( R_b \) is H, and the remaining occurrences of \( R_a \) and \( R_b \) are as
defined above for formula (17). In some variations of formula (17) described in the
paragraphs above, in four occurrences of \( R_a \) and \( R_b \), each of \( R_a \) and \( R_b \) is CH\(_3\), and the
remaining occurrences of \( R_a \) and \( R_b \) are as defined above for formula (17). In some variations of formula (17) described in the
paragraphs above, in four occurrences of \( R_a \) and \( R_b \), \( R_a \) and \( R_b \) are \( \frac{\text{H}}{\text{H}} \), and the remaining occurrences of \( R_a \) and \( R_b \) are as defined above for formula (17). In some variations of formula (17) described in the
paragraphs above, in four occurrences of $R_{a2}$ and $R_{b2}$, $R_{a2}$ and $R_{b2}$ are \( \gamma_{3,4} \), and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17).

[469] In some variations of formula (17) described in the paragraphs above, in five occurrences of $R_{a2}$ and $R_{b2}$, each of $R_{a2}$ and $R_{b2}$ is H, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in five occurrences of $R_{a2}$ and $R_{b2}$, each of $R_{a2}$ and $R_{b2}$ is CH3, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in five occurrences of $R_{a2}$ and $R_{b2}$, each of $R_{a2}$ and $R_{b2}$ is $\gamma_{3,4}$, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in five occurrences of $R_{a2}$ and $R_{b2}$, $R_{a2}$ and $R_{b2}$ are \( \gamma_{3,4} \), and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17).

[470] In some variations of formula (17) described in the paragraphs above, in six occurrences of $R_{a2}$ and $R_{b2}$, each of $R_{a2}$ and $R_{b2}$ is H, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in six occurrences of $R_{a2}$ and $R_{b2}$, each of $R_{a2}$ and $R_{b2}$ is CH3, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in six occurrences of $R_{a2}$ and $R_{b2}$, six of $R_{a2}$ are H, six of $R_{b2}$ are CH3, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in six occurrences of $R_{a2}$ and $R_{b2}$, $R_{a2}$ and $R_{b2}$ are \( \gamma_{3,4} \), and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in six occurrences of $R_{a2}$ and $R_{b2}$, $R_{a2}$ and $R_{b2}$ are \( \gamma_{3,4} \), and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17).

[471] In some variations of formula (17) described in the paragraphs above, in seven occurrences of $R_{a2}$ and $R_{b2}$, each of $R_{a2}$ and $R_{b2}$ is H, and the remaining occurrences of $R_{a2}$ and
R_{b2} are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in seven occurrences of R_{a2} and R_{b2}, each of R_{a2} and R_{b2} is CH\textsubscript{3}, and the remaining occurrences of R_{a2} and R_{b2} are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in seven occurrences of R_{a2} and R_{b2}, seven of R_{a2} are H, seven of R_{b2} are CH\textsubscript{3}, and the remaining occurrences of R_{a2} and R_{b2} are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in seven occurrences of R_{a2} and R_{b2}, R_{a2} and R_{b2} are \( \text{H} \), and the remaining occurrences of R_{a2} and R_{b2} are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in seven occurrences of R_{a2} and R_{b2}, R_{a2} and R_{b2} are \( \text{H} \), and the remaining occurrences of R_{a2} and R_{b2} are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in seven occurrences of R_{a2} and R_{b2}, R_{a2} and R_{b2} are \( \text{H} \), and the remaining occurrences of R_{a2} and R_{b2} are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in seven occurrences of R_{a2} and R_{b2}, R_{a2} and R_{b2} are \( \text{H} \), and the remaining occurrences of R_{a2} and R_{b2} are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in seven occurrences of R_{a2} and R_{b2}, R_{a2} and R_{b2} are \( \text{H} \), and the remaining occurrences of R_{a2} and R_{b2} are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in seven occurrences of R_{a2} and R_{b2}, R_{a2} and R_{b2} are \( \text{H} \), and the remaining occurrences of R_{a2} and R_{b2} are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in seven occurrences of R_{a2} and R_{b2}, R_{a2} and R_{b2} are \( \text{H} \), and the remaining occurrences of R_{a2} and R_{b2} are as defined above for formula (17).
occurrences of $R_{a2}$ and $R_{b2}$, $R_{a2}$ and $R_{b2}$ are $\overline{\underline{\text{O}}}$, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in nine occurrences of $R_{a2}$ and $R_{b2}$, $R_{a2}$ and $R_{b2}$ are $\overline{\underline{\text{O}}}$, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17).

[474] In some variations of formula (17) described in the paragraphs above, in ten occurrences of $R_{a2}$ and $R_{b2}$, each of $R_{a2}$ and $R_{b2}$ is H, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in ten occurrences of $R_{a2}$ and $R_{b2}$, each of $R_{a2}$ and $R_{b2}$ is CH$_3$, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in ten occurrences of $R_{a2}$ and $R_{b2}$, $R_{a2}$ and $R_{b2}$ are $\overline{\underline{\text{O}}}$, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, in ten occurrences of $R_{a2}$ and $R_{b2}$, $R_{a2}$ and $R_{b2}$ are $\overline{\underline{\text{O}}}$, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17).

[475] In some variations of formula (17) described in the paragraphs above, two occurrences of $R_{a2}$ and $R_{b2}$ are $\overline{\underline{\text{O}}}$, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, four occurrences of $R_{a2}$ and $R_{b2}$ are $\overline{\underline{\text{O}}}$, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, six occurrences of $R_{a2}$ and $R_{b2}$ are $\overline{\underline{\text{O}}}$, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, eight occurrences of $R_{a2}$ and $R_{b2}$ are $\overline{\underline{\text{O}}}$, and the remaining occurrences of $R_{a2}$ and $R_{b2}$ are as defined above for formula (17). In some variations of formula (17) described in the paragraphs above, five occurrences of $R_{a2}$ and $R_{b2}$ are $\overline{\underline{\text{O}}}$.
In some variations of formula (17) described in the paragraphs above, D1 is safranin-O. In some variations of formula (17) described in the paragraphs above, D2 is safranin-O. In some variations of formula (17) described in the paragraphs above, D3 is safranin-O. In some variations of formula (17) described in the paragraphs above, D1 and D2 are safranin-O. In some variations of formula (17) described in the paragraphs above, D1 and D3 are safranin-O. In some variations of formula (17) described in the paragraphs above, D2 and D3 are safranin-O.

In some variations of formula (17) described in the paragraph above, the pendant phenyl ring of D1 is unsubstituted. In some variations of formula (17) described in the paragraph above, the pendant phenyl ring of D1 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O⁻, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NO₂, —NR⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

In some variations of formula (17) described in the two paragraphs above, the pendant phenyl ring of D2 is unsubstituted. In some variations of formula (17) described in the paragraph above, the pendant phenyl ring of D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O⁻, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NO₂, —NR⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-
In some variations of formula (17) described in the three paragraphs above, the pendant phenyl ring of D3 is unsubstituted. In some variations of formula (17) described in the paragraph above, the pendant phenyl ring of D3 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₂), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl).

Some cationic dye dimers fall within formula (18):

\[
\text{D1} \quad \text{D2} \quad \text{D2}
\]

wherein each of D₁, D₂, and D₃ is a cationic dye moiety, n and nb independently are 0-6, and n₁ and nb₁ independently are 1-4.

In some variations of formula (18), D₁, D₂, and D₃ are different cationic dye moieties. In some variations of formula (18), D₁, D₂, and D₃ are the same cationic dye moiety. In other variations of formula (18), D₁ and D₂ are the same cationic dye moiety and D₃ is a different cationic dye moiety. In other variations of formula (18), D₁ and D₃ are the same cationic dye moiety and D₂ is a different cationic dye moiety. In other variations of formula (18), D₂ and D₃ are the same cationic dye moiety and D₁ is a different cationic dye moiety. In some variations of formula (18), each of D₁, D₂, and D₃ independently is selected from the group consisting of
safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

[482] In some variations of formula (18) described in the paragraphs above, \( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

[483] In some variations of formula (18) described in the paragraphs above, \( nb \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

[484] In some variations of formula (18) described in the paragraphs above, \( n_I \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[485] In some variations of formula (18) described in the paragraphs above, \( n_{bl} \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[486] In some variations of formula (18) described in the paragraphs above, \( D_1 \) is safranin-O. In some variations of formula (18) described in the paragraphs above, \( D_2 \) is safranin-O. In some variations of formula (18) described in the paragraphs above, \( D_3 \) is safranin-O. In some variations of formula (18) described in the paragraphs above, \( D_1 \) and \( D_2 \) are safranin-O. In some variations of formula (18) described in the paragraphs above, \( D_1 \) and \( D_3 \) are safranin-O. In some variations of formula (18) described in the paragraphs above, \( D_2 \) and \( D_3 \) are safranin-O.

[487] In some variations of formula (18) described in the paragraph above, the pendant phenyl ring of \( D_1 \) is unsubstituted. In some variations of formula (18) described in the paragraph above, the pendant phenyl ring of \( D_1 \) is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of \( D_1 \) is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl). In some embodiments in which the pendant phenyl ring of \( D_1 \) is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-
In some variations of formula (18) described in the two paragraphs above, the pendant phenyl ring of D2 is unsubstituted. In some variations of formula (18) described in the paragraph above, the pendant phenyl ring of D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O⁻, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂-C₃, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —S₀₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl).

In some variations of formula (18) described in the three paragraphs above, the pendant phenyl ring of D₃ is unsubstituted. In some variations of formula (18) described in the paragraph above, the pendant phenyl ring of D₃ is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D₃ is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O⁻, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D₃ is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —S₀₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl).

Some cationic dye dimers fall within formula (19):
wherein each of **D1**, **D2**, and **D3** is a cationic dye moiety, \(n_l\) and \(n_{ij,i}\) independently are 0-5, and \(n_2\) and \(n_{b2}\) independently are 1-5.

[491] In some variations of formula (19), **D1**, **D2**, and **D3** independently are selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue. In some variations of formula (19), **D1** and **D2** are different cationic dye moieties. In other variations of formula (19), **D1** and **D2** are the same cationic dye moiety.

[492] In some variations of formula (19) described in the paragraphs above, \(n_l\) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[493] In some variations of formula (19) described in the paragraphs above, \(n_{b1}\) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[494] In some variations of formula (19) described in the paragraphs above, \(n_2\) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[495] In some variations of formula (19) described in the paragraphs above, \(n_{b2}\) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[496] In some variations of formula (19) described in the paragraphs above, **D1** is safranin-O. In some variations of formula (19) described in the paragraphs above, **D2** is safranin-O. In some variations of formula (19) described in the paragraphs above, **D3** is safranin-O. In some variations of formula (19) described in the paragraphs above, **D1** and **D2** are safranin-O. In some variations of formula (19) described in the paragraphs above, **D1** and **D3** are safranin-O. In some variations of formula (19) described in the paragraphs above, **D2** and **D3** are safranin-O.

[497] In some variations of formula (19) described in the paragraph above, the pendant phenyl ring of **D1** is unsubstituted. In some variations of formula (19) described in the paragraph above, the pendant phenyl ring of **D1** is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl.
ring. In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₂), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some variations of formula (19) described in the two paragraphs above, the pendant phenyl ring of D2 is unsubstituted. In some variations of formula (19) described in the paragraph above, the pendant phenyl ring of D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₂), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[498] In some variations of formula (19) described in the three paragraphs above, the pendant phenyl ring of D3 is unsubstituted. In some variations of formula (19) described in the paragraph above, the pendant phenyl ring of D3 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).
C4, C2-C3, C2, C3-C6, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —N0₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₂), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

Some cationic dye trimers fall within formula (20):

![Diagram of formula (20)]

, in which each of D1 and D2 is a cationic dye moiety, and independently are 0-5 and independently are 1-5.

In some variations of formula (20), each of D1, D2, and D3 independently is selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue. In some variations of formula (20), D1, D2, and D3 are different cationic dye moieties. In some variations of formula (20), D1, D2, and D3 are the same cationic dye moiety. In other variations of formula (20), D1 and D2 are the same cationic dye moiety and D3 is a different cationic dye moiety. In other variations of formula (20), D1 and D3 are the same cationic dye moiety and D2 is a different cationic dye moiety. In other variations of formula (20), D2 and D3 are the same cationic dye moiety and D1 is a different cationic dye moiety.

In some variations of formula (20) described in the paragraphs above, is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (20) described in the paragraphs above, is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.
In some variations of formula (20) described in the paragraphs above, \( n_{bi} \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (20) described in the paragraphs above, \( n^{A} \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (20) described in the paragraphs above, \( D_{1} \) is safranin-O. In some variations of formula (20) described in the paragraphs above, \( D_{2} \) is safranin-O. In some variations of formula (20) described in the paragraphs above, \( D_{3} \) is safranin-O. In some variations of formula (20) described in the paragraphs above, \( D_{1} \) and \( D_{2} \) are safranin-O. In some variations of formula (20) described in the paragraphs above, \( D_{1} \) and \( D_{3} \) are safranin-O. In some variations of formula (20) described in the paragraphs above, \( D_{2} \) and \( D_{3} \) are safranin-O.

In some variations of formula (20) described in the paragraph above, the pendant phenyl ring of \( D_{1} \) is unsubstituted. In some variations of formula (20) described in the paragraph above, the pendant phenyl ring of \( D_{1} \) is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of \( D_{1} \) is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of \( D_{1} \) is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, CI, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₂), —CN, —S0₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

In some variations of formula (20) described in the two paragraphs above, the pendant phenyl ring of \( D_{2} \) is unsubstituted. In some variations of formula (20) described in the paragraph above, the pendant phenyl ring of \( D_{2} \) is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of \( D_{2} \) is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6.
linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₂), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some variations of formula (20) described in the three paragraphs above, the pendant phenyl ring of D3 is unsubstituted. In some variations of formula (20) described in the paragraph above, the pendant phenyl ring of D3 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₂), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[510] Some cationic dye trimers fall within formula (21):

![Diagram of D1, D2, and D3](image)

(21) in which each of D1, D2, and D3 is a cationic dye moiety, n₁ and n₂ independently are 0-5 and n₁ and n₂ independently are 1-5.
[511] In some variations of formula (21), D1, D2, and D3 are different cationic dye moieties. In some variations of formula (21), D1, D2, and D3 are the same cationic dye moiety. In other variations of formula (21), D1 and D2 are the same cationic dye moiety and D3 is a different cationic dye moiety. In other variations of formula (21), D1 and D3 are the same cationic dye moiety and D2 is a different cationic dye moiety. In other variations of formula (21), D2 and D3 are the same cationic dye moiety and D1 is a different cationic dye moiety. In some variations of formula (21), each of D1, D2, and D3 independently is selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

[512] In some variations of formula (21) described in the paragraphs above, \( n_1 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[513] In some variations of formula (21) described in the paragraphs above, \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[514] In some variations of formula (21) described in the paragraphs above, \( n_{b1} \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[515] In some variations of formula (21) described in the paragraphs above, \( n_{b2} \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[516] In some variations of formula (21) described in the paragraphs above, D1 is safranin-O. In some variations of formula (21) described in the paragraphs above, D2 is safranin-O. In some variations of formula (21) described in the paragraphs above, D3 is safranin-O. In some variations of formula (21) described in the paragraphs above, D1 and D2 are safranin-O. In some variations of formula (21) described in the paragraphs above, D1 and D3 are safranin-O. In some variations of formula (21) described in the paragraphs above, D2 and D3 are safranin-O.

[517] In some variations of formula (21) described in the paragraph above, the pendant phenyl ring of D1 is unsubstituted. In some variations of formula (21) described in the paragraph above, the pendant phenyl ring of D1 is substituted with 1-3 \( \text{e.g., } 1-3, 1-2, 1, 2, \text{ or } 3 \) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NH\(_2\), —NHR, —NR\(_2\), —OH, —O\(^-\), —NHCOCH\(_3\), —NHCOR, —OCH\(_3\), —OR, —C\(_2\)H\(_5\), —R, and —C\(_6\)H\(_5\), wherein R is C1-C6 linear or branched alkyl \( \text{e.g., } C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-
C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NO2, —NR3+, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF3, —CCl3, —CBr3, —Cl3), —CN, —SO2H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1-C2, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[518] In some variations of formula (21) described in the two paragraphs above, the pendant phenyl ring of D2 is unsubstated. In some variations of formula (21) described in the paragraph above, the pendant phenyl ring of D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NH2, —NHR, —NR2, —OH, —O', —NHCOCH3, —NHCOR, —OCH3, —OR, —C2H5, —R, and —C6H5, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NO2, —NR3+, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF3, —CCl3, —CBr3, —Cl3), —CN, —SO2H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[519] In some variations of formula (21) described in the three paragraphs above, the pendant phenyl ring of D3 is unsubstated. In some variations of formula (21) described in the paragraph above, the pendant phenyl ring of D3 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —NH2, —NHR, —NR2, —OH, —O', —NHCOCH3, —NHCOR, —OCH3, —OR, —C2H5, —R, and —C6H5, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —NO2, —NR3+, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF3, —CCl3, —CBr3, —Cl3), —CN, —SO2H, —COOH, —COOR, —CHO, and
—COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[520] Some cationic dye trimers fall within formula (22):

![Diagram of formula (22)]

(22)  

, in which each of D1, D2, and D3 is a cationic dye moiety, \( n_1 \), \( n_2 \), \( n_{1b} \), and \( nbi \) independently are 1-5.

[521] In some variations of formula (22), D1, D2, and D3 are different cationic dye moieties. In some variations of formula (22), D1, D2, and D3 are the same cationic dye moiety. In other variations of formula (22), D1 and D2 are the same cationic dye moiety and D3 is a different cationic dye moiety. In other variations of formula (22), D1 and D3 are the same cationic dye moiety and D2 is a different cationic dye moiety. In other variations of formula (22), D2 and D3 are the same cationic dye moiety and D1 is a different cationic dye moiety. In some variations of formula (22), each of D1, D2, and D3 independently is selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

[522] In some variations of formula (22) described in the paragraphs above, \( n_1 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[523] In some variations of formula (22) described in the paragraphs above, \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[524] In some variations of formula (22) described in the paragraphs above, \( n_{1b} \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[525] In some variations of formula (22) described in the paragraphs above, \( nbi \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[526] In some variations of formula (22) described in the paragraphs above, D1 is safranin-O. In some variations of formula (22) described in the paragraphs above, D2 is safranin-O. In some variations of formula (22) described in the paragraphs above, D3 is safranin-O. In some
variations of formula (22) described in the paragraphs above, D1 and D2 are safranin-O. In some variations of formula (22) described in the paragraphs above, D1 and D3 are safranin-O. In some variations of formula (22) described in the paragraphs above, D2 and D3 are safranin-O.

[527] In some variations of formula (22) described in the paragraph above, the pendant phenyl ring of D1 is unsubstituted. In some variations of formula (22) described in the paragraph above, the pendant phenyl ring of D1 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOC₂H₅, —NHCOC₃H₇, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, Cl, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —S₀₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, Cl, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl).

[528] In some variations of formula (22) described in the two paragraphs above, the pendant phenyl ring of D2 is unsubstituted. In some variations of formula (22) described in the paragraph above, the pendant phenyl ring of D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOC₂H₅, —NHCOC₃H₇, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, Cl, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —S₀₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, Cl, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl).
In some variations of formula (22) described in the three paragraphs above, the pendant phenyl ring of D3 is unsubstituted. In some variations of formula (22) described in the paragraph above, the pendant phenyl ring of D3 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —NH2, —NHR, —NR2, —OH, —O’, —NHCOC1, —NHCOCH3, —NHCOR, —OCH3, —OR, —C2H5, —R, and —C6H5, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —N02, —NR3+, halo (e.g., F, Br, Cl, I), trihalide (e.g., CF3, CC13, CBr3, Cl3), —CN, —SO2H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

Some cationic dye trimers fall within formula (23):

![Diagram](23)

In which each of D1, D2, and D3 is a cationic dye moiety and n and nb independently are 1-6.

In some variations of formula (23), D1, D2, and D3 are different cationic dye moieties. In some variations of formula (23), D1, D2, and D3 are the same cationic dye moiety. In other variations of formula (23), D1 and D2 are the same cationic dye moiety and D3 is a different cationic dye moiety. In other variations of formula (23), D1 and D3 are the same cationic dye moiety and D2 is a different cationic dye moiety. In other variations of formula (23), D2 and D3 are the same cationic dye moiety and D1 is a different cationic dye moiety. In some variations of formula (23), each of D1, D2, and D3 independently is selected from the group consisting of
safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

[532] In some variations of formula (23) described above, \( n \) is 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 12-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 1, 2, 3, 4, 5, or 6.

[533] In some variations of formula (23) described above, \( nb \) is 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 12-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 1, 2, 3, 4, 5, or 6.

[534] In some variations of formula (23) described in the paragraphs above, \( \textbf{D}1 \) is safranin-O. In some variations of formula (23) described in the paragraphs above, \( \textbf{D}2 \) is safranin-O. In some variations of formula (23) described in the paragraphs above, \( \textbf{D}3 \) is safranin-O. In some variations of formula (23) described in the paragraphs above, \( \textbf{D}1 \) and \( \textbf{D}2 \) are safranin-O. In some variations of formula (23) described in the paragraphs above, \( \textbf{D}1 \) and \( \textbf{D}3 \) are safranin-O. In some variations of formula (23) described in the paragraphs above, \( \textbf{D}2 \) and \( \textbf{D}3 \) are safranin-O.

[535] In some variations of formula (23) described in the paragraph above, the pendant phenyl ring of \( \textbf{D}1 \) is unsubstituted. In some variations of formula (23) described in the paragraph above, the pendant phenyl ring of \( \textbf{D}1 \) is substituted with 1-3 \( \text{e.g.,} \) 1-3, 1-2, 1.2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of \( \textbf{D}1 \) is substituted, the substituents are selected independently from \(-\text{NH}_2\), \(-\text{NHR}\), \(-\text{NR}_2\), \(-\text{OH}\), \(-\text{O}^\cdot\), \(-\text{NHCOCH}_3\), \(-\text{NHCOR}\), \(-\text{OCH}_3\), \(-\text{OR}\), \(-\text{C}_2\text{H}_5\), \(-\text{R}\), and \(-\text{C}_6\text{H}_5\), wherein \( \text{R} \) is C1-C6 linear or branched alkyl \( \text{e.g.,} \) C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of \( \textbf{D}1 \) is substituted, the substituents are selected independently from \(-\text{NO}_2\), \(-\text{NR}_3^+\), halo \( \text{e.g.,} \) F, Br, Cl, I), trihalide \( \text{e.g.,} \) \(-\text{CF}_2\), \(-\text{CCl}_3\), \(-\text{CB}_3\), \(-\text{Cl}_3\), \(-\text{CN}\), \(-\text{S}_0 \text{H}-\text{COOH}\), \(-\text{COOR}\), \(-\text{CHO}\), and \(-\text{COR}\), wherein \( \text{R} \) is C1-C6 linear or branched alkyl \( \text{e.g.,} \) C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[536] In some variations of formula (23) described in the two paragraphs above, the pendant phenyl ring of \( \textbf{D}2 \) is unsubstituted. In some variations of formula (23) described in the paragraph above, the pendant phenyl ring of \( \textbf{D}2 \) is substituted with 1-3 \( \text{e.g.,} \) 1-3, 1-2, 1.2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of \( \textbf{D}2 \) is substituted, the
substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O⁻,
—NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6
linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-
C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or
branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the
substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide
(e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₂H, —COOH, —COOR, —CHO, and
—COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-
C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-
C6, C5, or C6 linear or branched alkyl).

[537] In some variations of formula (23) described in the three paragraphs above, the pendant
phenyl ring of D3 is unsubstituted. In some variations of formula (23) described in the paragraph
above, the pendant phenyl ring of D3 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-
donating or electron-withdrawing groups, which may be at any available position on the pendant
phenyl ring. In some embodiments in which the pendant phenyl ring of D3 is substituted, the
substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O⁻,
—NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6
linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-
C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or
branched alkyl). In some embodiments in which the pendant phenyl ring of D3 is substituted, the
substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide
(e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₂H, —COOH, —COOR, —CHO, and
—COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-
C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-
C6, C5, or C6 linear or branched alkyl).
Some cationic dye multimers fall within formula (24):

\[
\begin{array}{c}
\text{D1} \\
\text{R}_{a1} \\
\text{R}_{a2} \\
\text{D2} \\
\text{R}_{b1} \\
\text{R}_{b2} \\
\text{A} \\
\end{array}
\]

\[m\]

, in which \(m\) is 2; each of D1, a first D2, and a second D2 is a cationic dye moiety; \(I\) and \(l_2\) independently are 1-4; ring A is aryl, heteroaryl, cycloalkyl, or heterocyclyl; for each independent instance of \(R_{a1}\) and \(R_{b1}\), \(R_{a2}\) and \(R_{b2}\) (1)

independently are H or CH₃, or (2) \(R_{a1}\) and \(R_{b1}\) are \(\text{OCH₃}\) or \(\text{NH}_{2}\), or (3) two of \(R_{a1}\) or \(R_{b1}\) are \(\text{CH₃}\); and, for each independent instance of \(R_{a2}\) and \(R_{b2}\), \(R_{a2}\) and \(R_{b2}\) (1) independently are H or CH₃, or (2) \(R_{a2}\) and \(R_{b2}\) are \(\text{OCH₃}\) or \(\text{NH}_{2}\), or (3) two of \(R_{a2}\) or \(R_{b2}\) are \(\text{CH₃}\).

In some variations of formula (24), D1, the first D2, and the second D2 are different cationic dye moieties. In some variations of formula (24), D1, the first D2, and the second D2 are the same cationic dye moiety. In other variations of formula (24), D1 and the first D2 are the same cationic dye moiety and the second D2 is a different cationic dye moiety. In other variations of formula (24), D1 and the second D2 are the same cationic dye moiety and the first D2 is a different cationic dye moiety. In other variations of formula (24), the first D2 and the second D2 are the same cationic dye moiety and D1 is a different cationic dye moiety. In some variations of formula (24), each of D1, the first D2, and the second D2 independently is selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

In some variations of formula (24), \(I\) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (24) described in the paragraphs above, \(\frac{1}{4}\) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (24) described in the paragraphs above in which \(I\) is 1, \(R_{a1}\) and \(R_{b1}\) are both H. In some variations of formula (24) described in the paragraphs above in which \(I\) is 1, \(R_{a1}\) is H and \(R_{b1}\) is CH₃. In some variations of formula (24) described in the
paragraphs above in which \( /_f \) is 1, \( R_a^i \) and \( R_b^i \) are both \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( /_f \) is 1, \( R_a^i \) and \( R_b^i \) are \( \frac{3}{2}/4 \). In some variations of formula (24) described in the paragraphs above in which \( /_f \) is 1, \( R_a^i \) and \( R_b^i \) are \( \frac{3}{2}/4 \).

[543] In variations of formula (24) described in the paragraphs above in which \( /_f \) is 2, the two instances of \( R_a \) and \( R_b \) are indicated as \( R_a^i \) and \( R_b^i \) and \( R_a^2 \) and \( R_b^2 \), respectively. In some variations of formula (24) described in the paragraphs above in which \( /_f \) is 2, each of \( R_a^i \) and \( R_b^i \) and \( R_a^2 \) and \( R_b^2 \) is \( \text{H} \). In some variations of formula (24) described in the paragraphs above in which \( /_f \) is 2, each of \( R_a^i \) and \( R_b^i \) and \( R_a^2 \) and \( R_b^2 \) is \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( /_f \) is 2, each of \( R_a^i \) and \( R_a^2 \) is \( \text{H} \) and each of \( R_b^i \) and \( R_b^2 \) is \( \text{CH}_3 \).

[544] In some variations of formula (24) described in the paragraphs above in which \( /_f \) is 2, each of \( R_a^i \) and \( R_b^i \) is \( \text{H} \) and \( R_a^2 \) and \( R_b^2 \) are \( \frac{3}{2}/4 \). In some variations of formula (24) described in the paragraphs above in which \( /_f \) is 2, each of \( R_a^i \) and \( R_b^i \) is \( \text{H} \) and \( R_a^2 \) and \( R_b^2 \) are \( \frac{3}{2}/4 \). In some variations of formula (24) described in the paragraphs above in which \( /_f \) is 2, each of \( R_a^i \) and \( R_b^i \) is \( \text{CH}_3 \) and \( R_a^2 \) and \( R_b^2 \) are \( \frac{3}{2}/4 \). In some variations of formula (24) described in the paragraphs above in which \( /_f \) is 2, each of \( R_a^i \) and \( R_b^i \) is \( \text{CH}_3 \) and \( R_a^2 \) and \( R_b^2 \) are \( \frac{3}{2}/4 \). In some variations of formula (24) described in the paragraphs above in which \( /_f \) is 2, \( R_a^i \) is \( \text{H} \), \( R_b^i \) is \( \text{CH}_3 \), and \( R_a^2 \) and \( R_b^2 \) are \( \frac{3}{2}/4 \). In some variations of formula (24) described in the paragraphs above in which \( /_f \) is 2, \( R_a^i \) is \( \text{H} \), \( R_b^i \) is \( \text{CH}_3 \), and \( R_a^2 \) and \( R_b^2 \) are \( \frac{3}{2}/4 \). In some variations of formula (24) described in the paragraphs above in which \( /_f \) is 2, \( R_a^i \) and \( R_b^i \) and \( R_a^2 \) and \( R_b^2 \) together are \( \frac{3}{2} \). In some variations of formula (24) described in the paragraphs above in which \( /_f \) is 2, \( R_a^i \) and \( R_b^i \) are \( \frac{3}{2}/4 \). In some variations of formula (24) described in the paragraphs above in which \( /_f \) is 2, \( R_a^i \) and \( R_b^i \) are \( \frac{3}{2}/4 \). In some variations of formula (24) described in the paragraphs above in which \( /_f \) is 2, \( R_a^i \) and \( R_b^i \) are \( \frac{3}{2}/4 \). In some variations of formula (24) described in the paragraphs above in which \( /_f \) is 2, \( R_a^i \) and \( R_b^i \) are \( \frac{3}{2}/4 \).
In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 2, \( R_{al} \) and \( R_{bl} \) are \( O\). In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), and \( R_{b2} \) are \( O\).

[545] In variations of formula (24) described in the paragraphs above in which \( I_I \) is 3, the three instances of \( R_a \) and \( R_b \) are indicated as \( R_{ai} \) and \( R_{bi} \); \( R_{a2} \) and \( R_{b2} \); and \( R_{a3} \) and \( R_{b3} \), respectively. In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 3, In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), \( R_{a3} \), and \( R_{b3} \) is H. In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), \( R_{b2} \), \( R_{a3} \), and \( R_{b3} \) is CH₃. In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), and \( R_{b2} \) is H and each of \( R_{a3} \) and \( R_{b3} \) is CH₃. In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), and \( R_{b2} \) is CH₃ and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), and \( R_{a3} \) is H and each of \( R_{b1} \), \( R_{b2} \), and \( R_{b3} \) is CH₃.

[546] In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), and \( R_{b2} \) is H and \( R_{a3} \) and \( R_{b3} \) are \( O\). In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), and \( R_{b2} \) is CH₃ and \( R_{a3} \) and \( R_{b3} \) are \( O\). In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 3, each of \( R_{ai} \) and \( R_{a2} \) is H and each of \( R_{bi} \) and \( R_{b2} \) is CH₃, and \( R_{a3} \) and \( R_{b3} \) are \( O\). In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 3, each of \( R_{ai} \) and \( R_{a2} \) is H and each of \( R_{bi} \) and \( R_{b2} \) is CH₃, and \( R_{a3} \) and \( R_{b3} \) are \( O\).

[547] In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), and \( R_{b2} \) is H and \( R_{a3} \) and \( R_{b3} \) are \( O\). In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 3, each of \( R_{ai} \), \( R_{bi} \), \( R_{a2} \), and \( R_{b2} \) is CH₃ and \( R_{a3} \).
and \( R_{b3} \) are \( \gamma_5 \). In some variations of formula (24) described in the paragraphs above in which \( l_I \) is 3, \( R_{a1} \) is H and each of \( R_{a2}, R_{b1}, \) and \( R_{b2} \) is \( \text{CH}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \gamma_4 \). In some variations of formula (24) described in the paragraphs above in which \( l_I \) is 3, each of \( R_{a1} \) and \( R_{a2} \) is H and each of \( R_{b1} \) and \( R_{b2} \) is \( \text{CH}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \gamma_4 \).

[548] In some variations of formula (24) described in the paragraphs above in which \( l_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \gamma_4 \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma_5 \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (24) described in the paragraphs above in which \( l_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \gamma_4 \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma_5 \), \( R_{a3} \) is H, and \( R_{b3} \) is \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( l_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \gamma_4 \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma_5 \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (24) described in the paragraphs above in which \( l_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \gamma_4 \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma_5 \), and each of \( R_{a3} \) and \( R_{b3} \) is \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( l_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \gamma_4 \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma_5 \), \( R_{a3} \) is H, and \( R_{b3} \) is \( \text{CH}_3 \).

[549] In some variations of formula (24) described in the paragraphs above in which \( l_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \gamma_4 \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma_5 \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (24) described in the paragraphs above in which \( l_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \gamma_4 \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma_5 \), \( R_{a3} \) is H, and \( R_{b3} \) is \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( l_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \gamma_4 \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma_5 \), \( R_{a3} \) is H, and \( R_{b3} \) is \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( l_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \gamma_4 \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma_5 \), \( R_{a3} \) is H, and \( R_{b3} \) is \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( l_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \gamma_4 \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma_5 \), \( R_{a3} \) is H, and \( R_{b3} \) is \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( l_I \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \gamma_4 \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma_5 \), \( R_{a3} \) is H, and \( R_{b3} \) is \( \text{CH}_3 \).
is 3, \( R_{a1} \) and \( R_{b1} \) are \( \frac{1}{12} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{1}{12} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \frac{1}{12} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{1}{12} \), and each of \( R_{a3} \) and \( R_{b3} \) is CH₃. In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \frac{1}{12} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{1}{12} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \frac{1}{12} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{1}{12} \), and each of \( R_{a3} \) and \( R_{b3} \) is CH₃. In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \frac{1}{12} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{1}{12} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \frac{1}{12} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{1}{12} \), and each of \( R_{a3} \) and \( R_{b3} \) is CH₃. In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \frac{1}{12} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{1}{12} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \frac{1}{12} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{1}{12} \), and each of \( R_{a3} \) and \( R_{b3} \) is CH₃.
\( R_{a3} \) is H, and \( R_{b3} \) is CH₃. In some variations of formula (24) described in the paragraphs above in which \( I_i \) is 3, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \overbrace{\text{H}}^{\text{H}} \), and \( R_{a3} \) and \( R_{b3} \) are \( \overbrace{\text{H}}^{\text{H}} \). In some variations of formula (24) described in the paragraphs above in which \( I_i \) is 3, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \overbrace{\text{H}}^{\text{H}} \), and \( R_{a3} \) and \( R_{b3} \) are \( \overbrace{\text{O}}^{\text{O}} \).

[552] In variations of formula (24) described in the paragraphs above in which \( I_i \) is 4, the three instances of \( R_a \) and \( R_b \) are indicated as \( R_{a1} \) and \( R_{b1} \); \( R_{a2} \) and \( R_{b2} \); \( R_{a3} \) and \( R_{b3} \); and \( R_{a4} \) and \( R_{b4} \), respectively. In some variations of formula (24) described in the paragraphs above in which \( I_i \) is 4, each of \( R_{ai}, R_{bi}, R_{a2}, R_{b2}, R_{a3}, R_{b3}, R_{a4}, \) and \( R_{b4} \) is H. In some variations of formula (24) described in the paragraphs above in which \( I_i \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, \) and \( R_{b2} \) is H and each of \( R_{a3}, R_{b3}, R_{a4}, \) and \( R_{b4} \) is CH₃. In some variations of formula (24) described in the paragraphs above in which \( I_i \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3}, \) and \( R_{b3} \) is CH₃ and each of \( R_{a4} \) and \( R_{b4} \) is H.

[553] In some variations of formula (24) described in the paragraphs above in which \( I_i \) is 4, each of \( R_{a1}, R_{a2}, \) and \( R_{a3} \) is H and each of \( R_{b1}, R_{b2}, \) and \( R_{b3} \) is CH₃. In some variations of formula (24) described in the paragraphs above in which \( I_i \) is 4, \( R_{ai} \) is H, \( R_{bi} \) is CH₃, and each of \( R_{a1}, R_{a2}, R_{a3}, \) and \( R_{a4} \) is H. In some variations of formula (24) described in the paragraphs above in which \( I_i \) is 4, each of \( R_{a1}, R_{a2}, R_{a3}, \) and \( R_{a4} \) is H, each of \( R_{b1} \) and \( R_{b2} \) is CH₃, and each of \( R_{b3} \) and \( R_{b4} \) is H. In some variations of formula (24) described in the paragraphs above in which \( I_i \) is 4, each of \( R_{a1} \) and \( R_{a2} \) is H, each of \( R_{bi} \) and \( R_{b2} \) is CH₃, and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (24) described in the paragraphs above in which \( I_i \) is 4, each of \( R_{a1} \) and \( R_{a2} \) is H, each of \( R_{bi} \) and \( R_{b2} \) is CH₃, and each of \( R_{a3} \) and \( R_{b3} \) is CH₃.

[554] In some variations of formula (24) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are H, \( R_{a3} \) and \( R_{b3} \) are H, and \( R_{a4} \) and \( R_{b4} \) are \( \overbrace{\text{H}}^{\text{H}} \). In some variations of formula (24) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are H, \( R_{a3} \) and \( R_{b3} \) are CH₃, and \( R_{a4} \) and \( R_{b4} \) are \( \overbrace{\text{O}}^{\text{O}} \). In some variations of
formula (24) described in the paragraphs above in which \( I \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_2 \). In some variations of formula (24) described in the paragraphs above in which \( I \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( I \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( I \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( I \) is 4, \( R_{a1} \) is \( \text{H} \), \( R_{b1} \) is \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( I \) is 4, \( R_{a1} \) is \( \text{H} \), \( R_{b1} \) is \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( I \) is 4, \( R_{a1} \) is \( \text{H} \), \( R_{b1} \) is \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( I \) is 4, \( R_{a1} \) is \( \text{H} \), \( R_{b1} \) is \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some
variations of formula (24) described in the paragraphs above in which $I_f$ is 4, $R_a^i$ and $R_b^i$ are H, $R_a^2$ and $R_b^2$ are H, $R_a^3$ and $R_b^3$ are CH$_3$, and $R_a^4$ and $R_b^4$ are H. In some variations of formula (24) described in the paragraphs above in which $I_f$ is 4, $R_a^i$ and $R_b^i$ are H, $R_a^2$ and $R_b^2$ are CH$_3$, $R_a^3$ and $R_b^3$ are CH$_3$, and $R_a^4$ and $R_b^4$ are H. In some variations of formula (24) described in the paragraphs above in which $I_f$ is 4, $R_a^i$ and $R_b^i$ are CH$_3$, $R_a^2$ and $R_b^2$ are CH$_3$, $R_a^3$ and $R_b^3$ are CH$_3$, and $R_a^4$ and $R_b^4$ are H. In some variations of formula (24) described in the paragraphs above in which $I_f$ is 4, $R_a^i$ and $R_b^i$ are H, $R_a^2$ and $R_b^2$ are CH$_3$, $R_a^3$ and $R_b^3$ are CH$_3$, and $R_a^4$ and $R_b^4$ are H. In some variations of formula (24) described in the paragraphs above in which $I_f$ is 4, $R_a^i$ and $R_b^i$ are CH$_3$, $R_a^2$ and $R_b^2$ are CH$_3$, $R_a^3$ and $R_b^3$ are CH$_3$, and $R_a^4$ and $R_b^4$ are H.

[558] In some variations of formula (24) described in the paragraphs above in which $I_f$ is 4, $R_a^i$ and $R_b^i$ are H, $R_a^2$ and $R_b^2$ are H, $R_a^3$ and $R_b^3$ are CH$_3$, and $R_a^4$ and $R_b^4$ are H. In some variations of formula (24) described in the paragraphs above in which $I_f$ is 4, $R_a^i$ and $R_b^i$ are CH$_3$, $R_a^2$ and $R_b^2$ are CH$_3$, $R_a^3$ and $R_b^3$ are CH$_3$, and $R_a^4$ and $R_b^4$ are H. In some variations of formula (24) described in the paragraphs above in which $I_f$ is 4, $R_a^i$ is H, $R_b^i$ is CH$_3$, $R_a^2$ and $R_b^2$ are CH$_3$, $R_a^3$ and $R_b^3$ are CH$_3$, and $R_a^4$ and $R_b^4$ are H. In some variations of formula (24) described in the paragraphs above in which $I_f$ is 4, $R_a^i$ is H, $R_b^i$ is CH$_3$, $R_a^2$ is H, $R_b^2$ is CH$_3$, $R_a^3$ and $R_b^3$ are CH$_3$, and $R_a^4$ and $R_b^4$ are H.

[559] In some variations of formula (24) described in the paragraphs above in which $I_f$ is 4, $R_a^i$ and $R_b^i$ are H, $R_a^2$ and $R_b^2$ are CH$_3$, $R_a^3$ and $R_b^3$ are CH$_3$, and $R_a^4$ and $R_b^4$ are H. In some variations of formula (24) described in the paragraphs above in which $I_f$ is 4, $R_a^i$ and $R_b^i$ are CH$_3$, $R_a^2$ and $R_b^2$ are CH$_3$, $R_a^3$ and $R_b^3$ are CH$_3$, and $R_a^4$ and $R_b^4$ are H. In some variations of formula (24) described in the paragraphs above in which $I_f$ is 4, $R_a^i$ is H, $R_b^i$ is CH$_3$, $R_a^2$ and $R_b^2$ are CH$_3$, $R_a^3$ and $R_b^3$ are CH$_3$, and $R_a^4$ and $R_b^4$ are H.
(24) described in the paragraphs above in which $I_J$ is 4, $R_{a1}$ and $R_{b1}$ are $\frac{3}{4}$, $R_{a2}$ and $R_{b2}$ are $\frac{3}{4}$, $R_{a3}$ and $R_{b3}$ are $\frac{3}{4}$, and $R_{a4}$ and $R_{b4}$ are $\frac{3}{4}$.

[560] In some variations of formula (24) described in the paragraphs above in which $I_J$ is 4, $R_{a1}$ and $R_{b1}$ are $\frac{3}{4}$, $R_{a2}$ and $R_{b2}$ are $\frac{3}{4}$, $R_{a3}$ and $R_{b3}$ are $H$, and $R_{a4}$ and $R_{b4}$ are $\frac{3}{4}$. In some variations of formula (24) described in the paragraphs above in which $I_J$ is 4, $R_{a1}$ and $R_{b1}$ are $\frac{3}{4}$, $R_{a2}$ and $R_{b2}$ are $\frac{3}{4}$, $R_{a3}$ and $R_{b3}$ are $H$, and $R_{a4}$ and $R_{b4}$ are $\frac{3}{4}$. In some variations of formula (24) described in the paragraphs above in which $I_J$ is 4, $R_{a1}$ and $R_{b1}$ are $\frac{3}{4}$, $R_{a2}$ and $R_{b2}$ are $\frac{3}{4}$, $R_{a3}$ and $R_{b3}$ are $H$, and $R_{a4}$ and $R_{b4}$ are $\frac{3}{4}$.

[561] In some variations of formula (24) described in the paragraphs above in which $I_J$ is 4, $R_{a1}$ and $R_{b1}$ are $\frac{3}{4}$, $R_{a2}$ and $R_{b2}$ are $\frac{3}{4}$, $R_{a3}$ and $R_{b3}$ are $H$, and $R_{a4}$ and $R_{b4}$ are $\frac{3}{4}$. In some variations of formula (24) described in the paragraphs above in which $I_J$ is 4, $R_{a1}$ and $R_{b1}$ are $\frac{3}{4}$, $R_{a2}$ and $R_{b2}$ are $\frac{3}{4}$, $R_{a3}$ and $R_{b3}$ are $H$, and $R_{a4}$ and $R_{b4}$ are $\frac{3}{4}$.

[562] In some variations of formula (24) described in the paragraphs above in which $I_J$ is 4, $R_{a1}$ and $R_{b1}$ are $\frac{3}{4}$, $R_{a2}$ and $R_{b2}$ are $\frac{3}{4}$, $R_{a3}$ and $R_{b3}$ are $\frac{3}{4}$, and $R_{a4}$ and $R_{b4}$ are $\frac{3}{4}$.

[563] In some variations of formula (24) described in the paragraphs above in which $I_J$ is 4, $R_{a1}$ and $R_{b1}$ are $\frac{3}{4}$, $R_{a2}$ and $R_{b2}$ are $\frac{3}{4}$, $R_{a3}$ and $R_{b3}$ are $H$, and $R_{a4}$ and $R_{b4}$ are $\frac{3}{4}$. In some
variations of formula (24) described in the paragraphs above in which \( I_I \) is 4, \( R_{a_1} \) and \( R_{b_1} \) are
\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
and \( R_{a_2} \) and \( R_{b_2} \) are
\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 4, \( R_{a_1} \) and \( R_{b_1} \) are
\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
and \( R_{a_2} \) and \( R_{b_2} \) are
\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 4, \( R_{a_1} \) and \( R_{b_1} \) are
\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
and \( R_{a_2} \) and \( R_{b_2} \) are
\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 4, \( R_{a_1} \) and \( R_{b_1} \) are
\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
and \( R_{a_2} \) and \( R_{b_2} \) are
\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 4, \( R_{a_1} \) and \( R_{b_1} \) are
\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
and \( R_{a_2} \) and \( R_{b_2} \) are
\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 4, \( R_{a_1} \) and \( R_{b_1} \) are
\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
and \( R_{a_2} \) and \( R_{b_2} \) are
\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 4, \( R_{a_1} \) and \( R_{b_1} \) are
\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
and \( R_{a_2} \) and \( R_{b_2} \) are
\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 4, \( R_{a_1} \) and \( R_{b_1} \) are
\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
and \( R_{a_2} \) and \( R_{b_2} \) are
\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 4, \( R_{a_1} \) and \( R_{b_1} \) are
\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
and \( R_{a_2} \) and \( R_{b_2} \) are
\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 4, \( R_{a_1} \) and \( R_{b_1} \) are
\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
and \( R_{a_2} \) and \( R_{b_2} \) are
\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
In some variations of formula (24) described in the paragraphs above in which \( I_I \) is 4, \( R_{a_1} \) and \( R_{b_1} \) are
\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
and \( R_{a_2} \) and \( R_{b_2} \) are
\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & \quad \text{H} \\
\end{align*}
\]
are $H$, $R_{a2}$ and $R_{b2}$ are $CH_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{II} \). In some variations of formula (24) described in the paragraphs above in which $I_I$ is 4, $R_{a1}$ and $R_{a2}$ are $H$, $R_{b1}$ and $R_{b2}$ are $CH_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{II} \).

[568] In some variations of formula (24) described in the paragraphs above in which $I_I$ is 4, $R_{a1}$ and $R_{b1}$ are $H$, $R_{a2}$ and $R_{b2}$ are \( \text{II} \), and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{II} \). In some variations of formula (24) described in the paragraphs above in which $I_I$ is 4, $R_{a1}$ and $R_{b1}$ are \( \text{II} \), $R_{a2}$ and $R_{b2}$ are $CH_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{II} \). In some variations of formula (24) described in the paragraphs above in which $I_I$ is 4, $R_{a1}$ is $H$, $R_{b1}$ is $CH_3$, $R_{a2}$ and $R_{b2}$ are \( \text{II} \), and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{II} \).

[569] In some variations of formula (24) described in the paragraphs above in which $I_I$ is 4, $R_{a1}$ and $R_{b1}$ are \( \text{II} \), $R_{a2}$ and $R_{b2}$ are \( \text{II} \), and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{II} \). In some variations of formula (24) described in the paragraphs above in which $I_I$ is 4, $R_{a1}$ is $H$, $R_{b1}$ is $CH_3$, $R_{a2}$ and $R_{b2}$ are \( \text{II} \), and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{II} \).

[570] In some variations of formula (24) described in the paragraphs above in which $I_I$ is 4, $R_{a1}$ and $R_{b1}$ are \( \text{II} \), $R_{a2}$ and $R_{b2}$ are \( \text{II} \), and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{II} \). In some variations of formula (24) described in the paragraphs above in which $I_I$ is 4, $R_{a1}$ and $R_{b1}$ are \( \text{II} \), $R_{a2}$ and $R_{b2}$ are \( \text{II} \), and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{II} \). In some variations of formula (24) described in the paragraphs above in which $I_I$ is 4, $R_{a1}$ and $R_{b1}$ are \( \text{II} \), $R_{a2}$ and $R_{b2}$ are \( \text{II} \), and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{II} \).
In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 4, \( R_a \) and \( R_b \), or together are and \( R_b i \) are both H. In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 1, \( R_a \) is H and \( R_b i \) is CH₃. In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 1, \( R_a \) and \( R_b i \) are both CH₃. In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 1, \( R_a \) and \( R_b i \) are together are and \( R_b i \) are both H. In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 1, \( R_a \) is H and \( R_b i \) is CH₃. In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 1, \( R_a \) and \( R_b i \) are both CH₃. In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 2, each of \( R_a \) and \( R_b i \) and \( R_a 2 \) and \( R_b 2 \) together are and \( R_b i \) are both H. In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 2, each of \( R_a \) and \( R_b i \) and \( R_a 2 \) and \( R_b 2 \) together are and \( R_b i \) are both H. In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 2, each of \( R_a \) and \( R_b i \) and \( R_a 2 \) and \( R_b 2 \) together are and \( R_b i \) is H and \( R_b 2 \) is CH₃. In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 2, each of \( R_a \) and \( R_b i \) and \( R_b i \) is H and \( R_b 2 \) is CH₃. In some variations of formula (24) described in the paragraphs above in which \( I_f \) is 2, each of \( R_a \) and \( R_b i \) and \( R_b i \) is H and \( R_b 2 \) is CH₃.
of \(R_a\) and \(R_b\) is \(CH_3\) and \(R_{a2}\) and \(R_{b2}\) are \(3/4\). In some variations of formula (24) described in the paragraphs above in which \(I_2\) is 2, each of \(R_{a1}\) and \(R_{b1}\) is \(CH_3\) and \(R_{a2}\) and \(R_{b2}\) are \(\frac{3}{4}\). In some variations of formula (24) described in the paragraphs above in which \(I_2\) is 2, \(R_{ai}\) is \(H\), \(R_{bi}\) is \(CH_3\), and \(R_{a2}\) and \(R_{b2}\) are \(\frac{3}{4}\). In some variations of formula (24) described in the paragraphs above in which \(I_2\) is 2, \(R_{ai}\) and \(R_{bi}\) and \(R_{a2}\) and \(R_{b2}\) together are \(\frac{3}{4}\). In some variations of formula (24) described in the paragraphs above in which \(I_2\) is 2, \(R_{a1}\) and \(R_{b1}\) are \(\frac{3}{4}\). \(R_{a2}\) and \(R_{b2}\) are \(\frac{3}{4}\). In some variations of formula (24) described in the paragraphs above in which \(I_2\) is 2, \(R_{ai}\) and \(R_{bi}\) are \(\frac{3}{4}\). \(R_{a2}\) and \(R_{b2}\) are \(\frac{3}{4}\). In some variations of formula (24) described in the paragraphs above in which \(I_2\) is 2, \(R_{a1}\) and \(R_{b1}\) are \(\frac{3}{4}\). \(R_{a2}\) and \(R_{b2}\) are \(\frac{3}{4}\).

[576] In variations of formula (24) described in the paragraphs above in which \(I_2\) is 3, the three instances of \(R_{a}\) and \(R_{b}\) are indicated as \(R_{a1}\) and \(R_{b1}\); \(R_{a2}\) and \(R_{b2}\); and \(R_{a3}\) and \(R_{b3}\), respectively. In some variations of formula (24) described in the paragraphs above in which \(\frac{3}{4}\) is 3, In some variations of formula (24) described in the paragraphs above in which \(I_2\) is 3, each of \(R_{ai}\), \(R_{bi}\), \(R_{a2}\), \(R_{b2}\), \(R_{a3}\), \(R_{b3}\), and \(R_{b3}\) is \(H\). In some variations of formula (24) described in the paragraphs above in which \(I_2\) is 3, each of \(R_{ai}\), \(R_{bi}\), \(R_{a2}\), \(R_{b2}\), \(R_{a3}\), \(R_{b3}\), and \(R_{b3}\) is \(CH_3\). In some variations of formula (24) described in the paragraphs above in which \(\frac{3}{4}\) is 3, each of \(R_{ai}\), \(R_{bi}\), \(R_{a2}\), and \(R_{b2}\) is \(H\) and each of \(R_{a3}\) and \(R_{b3}\) is \(CH_3\). In some variations of formula (24) described in the paragraphs above in which \(I_2\) is 3, each of \(R_{ai}\), \(R_{bi}\), \(R_{a2}\), and \(R_{b2}\) is \(CH_3\) and each of \(R_{a3}\) and \(R_{b3}\) is \(H\). In some variations of formula (24) described in the paragraphs above in which \(I_2\) is 3, each of \(R_{ai}\), \(R_{bi}\), \(R_{a2}\), and \(R_{b2}\) is \(H\) and each of \(R_{a3}\), \(R_{bi}\), \(R_{b2}\), and \(R_{b3}\) is \(CH_3\). In some variations of formula (24) described in the paragraphs above in which \(I_2\) is 3, each of \(R_{ai}\), \(R_{a2}\), and \(R_{a3}\) is \(H\) and each of \(R_{bi}\), \(R_{b2}\), and \(R_{b3}\) is \(CH_3\).
In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{a1}, R_{bi}, R_{a2}, \) and \( R_{b2} \) is H and \( R_{a3} \) and \( R_{b3} \) are \( \text{---} \). In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{a1}, R_{bi}, R_{a2}, \) and \( R_{b2} \) is \( \text{CH}_3 \) and \( R_{a3} \) and \( R_{b3} \) are \( \text{---} \). In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 3, \( R_{a1} \) and \( R_{a2} \) are H and each of \( R_{b1} \) and \( R_{b2} \) is \( \text{CH}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{---} \).

In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{a1}, R_{bi}, R_{a2}, \) and \( R_{b2} \) is H and \( R_{a3} \) and \( R_{b3} \) are \( \text{---} \). In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_{a1}, R_{bi}, R_{a2}, \) and \( R_{b2} \) is \( \text{CH}_3 \) and \( R_{a3} \) and \( R_{b3} \) are \( \text{---} \). In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 3, \( R_{a1} \) and \( R_{a2} \) are H and each of \( R_{b1} \) and \( R_{b2} \) is \( \text{CH}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{---} \).

In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \text{---} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{---} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \text{---} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{---} \), and each of \( R_{a3} \) and \( R_{b3} \) is \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \text{---} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{---} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \text{---} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{---} \), and each of \( R_{a3} \) and \( R_{b3} \) is \( \text{CH}_3 \).
and each of $R_{a3}$ and $R_{b3}$ is $CH_3$. In some variations of formula (24) described in the paragraphs above in which $I_2$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{\textbullet\textcircled{C}H}_3$, $R_{a2}$ and $R_{b2}$ are $\text{\textbullet\textcircled{C}H}_3$, $R_{a3}$ is $H$, and $R_{b3}$ is $CH_3$. 

[580] In some variations of formula (24) described in the paragraphs above in which $I_2$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{\textbullet\textcircled{C}H}_3$, $R_{a2}$ and $R_{b2}$ are $\text{\textbullet\textcircled{C}H}_3$, and each of $R_{a3}$ and $R_{b3}$ is $H$. In some variations of formula (24) described in the paragraphs above in which $I_2$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{\textbullet\textcircled{C}H}_3$, $R_{a2}$ and $R_{b2}$ are $\text{\textbullet\textcircled{C}H}_3$, $R_{a3}$ is $H$, and $R_{b3}$ is $CH_3$. In some variations of formula (24) described in the paragraphs above in which $I_2$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{\textbullet\textcircled{C}H}_3$, $R_{a2}$ and $R_{b2}$ are $\text{\textbullet\textcircled{C}H}_3$, and each of $R_{a3}$ and $R_{b3}$ is $H$. In some variations of formula (24) described in the paragraphs above in which $I_2$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{\textbullet\textcircled{C}H}_3$, $R_{a2}$ and $R_{b2}$ are $\text{\textbullet\textcircled{C}H}_3$, $R_{a3}$ is $H$, and $R_{b3}$ is $CH_3$. 

[581] In some variations of formula (24) described in the paragraphs above in which $\frac{3}{4}$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{\textbullet\textcircled{C}H}_3$, $R_{a2}$ and $R_{b2}$ are $\text{\textbullet\textcircled{C}H}_3$, and each of $R_{a3}$ and $R_{b3}$ is $H$. In some variations of formula (24) described in the paragraphs above in which $I_2$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{\textbullet\textcircled{C}H}_3$, $R_{a2}$ and $R_{b2}$ are $\text{\textbullet\textcircled{C}H}_3$, $R_{a3}$ is $H$, and $R_{b3}$ is $CH_3$. In some variations of formula (24) described in the paragraphs above in which $I_2$ is 3,
$R_{a1}$ and $R_{b1}$ are $\text{O} \text{O}$, $R_{a2}$ and $R_{b2}$ are $\text{O} \text{O}$, and each of $R_{a3}$ and $R_{b3}$ is H. In some variations of formula (24) described in the paragraphs above in which $I_2$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{O} \text{O}$, $R_{a2}$ and $R_{b2}$ are $\text{O} \text{O}$, and each of $R_{a3}$ and $R_{b3}$ is CH$_3$. In some variations of formula (24) described in the paragraphs above in which $I_2$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{O} \text{O}$, $R_{a2}$ and $R_{b2}$ are $\text{O} \text{O}$, $R_{a3}$ is H, and $R_{b3}$ is CH$_3$.

[582] In some variations of formula (24) described in the paragraphs above in which $I_2$ is 3, $R_{a1}$ and $R_{b1}$ and $R_{a2}$ and $R_{b2}$ together are $\text{O} \text{O}$, and each of $R_{a3}$ and $R_{b3}$ is H. In some variations of formula (24) described in the paragraphs above in which $I_2$ is 3, $R_{a1}$ and $R_{b1}$ and $R_{a2}$ and $R_{b2}$ together are $\text{O} \text{O}$, each of $R_{a3}$ and $R_{b3}$ is CH$_3$. In some variations of formula (24) described in the paragraphs above in which $I_2$ is 3, $R_{a1}$ and $R_{b1}$ and $R_{a2}$ and $R_{b2}$ together are $\text{O} \text{O}$, $R_{a3}$ is H, and $R_{b3}$ is CH$_3$. In some variations of formula (24) described in the paragraphs above in which $I_2$ is 3, $R_{a1}$ and $R_{b1}$ and $R_{a2}$ and $R_{b2}$ together are $\text{O} \text{O}$, and $R_{a3}$ and $R_{b3}$ are $\text{O} \text{O}$.

[583] In variations of formula (24) described in the paragraphs above in which $I_2$ is 4, the three instances of $R_a$ and $R_b$ are indicated as $R_{a1}$ and $R_{b1}$; $R_{a2}$ and $R_{b2}$; $R_{a3}$ and $R_{b3}$; and $R_{a4}$ and $R_{b4}$, respectively. In some variations of formula (24) described in the paragraphs above in which $I_2$ is 4, in some variations of formula (24) described in the paragraphs above in which $I_2$ is 4, each of $R_{a1}$, $R_{b1}$, $R_{a2}$, $R_{b2}$, $R_{a3}$, $R_{b3}$, $R_{a4}$, and $R_{b4}$ is H. In some variations of formula (24) described in the paragraphs above in which $I_2$ is 4, each of $R_{a1}$, $R_{b1}$, $R_{a2}$, $R_{b2}$, $R_{a3}$, $R_{b3}$, $R_{a4}$, and $R_{b4}$ is CH$_3$. In some variations of formula (24) described in the paragraphs above in which $I_2$ is 4, each of $R_{a1}$, $R_{b1}$, $R_{a2}$, $R_{b2}$, $R_{a3}$, $R_{b3}$, $R_{a4}$, and $R_{b4}$ is CH$_3$. In some variations of formula (24) described in the paragraphs above in which $I_2$ is 4, each of $R_{a1}$, $R_{b1}$, $R_{a2}$, $R_{b2}$, $R_{a3}$, $R_{b3}$, and $R_{b4}$ is CH$_3$ and each of $R_{a4}$ and $R_{b4}$ is H.
In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 4, each of \( R_{a_1}, R_{a_2}, \) and \( R_{a_3} \) is \( \text{H} \) and each of \( R_{b_1}, R_{b_2}, \) and \( R_{b_3} \) is \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 4, \( R_{a_1} \) is \( \text{H}, R_{a_2} \) is \( \text{CH}_3 \), and each of \( R_{a_3}, R_{b_1}, R_{b_2}, R_{b_3} \) is \( \text{H} \). In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 4, each of \( R_{a_1} \) and \( R_{a_2} \) is \( \text{H} \), each of \( R_{b_1} \) and \( R_{b_2} \) is \( \text{CH}_3 \), and each of \( R_{a_3} \) and \( R_{b_3} \) is \( \text{CH}_3 \).

In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 4, \( R_{a_1} \) and \( R_{b_1} \) are \( \text{H}, R_{a_2} \) and \( R_{b_2} \) are \( \text{H}, R_{a_3} \) and \( R_{b_3} \) are \( \text{H}, R_{a_4} \) and \( R_{b_4} \) are \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 4, \( R_{a_1} \) and \( R_{b_1} \) are \( \text{H}, R_{a_2} \) and \( R_{b_2} \) are \( \text{H}, R_{a_3} \) and \( R_{b_3} \) are \( \text{CH}_3 \), and \( R_{a_4} \) and \( R_{b_4} \) are \( \text{CH}_3 \). In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 4, \( R_{a_1} \) and \( R_{b_1} \) are \( \text{H}, R_{a_2} \) and \( R_{b_2} \) are \( \text{CH}_3 \), and \( R_{a_3} \) and \( R_{b_3} \) are \( \text{CH}_3 \), and \( R_{a_4} \) and \( R_{b_4} \) are \( \text{CH}_3 \).
[587] In some variations of formula (24) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (24) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (24) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \frac{3}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \).

[588] In some variations of formula (24) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are H, \( R_{a3} \) and \( R_{b3} \) are H, and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (24) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (24) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are CH₃, \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \).

[589] In some variations of formula (24) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are H, \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (24) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (24) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) is H, \( R_{b1} \) is \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \).
CH₃, Rₐ3 and Rₜ₃ are \( O \), and Rₐ₄ and Rₜ₄ are \( O \). In some variations of formula (24) described in the paragraphs above in which \( l₂ \) is 4, Rₐ₁ is H, Rₜ₁ is CH₃, Rₐ₂ is H, Rₜ₂ is CH₃, Rₐ₃ and Rₜ₃ are \( O \), and Rₐ₄ and Rₜ₄ are \( O \). In some variations of formula (24) described in the paragraphs above in which \( l₂ \) is 4, Rₐ₁ and Rₜ₁ are CH₃, Rₐ₂ and Rₜ₂ are \( O \), Rₐ₃ and Rₜ₃ are \( O \), and Rₐ₄ and Rₜ₄ are \( O \). In some variations of formula (24) described in the paragraphs above in which \( l₂ \) is 4, Rₐ₁ and Rₜ₁ are \( O \), Rₐ₂ and Rₜ₂ are CH₃, Rₐ₃ and Rₜ₃ are \( O \), and Rₐ₄ and Rₜ₄ are \( O \). In some variations of formula (24) described in the paragraphs above in which \( l₂ \) is 4, Rₐ₁ and Rₜ₁ are \( O \), Rₐ₂ and Rₜ₂ are \( O \), Rₐ₃ and Rₜ₃ are \( O \), and Rₐ₄ and Rₜ₄ are \( O \).
In some variations of formula (24) described in the paragraphs above in which \( l_2 \) is 4, \( R_{i} \) and \( R_{j} \) are
\[ \begin{align*}
R_{a2} & = \text{some}, \\
R_{b2} & = \text{some},
\end{align*} \]
and \( R_{b1} \) are
\[ \begin{align*}
R_{a2} & = \text{some}, \\
R_{b2} & = \text{some},
\end{align*} \]
In some variations of formula (24) described in the paragraphs above in which \( l_2 \) is 4, \( R_{i} \) and \( R_{j} \) are
\[ \begin{align*}
R_{a2} & = \text{some}, \\
R_{b2} & = \text{some},
\end{align*} \]
In some variations of formula (24) described in the paragraphs above in which \( l_2 \) is 4, \( R_{i} \) and \( R_{j} \) are
\[ \begin{align*}
R_{a2} & = \text{some}, \\
R_{b2} & = \text{some},
\end{align*} \]
of formula (24) described in the paragraphs above in which $l_2$ is 4, $R_{a1}$ and $R_{b1}$ are \( \text{O} \cdot \), $R_{a2}$ and $R_b$ are \( \text{H} \cdot \), $R_{a3}$ and $R_{b3}$ are CH$_3$, and $R_{a4}$ and $R_{b4}$ are \( \text{O} \cdot \). In some variations of formula (24) described in the paragraphs above in which $l_2$ is 4, $R_{a1}$ and $R_{b1}$ are \( \text{O} \cdot \), $R_{a2}$ and $R_b$ are \( \text{H} \cdot \), $R_{a3}$ and $R_{b3}$ are H, and $R_{a4}$ and $R_{b4}$ are \( \text{O} \cdot \). [597] In some variations of formula (24) described in the paragraphs above in which $l_2$ is 4, $R_{a1}$ and $R_{b1}$ are H, $R_{a2}$ and $R_{b2}$ are H, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{O} \cdot \). In some variations of formula (24) described in the paragraphs above in which $l_2$ is 4, $R_{a1}$ and $R_{b1}$ are H, $R_{a2}$ and $R_{b2}$ are CH$_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{O} \cdot \). In some variations of formula (24) described in the paragraphs above in which $l_2$ is 4, $R_{a1}$ and $R_{a2}$ are H, $R_{b1}$ and $R_{b2}$ are CH$_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{O} \cdot \). [599] In some variations of formula (24) described in the paragraphs above in which $l_2$ is 4, $R_{a1}$ and $R_{b1}$ are H, $R_{a2}$ and $R_{b2}$ are \( \text{O} \cdot \), and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{O} \cdot \). In some variations of formula (24) described in the paragraphs above in which $l_2$ is 4, $R_{a1}$ and $R_{b1}$ are \( \text{O} \cdot \), $R_{a2}$ and $R_{b2}$ are CH$_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{O} \cdot \). In some variations of formula (24) described in the paragraphs above in which $l_2$ is 4, $R_{a1}$ is H, $R_{b1}$ is CH$_3$, $R_{a2}$ and $R_{b2}$ are \( \text{O} \cdot \), and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{O} \cdot \). [600] In some variations of formula (24) described in the paragraphs above in which $l_2$ is 4, $R_{a1}$ and $R_{b1}$ are H, $R_{a2}$ and $R_{b2}$ are \( \text{O} \cdot \), and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{O} \cdot \). In some variations of formula (24) described in the paragraphs above in which $l_2$ is 4, $R_{a1}$ and $R_{b1}$ are \( \text{O} \cdot \), $R_{a2}$ and $R_{b2}$ are CH$_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are \( \text{O} \cdot \). In some
variations of formula (24) described in the paragraphs above in which \( I_2 \) is 4, \( R_{a1} \) is H, \( R_{b1} \) is CH\(_3\), \( R_{a2} \) and \( R_{b2} \) are

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\end{align*}
\]

and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are

\[
\begin{align*}
\text{N} & \quad \text{N} \\
\end{align*}
\]

[601] In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\end{align*}
\]

\( R_{a2} \) and \( R_{b2} \) are

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\end{align*}
\]

and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are

\[
\begin{align*}
\text{N} & \quad \text{N} \\
\end{align*}
\]

In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\end{align*}
\]

\( R_{a2} \) and \( R_{b2} \) are

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\end{align*}
\]

and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are

\[
\begin{align*}
\text{N} & \quad \text{N} \\
\end{align*}
\]

[602] In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\end{align*}
\]

\( R_{a2} \) and \( R_{b2} \) are

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\end{align*}
\]

and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are

\[
\begin{align*}
\text{N} & \quad \text{N} \\
\end{align*}
\]

[603] In some variations of formula (24) described in the paragraphs above in which \( I_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) together are

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\end{align*}
\]

and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are

\[
\begin{align*}
\text{N} & \quad \text{N} \\
\end{align*}
\]

[604] In some variations of formula (24) described in the paragraphs above, ring A is

\[
\begin{align*}
\text{N} & \quad \text{N} \\
\end{align*}
\]

(a)

\[
\begin{align*}
\text{N} & \quad \text{N} \\
\end{align*}
\]

or

(b)

\[
\begin{align*}
\text{N} & \quad \text{N} \\
\end{align*}
\]

optionally substituted with halo or C1-C6 linear or branched alkyl;
optionally substituted with halo or C1-C6 linear or branched alkyl.

[605] In some variations of formula (24) described in the paragraphs above, ring A is substituted with halo. In some variations, the halo is F, Br, I, or Cl.

[606] In some variations of formula (24) described in the paragraphs above, ring A is substituted with C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[607] In some variations of formula (24) described in the paragraphs above, D1 is safranin-O. In some variations of formula (24) described in the paragraphs above, the first D2 is safranin-O. In some variations of formula (24) described in the paragraphs above, the second D2 is safranin-O. In some variations of formula (24) described in the paragraphs above, D1 and the first D2 are safranin-O. In some variations of formula (24) described in the paragraphs above, D1 and the second D2 are safranin-O. In some variations of formula (24) described in the paragraphs above, the first D2 and the second D2 are safranin-O.

[608] In some variations of formula (24) described in the paragraph above, the pendant phenyl ring of D1 is unsubstituted. In some variations of formula (24) described in the paragraph above, the pendant phenyl ring of D1 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O⁻, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —N0₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, Cl-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).
In some variations of formula (24) described in the two paragraphs above, the pendant phenyl ring of the first D2 is unsubstituted. In some variations of formula (24) described in the paragraph above, the pendant phenyl ring of the first D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of the first D2 is substituted, the substituents are selected independently from —NH2, —NHR, —NR2, —OH, —O’, —NHCOCOCH3, —NHCOR, —OCH3, —OR, —C2H5, —R, and —C6H5, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of the first D2 is substituted, the substituents are selected independently from —NO2, —NR3+, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF3, —CCl3, —CBr3, —Cl3), —CN, —SO2H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some variations of formula (24) described above, in which each D is a safranin-O moiety, as shown in formula (24a):  

[610] In some variations of formula (24) described in the three paragraphs above, the pendant phenyl ring of the second D2 is unsubstituted. In some variations of formula (24) described in the paragraph above, the pendant phenyl ring of the second D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of the second D2 is substituted, the substituents are selected independently from —NH2, —NHR, —NR2, —OH, —O’, —NHCOCOCH3, —NHCOR, —OCH3, —OR, —C2H5, —R, and —C6H5, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of the second D2 is substituted, the substituents are selected independently from —NO2, —NR3+, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF3, —CCl3, —CBr3, —Cl3), —CN, —SO2H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some variations of formula (24) described above, in which each D is a safranin-O moiety, as shown in formula (24a):
A, Rai, Rbi R₂, and R₃ are as defined in the paragraphs above, Ri, R₂, R₃, R₄, R₅, and R₆ independently are absent or independently are selected from —NH₂, —NHR, —NR₂, —OH, —O', —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₆H₅ —R, —C₆H₅ —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —S0₃H, —COOH, —COOR, —CHO, and —COR), and R is C₁-C₆ linear or branched alkyl (e.g., C₁-C₆, C₁-C₅, C₁-C₄, C₁-C₃, C₁-C₂, C₁, C₂-C₆, C₂-C₅, C₂-C₄, C₂-C₃, C₂, C₃-C₆, C₃-C₅, C₃-C₄, C₃, C₄-C₆, C₄-C₅, C₄, C₅-C₆, C₅, or C₆ linear or branched alkyl).

[612] One of skill in the art can readily visualize and prepare other cationic multimers falling within formula (24) in which other cationic dye moieties are used in place of one or both of the safranin-0 moieties.

[613] Some cationic dye multimers fall within formula (25):

Rai and Rbi(1) independently are H or CH₃, or (2) R₁ and Rbi independently are (3) two of CRaiRbi are ; for each independent instance of Rₐ and Rₐ₁, Rₐ₂, and Rₐ₁, Rₐ₂ (1) independently are H or CH₃, or (2) Rₐ and Rₐ₂ independently are , or (3) two of CRₐRₐ₂ are ; for each independent instance of Rₐ₁ and Rₐ₁, Rₐ₂ and Rₐ₂ (1) independently are H or CH₃, or (2) Rₐ and Rₐ₂ independently are , or (3) two of CRₐRₐ₂ are ; for each independent instance of Rₐ and Rₐ₁, Rₐ₂ and Rₐ₂ (1)
independently are H or CH₃, or (2) Rᵢ and Rᵢ d independently are \(\text{H} \quad \text{or} \quad \text{CH}₃\), or (3) two of CRᵢ Rᵢ d are \(\text{H} \quad \text{or} \quad \text{CH}₃\); and, for each independent instance of Rᵢ c and Rᵢ d, Rᵢ c and Rᵢ d (1)

independently are H or CH₃, or (2) Rᵢ c and Rᵢ d independently are \(\text{H} \quad \text{or} \quad \text{CH}₃\), or (3) two of CRᵢ c Rᵢ d are \(\text{H} \quad \text{or} \quad \text{CH}₃\).

[614] In some variations of formula (25), D₁, the first D₂, and the second D₂ are different cationic dye moieties. In some variations of formula (25), D₁, the first D₂, and the second D₂ are the same cationic dye moiety. In other variations of formula (25), D₁ and the first D₂ are the same cationic dye moiety and the second D₂ is a different cationic dye moiety. In other variations of formula (25), D₁ and the second D₂ are the same cationic dye moiety and the first D₂ is a different cationic dye moiety. In other variations of formula (25), the first D₂ and the second D₂ are the same cationic dye moiety and D₁ is a different cationic dye moiety. In some variations of formula (25), each of D₁, the first D₂, and the second D₂ independently is selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

[615] In some variations of formula (25) described in the paragraphs above, \(I_1\) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[616] In some variations of formula (25) described in the paragraphs above, \(I_2\) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[617] In some previous variations of formula (25) described in the paragraphs above, \(\alpha_1\) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[618] In some previous variations of formula (25) described in the paragraphs above, \(\alpha_2\) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[619] In some variations of formula (25) described in the paragraphs above in which \(I_1\) is 1, Rᵢ a and Rᵢ b are both H. In some variations of formula (25) described in the paragraphs above in which \(I_1\) is 1, Rᵢ a is H and Rᵢ b is CH₃. In some variations of formula (25) described in the paragraphs above in which \(I_1\) is 1, Rᵢ a and Rᵢ b are both CH₃. In some variations of formula (25)
described in the paragraphs above in which / is 1, R_a i and R_b i are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which / is 1, R_a i and R_b i are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which / is 2, the two instances of R_a and R_b are indicated as R_a i and R_b i and R_a 2 and R_b 2, respectively. In some variations of formula (25) described in the paragraphs above in which / is 2, each of R_a i and R_b i and R_a 2 and R_b 2 is H. In some variations of formula (25) described in the paragraphs above in which / is 2, each of R_a i and R_b i and R_a 2 and R_b 2 is CH₃. In some variations of formula (25) described in the paragraphs above in which / is 2, each of R_a i and R_a 2 is H and each of R_b i and R_b 2 is CH₃. In some variations of formula (25) described in the paragraphs above in which / is 2, each of R_a i, R_a 2, and R_b i is H and R_b 2 is CH₃.

[620] In some variations of formula (25) described in the paragraphs above in which / is 2, each of R_a i and R_b i is H and R_a 2 and R_b 2 are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which / is 2, each of R_a i and R_b i is H and R_a 2 and R_b 2 are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which / is 2, each of R_a i and R_b i is CH₃ and R_a 2 and R_b 2 are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which / is 2, each of R_a i and R_b i is CH₃ and R_a 2 and R_b 2 are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which / is 2, R_a i is H, R_b i is CH₃, and R_a 2 and R_b 2 are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which / is 2, R_a i is H, R_b i is CH₃, and R_a 2 and R_b 2 are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which / is 2, R_a i and R_b i and R_a 2 and R_b 2 together are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which / is 2, R_a i and R_b i and R_a 2 and R_b 2 together are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which / is 2, R_a i and R_b i and R_a 2 and R_b 2 together are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which / is 2, R_a i and R_b i and R_a 2 and R_b 2 together are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which / is 2, R_a i and R_b i and R_a 2 and R_b 2 together are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which / is 2, R_a i and R_b i and R_a 2 and R_b 2 together are \( \frac{3}{4} \).
In some variations of formula (25) described in the paragraphs above in which $I_f$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{O}$ and $R_{a2}$ and $R_{b2}$ are $\text{O}$. In some variations of formula (25) described in the paragraphs above in which $I_f$ is 3, each of $R_a$, $R_b$, $R_{a1}$, and $R_{b1}$ is $\text{CH}_3$ and $R_{b3}$ is H. In some variations of formula (25) described in the paragraphs above in which $I_f$ is 3, each of $R_a$, $R_{b1}$, $R_{a2}$, $R_{b2}$, $R_{a3}$, and $R_{b3}$ is CH$_3$. In some variations of formula (25) described in the paragraphs above in which $I_f$ is 3, each of $R_a$, $R_{b1}$, $R_{a2}$, $R_{b2}$, and $R_{b3}$ is CH$_3$. In some variations of formula (25) described in the paragraphs above in which $I_f$ is 3, each of $R_a$, $R_{b1}$, $R_{a2}$, and $R_{b2}$ is H and each of $R_{a3}$ and $R_{b3}$ is $\text{CH}_3$. In some variations of formula (25) described in the paragraphs above in which $I_f$ is 3, each of $R_a$, $R_{b1}$, and $R_{b2}$ is CH$_3$ and each of $R_{a3}$ and $R_{b3}$ is H. In some variations of formula (25) described in the paragraphs above in which $I_f$ is 3, each of $R_a$, $R_{b1}$, and $R_{b2}$ is H and each of $R_{a3}$ and $R_{b3}$ is $\text{CH}_3$. In some variations of formula (25) described in the paragraphs above in which $I_f$ is 3, each of $R_a$, $R_{b1}$, $R_{a2}$, and $R_{b2}$ is H and each of $R_{a3}$ and $R_{b3}$ is $\text{CH}_3$. In some variations of formula (25) described in the paragraphs above in which $I_f$ is 3, each of $R_a$, $R_{b1}$, and $R_{b2}$ is $\text{CH}_3$ and each of $R_{a3}$ and $R_{b3}$ is H. In some variations of formula (25) described in the paragraphs above in which $I_f$ is 3, each of $R_a$, $R_{b1}$, $R_{a2}$, $R_{b2}$, and $R_{b3}$ is CH$_3$. In some variations of formula (25) described in the paragraphs above in which $I_f$ is 3, each of $R_a$, $R_{b1}$, and $R_{b2}$ is H and each of $R_{a3}$ and $R_{b3}$ is $\text{CH}_3$. In some variations of formula (25) described in the paragraphs above in which $I_f$ is 3, each of $R_a$, $R_{b1}$, and $R_{b2}$ is $\text{CH}_3$ and each of $R_{a3}$ and $R_{b3}$ is H. In some variations of formula (25) described in the paragraphs above in which $I_f$ is 3, each of $R_a$, $R_{b1}$, $R_{a2}$, and $R_{b2}$ is H and each of $R_{a3}$ and $R_{b3}$ is $\text{CH}_3$. In some variations of formula (25) described in the paragraphs above in which $I_f$ is 3, each of $R_a$, $R_{b1}$, and $R_{b2}$ is $\text{CH}_3$ and each of $R_{a3}$ and $R_{b3}$ is H.
and \( R_{b3} \) are \( \gamma \). In some variations of formula (25) described in the paragraphs above in which \( I_I \) is 3, \( R_a \) is H and each of \( R_{a2}, R_{b1}, R_{b2} \) is CH\(_3\), and \( R_{a3} \) and \( R_{b3} \) are \( \gamma \). In some variations of formula (25) described in the paragraphs above in which \( I_I \) is 3, each of \( R_a \) and \( R_{a2} \) is H and each of \( R_{b1} \) and \( R_{b2} \) is CH\(_3\), and \( R_{a3} \) and \( R_{b3} \) are \( \gamma \).

[625] In some variations of formula (25) described in the paragraphs above in which \( I_I \) is 3, \( R_a \) and \( R_{b1} \) are \( \gamma \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (25) described in the paragraphs above in which \( I_I \) is 3, \( R_a \) and \( R_{b1} \) are \( \gamma \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma \), \( R_{a3} \) is H, and \( R_{b3} \) is CH\(_3\). In some variations of formula (25) described in the paragraphs above in which \( I_I \) is 3, \( R_a \) and \( R_{b1} \) are \( \gamma \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (25) described in the paragraphs above in which \( I_I \) is 3, \( R_a \) and \( R_{b1} \) are \( \gamma \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma \), \( R_{a3} \) is H, and \( R_{b3} \) is CH\(_3\). In some variations of formula (25) described in the paragraphs above in which \( I_I \) is 3, \( R_a \) and \( R_{b1} \) are \( \gamma \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma \), \( R_{a3} \) is H, and \( R_{b3} \) is CH\(_3\).

[626] In some variations of formula (25) described in the paragraphs above in which \( I_I \) is 3, \( R_a \) and \( R_{b1} \) are \( \gamma \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (25) described in the paragraphs above in which \( I_I \) is 3, \( R_a \) and \( R_{b1} \) are \( \gamma \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma \), \( R_{a3} \) is H, and \( R_{b3} \) is CH\(_3\). In some variations of formula (25) described in the paragraphs above in which \( I_I \) is 3, \( R_a \) and \( R_{b1} \) are \( \gamma \), \( R_{a2} \) and \( R_{b2} \) are \( \gamma \), \( R_{a3} \) is H, and \( R_{b3} \) is CH\(_3\).
is 3, \( R_a^i \) and \( R_b^i \) are \( \gamma \) and \( \gamma \), \( R_a^2 \) and \( R_b^2 \) are \( \gamma \) and \( \gamma \), and each of \( R_a^3 \) and \( R_b^3 \) is H. In some variations of formula (25) described in the paragraphs above in which \( I_i \) is 3, \( R_a^i \) and \( R_b^i \) are \( \gamma \) and \( \gamma \), \( R_a^2 \) and \( R_b^2 \) are \( \gamma \) and \( \gamma \), and each of \( R_a^3 \) and \( R_b^3 \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( I_i \) is 3, \( R_a^i \) and \( R_b^i \) are \( \gamma \) and \( \gamma \), \( R_a^2 \) and \( R_b^2 \) are \( \gamma \) and \( \gamma \), and each of \( R_a^3 \) and \( R_b^3 \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( I_i \) is 3, \( R_a^i \) and \( R_b^i \) are \( \gamma \) and \( \gamma \), \( R_a^2 \) and \( R_b^2 \) are \( \gamma \) and \( \gamma \), and each of \( R_a^3 \) and \( R_b^3 \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( I_i \) is 3, \( R_a^i \) and \( R_b^i \) are \( \gamma \) and \( \gamma \), \( R_a^2 \) and \( R_b^2 \) are \( \gamma \) and \( \gamma \), and each of \( R_a^3 \) and \( R_b^3 \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( I_i \) is 3, \( R_a^i \) and \( R_b^i \) are \( \gamma \) and \( \gamma \), \( R_a^2 \) and \( R_b^2 \) are \( \gamma \) and \( \gamma \), and each of \( R_a^3 \) and \( R_b^3 \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( I_i \) is 3, \( R_a^i \) and \( R_b^i \) are \( \gamma \) and \( \gamma \), \( R_a^2 \) and \( R_b^2 \) are \( \gamma \) and \( \gamma \), and each of \( R_a^3 \) and \( R_b^3 \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( I_i \) is 3, \( R_a^i \) and \( R_b^i \) are \( \gamma \) and \( \gamma \), \( R_a^2 \) and \( R_b^2 \) are \( \gamma \) and \( \gamma \), and each of \( R_a^3 \) and \( R_b^3 \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( I_i \) is 3, \( R_a^i \) and \( R_b^i \) are \( \gamma \) and \( \gamma \), \( R_a^2 \) and \( R_b^2 \) are \( \gamma \) and \( \gamma \), and each of \( R_a^3 \) and \( R_b^3 \) is CH₃.
Rₐ is H, and Rₐ₂ is CH₃. In some variations of formula (25) described in the paragraphs above in which Iᵢ is 3, R₁ and R₂, and Rₐ₂ and Rₐ₃ together are \( \text{CH₃} \), and Rₐ₃ and Rₐ₄ are CH₃. In some variations of formula (25) described in the paragraphs above in which Iᵢ is 3, R₁ and R₂, and Rₐ₂ and Rₐ₃ together are \( \text{CH₃} \), and Rₐ₃ and Rₐ₄ are CH₃.

[629] In variations of formula (25) described in the paragraphs above in which Iᵢ is 4, the three instances of Rₐ and R₂ are indicated as Rₐ₁ and R₂; Rₐ₂ and Rₐ₃; and Rₐ₃ and Rₐ₄, respectively. In some variations of formula (25) described in the paragraphs above in which Iᵢ is 4, Rᵢ, R₂, Rₐ₁, and R₂ are H. In some variations of formula (25) described in the paragraphs above in which Iᵢ is 4, each of Rᵢ, R₂, Rₐ₁, and R₂ are CH₃. In some variations of formula (25) described in the paragraphs above in which Iᵢ is 4, each of Rᵢ, R₂, Rₐ₁, and R₂ are CH₃. In some variations of formula (25) described in the paragraphs above in which Iᵢ is 4, each of Rᵢ, R₂, Rₐ₁, and R₂ are CH₃. In some variations of formula (25) described in the paragraphs above in which Iᵢ is 4, each of Rᵢ, R₂, Rₐ₁, and R₂ are CH₃.

[630] In some variations of formula (25) described in the paragraphs above in which Iᵢ is 4, each of Rᵢ, R₂, and Rₐ are H and each of R₂, Rₐ, and Rₐ are CH₃. In some variations of formula (25) described in the paragraphs above in which Iᵢ is 4, Rᵢ, R₂, and Rₐ are H and each of R₂, Rₐ, and Rₐ are CH₃. In some variations of formula (25) described in the paragraphs above in which Iᵢ is 4, Rᵢ, R₂, and Rₐ are H and each of R₂, Rₐ, and Rₐ are CH₃. In some variations of formula (25) described in the paragraphs above in which Iᵢ is 4, Rᵢ, R₂, and Rₐ are H and each of R₂, Rₐ, and Rₐ are CH₃.

[631] In some variations of formula (25) described in the paragraphs above in which Iᵢ is 4, Rᵢ, R₂, and Rₐ are H and each of R₂, Rₐ, and Rₐ are CH₃. In some variations of formula (25) described in the paragraphs above in which Iᵢ is 4, Rᵢ, R₂, and Rₐ are H and each of R₂, Rₐ, and Rₐ are CH₃. In some variations of formula (25) described in the paragraphs above in which Iᵢ is 4, Rᵢ, R₂, and Rₐ are H and each of R₂, Rₐ, and Rₐ are CH₃. In some variations of formula (25) described in the paragraphs above in which Iᵢ is 4, Rᵢ, R₂, and Rₐ are H and each of R₂, Rₐ, and Rₐ are CH₃.
formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{O} \). In some variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), \( R_{a4} \) and \( R_{b4} \) are \( \text{O} \). In some variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some...
variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a'} \) and \( R_{b'} \) are H,

\( R_a^2 \) and \( R_b^2 \) are H, \( R_{a3} \) and \( R_{b3} \) are CH₃, and \( R_{a4} \) and \( R_{b4} \) are \( \frac{\varphi}{\varphi} \). In some variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a'} \) and \( R_{b'} \) are H, \( R_a^2 \) and \( R_b^2 \) are CH₃, \( R_{a3} \) and \( R_{b3} \) are CH₃, and \( R_{a4} \) and \( R_{b4} \) are \( \frac{\varphi}{\varphi} \). In some variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a'} \) and \( R_{b'} \) are CH₃, \( R_a^2 \) and \( R_b^2 \) are CH₃, \( R_{a3} \) and \( R_{b3} \) are CH₃, and \( R_{a4} \) and \( R_{b4} \) are \( \frac{\varphi}{\varphi} \).

[635] In some variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a'} \) and \( R_{b'} \) are H, \( R_a^2 \) and \( R_b^2 \) are H, \( R_{a3} \) and \( R_{b3} \) are \( \frac{\varphi}{\varphi} \), and \( R_{a4} \) and \( R_{b4} \) are \( \varphi \). In some variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a'} \) and \( R_{b'} \) are H, \( R_a^2 \) and \( R_b^2 \) are CH₃, \( R_{a3} \) and \( R_{b3} \) are \( \frac{\varphi}{\varphi} \), and \( R_{a4} \) and \( R_{b4} \) are \( \varphi \). In some variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a'} \) is H, \( R_{b'} \) is CH₃, \( R_a^2 \) and \( R_b^2 \) are CH₃, \( R_{a3} \) and \( R_{b3} \) are \( \frac{\varphi}{\varphi} \), and \( R_{a4} \) and \( R_{b4} \) are \( \varphi \).

[636] In some variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a'} \) and \( R_{b'} \) are H, \( R_a^2 \) and \( R_b^2 \) are \( \frac{\varphi}{\varphi} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{\varphi}{\varphi} \), and \( R_{a4} \) and \( R_{b4} \) are \( \varphi \). In some variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a'} \) and \( R_{b'} \) are H, \( R_a^2 \) and \( R_b^2 \) are CH₃, \( R_{a3} \) and \( R_{b3} \) are \( \frac{\varphi}{\varphi} \), and \( R_{a4} \) and \( R_{b4} \) are \( \varphi \). In some variations of formula (25) described in the paragraphs above in which \( I_f \) is 4, \( R_{a'} \) is H, \( R_{b'} \) is CH₃, \( R_a^2 \) and \( R_b^2 \) are \( \frac{\varphi}{\varphi} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{\varphi}{\varphi} \), and \( R_{a4} \) and \( R_{b4} \) are \( \varphi \). In some variations of formula...
(25) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{O} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{O} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{O} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{O} \).

[637] In some variations of formula (25) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{O} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{O} \). In some variations of formula (25) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{O} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{O} \). In some variations of formula (25) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{O} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{O} \).

[638] In some variations of formula (25) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{O} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{O} \). In some variations of formula (25) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{O} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{O} \). In some variations of formula (25) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{O} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{O} \).

[639] In some variations of formula (25) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{O} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{O} \).

[640] In some variations of formula (25) described in the paragraphs above in which \( I_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{O} \), \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{O} \).
variations of formula (25) described in the paragraphs above in which $I_I$ is 4, $R_{a_i}$ and $R_{b_i}$ are

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\text{In some variations of formula (25) described in the paragraphs above in which } I_I \text{ is 4, } R_{a_i} \text{ and } R_{b_i} \text{ are } R_{a_2} \text{ and } R_{b_2} \text{ are } R_{a_3} \text{ and } R_{b_3} \text{ are CH}_3, \text{ and } R_{a_4} \text{ and } R_{b_4} \text{ are } \cdot \cdot \cdot.
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[641] In some variations of formula (25) described in the paragraphs above in which $I_I$ is 4, $R_{a_i}$ and $R_{b_i}$ are

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\text{In some variations of formula (25) described in the paragraphs above in which } I_I \text{ is 4, } R_{a_i} \text{ and } R_{b_i} \text{ are } R_{a_2} \text{ and } R_{b_2} \text{ are } R_{a_3} \text{ and } R_{b_3} \text{ are CH}_3, \text{ and } R_{a_4} \text{ and } R_{b_4} \text{ are } \cdot \cdot \cdot.
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[642] In some variations of formula (25) described in the paragraphs above in which $I_I$ is 4, $R_{a_i}$ and $R_{b_i}$ are

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\text{In some variations of formula (25) described in the paragraphs above in which } I_I \text{ is 4, } R_{a_i} \text{ and } R_{b_i} \text{ are } R_{a_2} \text{ and } R_{b_2} \text{ are } R_{a_3} \text{ and } R_{b_3} \text{ are CH}_3, \text{ and } R_{a_4} \text{ and } R_{b_4} \text{ are } \cdot \cdot \cdot.
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[643] In some variations of formula (25) described in the paragraphs above in which $I_I$ is 4, $R_{a_i}$ and $R_{b_i}$ are

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\text{In some variations of formula (25) described in the paragraphs above in which } I_I \text{ is 4, } R_{a_i} \text{ and } R_{b_i} \text{ are } R_{a_2} \text{ and } R_{b_2} \text{ are } R_{a_3} \text{ and } R_{b_3} \text{ are CH}_3, \text{ and } R_{a_4} \text{ and } R_{b_4} \text{ are } \cdot \cdot \cdot.
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[644] In some variations of formula (25) described in the paragraphs above in which $I_I$ is 4, $R_{a_i}$ and $R_{b_i}$ are

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\text{In some variations of formula (25) described in the paragraphs above in which } I_I \text{ is 4, } R_{a_i} \text{ and } R_{b_i} \text{ are } R_{a_2} \text{ and } R_{b_2} \text{ are } R_{a_3} \text{ and } R_{b_3} \text{ are CH}_3, \text{ and } R_{a_4} \text{ and } R_{b_4} \text{ together are } \cdot \cdot \cdot.
\]
are H, R_{a2} and R_{b2} are CH_{3}, and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are . In some variations of formula (25) described in the paragraphs above in which I is 4, R_{a1} and R_{a2} are H, R_{b1} and R_{b2} are CH_{3}, and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are .

[645] In some variations of formula (25) described in the paragraphs above in which I is 4, R_{a1} and R_{b1} are H, R_{a2} and R_{b2} are , and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are . In some variations of formula (25) described in the paragraphs above in which I is 4, R_{a1} and R_{b1} are , R_{a2} and R_{b2} are CH_{3}, and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are . In some variations of formula (25) described in the paragraphs above in which I is 4, R_{a1} and R_{b1} is CH_{3}, R_{a2} and R_{b2} are , and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are .

[646] In some variations of formula (25) described in the paragraphs above in which I is 4, R_{a1} and R_{b1} are , R_{a2} and R_{b2} are , and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are . In some variations of formula (25) described in the paragraphs above in which I is 4, R_{a1} and R_{b1} is CH_{3}, R_{a2} and R_{b2} are , and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are .

[647] In some variations of formula (25) described in the paragraphs above in which I is 4, R_{a1} and R_{b1} are , R_{a2} and R_{b2} are , and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are . In some variations of formula (25) described in the paragraphs above in which I is 4, R_{a1} and R_{b1} are , R_{a2} and R_{b2} are , and R_{a3} and R_{b3} and R_{a4} and R_{b4} together are .
In some variations of formula (25) described in the paragraphs above in which $I_f$ is 4, $R_{a_1}$ and $R_{a_2}$ and $R_{b_2}$ are $\text{C}_n\text{H}_m\text{O}_p\text{R}_q\text{l}_r$, and $R_{a_3}$ and $R_{b_3}$ and $R_{a_4}$ and $R_{b_4}$ together are $\text{C}_n\text{H}_m\text{O}_p\text{R}_q\text{l}_r$.

In some variations of formula (25) described in the paragraphs above in which $I_f$ is 4, $R_{a_1}$ and $R_{b_4}$ are both $\text{H}$. In some variations of formula (25) described in the paragraphs above in which $I_g$ is 1, $R_{a_3}$ is $\text{H}$ and $R_{b_4}$ is $\text{CH}_3$. In some variations of formula (25) described in the paragraphs above in which $I_g$ is 1, $R_{a_3}$ and $R_{b_4}$ are both $\text{CH}_3$. In some variations of formula (25) described in the paragraphs above in which $I_g$ is 1, $R_{a_3}$ and $R_{b_4}$ are $\text{O}\text{C}_n\text{H}_m\text{R}_q\text{l}_r$.

In variations of formula (25) described in the paragraphs above in which $I_g$ is 2, the two instances of $R_{a_3}$ and $R_{b_4}$ are indicated as $R_{a_3}$ and $R_{b_4}$ and $R_{a_2}$ and $R_{b_2}$, respectively. In some variations of formula (25) described in the paragraphs above in which $I_g$ is 2, each of $R_{a_3}$ and $R_{b_4}$ and $R_{a_2}$ and $R_{b_2}$ is $\text{H}$. In some variations of formula (25) described in the paragraphs above in which $I_g$ is 2, each of $R_{a_3}$ and $R_{b_4}$ and $R_{a_2}$ and $R_{b_2}$ is $\text{CH}_3$. In some variations of formula (25) described in the paragraphs above in which $I_g$ is 2, each of $R_{a_3}$, $R_{a_2}$, and $R_{b_4}$ is $\text{H}$ and $R_{b_2}$ is $\text{CH}_3$.

In some variations of formula (25) described in the paragraphs above in which $I_g$ is 2, each of $R_{a_3}$ and $R_{b_4}$ is $\text{H}$ and $R_{a_2}$ and $R_{b_2}$ are $\text{O}\text{C}_n\text{H}_m\text{R}_q\text{l}_r$. In some variations of formula (25) described in the paragraphs above in which $I_g$ is 2, each of $R_{a_3}$ and $R_{b_4}$ is $\text{H}$ and $R_{a_2}$ and $R_{b_2}$ are $\text{O}\text{C}_n\text{H}_m\text{R}_q\text{l}_r$. In some variations of formula (25) described in the paragraphs above in which $I_g$ is 2, each...
of $R_a^i$ and $R_b^i$ is CH$_3$ and $R_a^{a2}$ and $R_b^{a2}$ are \( \text{H} \). In some variations of formula (25) described in
the paragraphs above in which $I_2$ is 2, each of $R_a^{a1}$ and $R_b^{a1}$ is CH$_3$ and $R_a^{a2}$ and $R_b^{a2}$ are

In some variations of formula (25) described in the paragraphs above in which $I_2$ is 2, $R_a^i$ is H, $R_b^i$ is CH$_3$, and $R_a^{a2}$ and $R_b^{a2}$ are \( \text{CH}_3 \). In some variations of formula (25) described in the
paragraphs above in which $I_2$ is 2, $R_a^i$ and $R_b^i$ and $R_a^{a2}$ and $R_b^{a2}$ together are \( \text{CH}_3 \). In some variations of formula (25) described in the
paragraphs above in which $I_2$ is 2, $R_a^i$ and $R_b^i$ are \( \text{CH}_3 \). In some variations of formula (25) described in the
paragraphs above in which $I_2$ is 2, $R_a^i$ and $R_b^i$ are \( \text{CH}_3 \). In some variations of formula (25) described in the
paragraphs above in which $I_2$ is 2, $R_a^{a1}$ and $R_b^{a1}$ are \( \text{H} \) and each $R_a^i$, $R_b^i$, $R_a^{a2}$ and $R_b^{a2}$ are \( \text{CH}_3 \). In some variations of formula (25) described in the
paragraphs above in which $I_2$ is 3, the three instances of $R_a^i$ and $R_b^i$ are indicated as $R_a^i$; $R_a^{a2}$ and $R_b^{a2}$; and $R_a^{a3}$ and $R_b^{a3}$, respectively. In some variations of formula (25) described in the
paragraphs above in which $I_2$ is 3, each of $R_a^i$ and $R_b^i$, $R_a^{a2}$, $R_b^{a2}$, $R_a^{a3}$, and $R_b^{a3}$ is H. In some variations of formula (25) described in the
paragraphs above in which $I_2$ is 3, each of $R_a^i$, $R_b^i$, $R_a^{a2}$, $R_b^{a2}$, $R_a^{a3}$, and $R_b^{a3}$ is CH$_3$. In some variations of formula (25) described in the
paragraphs above in which $I_2$ is 3, each of $R_a^i$, $R_b^i$, $R_a^{a2}$, $R_b^{a2}$, $R_a^{a3}$, and $R_b^{a3}$ is CH$_3$. In some variations of formula (25) described in the
paragraphs above in which $I_2$ is 3, each of $R_a^i$ and $R_a^{a2}$ is H and each of $R_a^{a3}$, $R_b^i$, $R_b^{a2}$, and $R_b^{a3}$ is CH$_3$. In some variations of formula (25) described in the
paragraphs above in which $I_2$ is 3, each of $R_a^i$, $R_a^{a2}$, and $R_a^{a3}$ is H and each of $R_b^i$, $R_b^{a2}$, and $R_b^{a3}$ is CH$_3$. 

[653] In variations of formula (25) described in the paragraphs above in which $I_2$ is 3, the three instances of $R_a^i$ and $R_b^i$ are indicated as $R_a^i$; $R_a^{a2}$ and $R_b^{a2}$; and $R_a^{a3}$ and $R_b^{a3}$, respectively. In some variations of formula (25) described in the paragraphs above in which $I_2$ is 3, each of $R_a^i$, $R_b^i$, $R_a^{a2}$, $R_b^{a2}$, $R_a^{a3}$, and $R_b^{a3}$ is H. In some variations of formula (25) described in the paragraphs above in which $I_2$ is 3, each of $R_a^i$, $R_b^i$, $R_a^{a2}$, $R_b^{a2}$, $R_a^{a3}$, and $R_b^{a3}$ is CH$_3$. In some variations of formula (25) described in the paragraphs above in which $I_2$ is 3, each of $R_a^i$ and $R_a^{a2}$ is H and each of $R_a^{a3}$, $R_b^i$, $R_b^{a2}$, and $R_b^{a3}$ is CH$_3$. In some variations of formula (25) described in the paragraphs above in which $I_2$ is 3, each of $R_a^i$, $R_a^{a2}$, and $R_a^{a3}$ is H and each of $R_b^i$, $R_b^{a2}$, and $R_b^{a3}$ is CH$_3$. 

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In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_a^1, R_a, R_b^2, \) and \( R_b^2, \) is \( H \) and \( R_a^3 \) and \( R_b^3 \) are \( H \). In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_a^1, R_a, R_b^2, \) and \( R_b^2, \) is \( \text{CH}_3 \) and \( R_a^3 \) and \( R_b^3 \) are \( H \). In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, \( R_a^1 \) is \( H \) and each of \( R_a^2, R_b^1, \) and \( R_b^2, \) is \( \text{CH}_3 \), and \( R_a^3 \) and \( R_b^3 \) are \( H \). In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_a^1 \) and \( R_a^2 \) is \( H \) and each of \( R_b^1 \) and \( R_b^2, \) is \( \text{CH}_3 \), and \( R_a^3 \) and \( R_b^3 \) are \( H \).

In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_a^1, R_b^1, R_a^2, \) and \( R_b^2, \) is \( H \) and \( R_a^3 \) and \( R_b^3 \) are \( H \). In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_a^1, R_b^1, R_a^2, \) and \( R_b^2, \) is \( \text{CH}_3 \) and \( R_a^3 \) and \( R_b^3 \) are \( H \). In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, \( R_a^1 \) is \( H \) and each of \( R_a^2, R_b^1, \) and \( R_b^2, \) is \( \text{CH}_3 \), and \( R_a^3 \) and \( R_b^3 \) are \( H \). In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, each of \( R_a^1 \) and \( R_a^2 \) is \( H \) and each of \( R_b^1 \) and \( R_b^2, \) is \( \text{CH}_3 \), and \( R_a^3 \) and \( R_b^3 \) are \( H \).

In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, \( R_a^1 \) and \( R_b^1 \) are \( H \), \( R_a^2 \) and \( R_b^2, \) are \( H \), and each of \( R_a^3 \) and \( R_b^3 \) is \( H \). In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, \( R_a^1 \) and \( R_b^1 \) are \( H \), \( R_a^2 \) and \( R_b^2, \) are \( \text{CH}_3 \), and each of \( R_a^3 \) and \( R_b^3 \) is \( \text{CH}_3 \). In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, \( R_a^1 \) and \( R_b^1 \) are \( H \), \( R_a^2 \) and \( R_b^2, \) are \( \text{CH}_3 \), and each of \( R_a^3 \) and \( R_b^3 \) is \( H \). In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, \( R_a^1 \) and \( R_b^1 \) are
\[ \text{In some variations of formula (25) described in the paragraphs above in which } I_2 \text{ is 3, } R_{a1} \text{ and } R_{b1} \text{ are } \begin{smallmatrix} \text{CH}_3 \end{smallmatrix}, \text{ and each of } R_{a3} \text{ and } R_{b3} \text{ is } \text{CH}_3. \]

[657] In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \begin{smallmatrix} \text{CH}_3 \end{smallmatrix} \), \( R_{a2} \) and \( R_{b2} \) are \( \begin{smallmatrix} \text{CH}_3 \end{smallmatrix} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \begin{smallmatrix} \text{CH}_3 \end{smallmatrix} \), \( R_{a2} \) and \( R_{b2} \) are \( \begin{smallmatrix} \text{CH}_3 \end{smallmatrix} \), and each of \( R_{a3} \) and \( R_{b3} \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \begin{smallmatrix} \text{CH}_3 \end{smallmatrix} \), \( R_{a2} \) and \( R_{b2} \) are \( \begin{smallmatrix} \text{CH}_3 \end{smallmatrix} \), and each of \( R_{a3} \) and \( R_{b3} \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \begin{smallmatrix} \text{CH}_3 \end{smallmatrix} \), \( R_{a2} \) and \( R_{b2} \) are \( \begin{smallmatrix} \text{CH}_3 \end{smallmatrix} \), and each of \( R_{a3} \) and \( R_{b3} \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \begin{smallmatrix} \text{CH}_3 \end{smallmatrix} \), \( R_{a2} \) and \( R_{b2} \) are \( \begin{smallmatrix} \text{CH}_3 \end{smallmatrix} \), and each of \( R_{a3} \) and \( R_{b3} \) is CH₃.

[658] In some variations of formula (25) described in the paragraphs above in which \( \frac{3}{4} \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \begin{smallmatrix} \text{CH}_3 \end{smallmatrix} \), \( R_{a2} \) and \( R_{b2} \) are \( \begin{smallmatrix} \text{CH}_3 \end{smallmatrix} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \begin{smallmatrix} \text{CH}_3 \end{smallmatrix} \), \( R_{a2} \) and \( R_{b2} \) are \( \begin{smallmatrix} \text{CH}_3 \end{smallmatrix} \), and each of \( R_{a3} \) and \( R_{b3} \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3, \( R_{a1} \) and \( R_{b1} \) are \( \begin{smallmatrix} \text{CH}_3 \end{smallmatrix} \), \( R_{a2} \) and \( R_{b2} \) are \( \begin{smallmatrix} \text{CH}_3 \end{smallmatrix} \), and each of \( R_{a3} \) and \( R_{b3} \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( I_2 \) is 3,
$R_a^i$ and $R_b^i$ are \( \text{and} \), $R_a^2$ and $R_b^2$ are \( \text{and} \), and each of $R_a^3$ and $R_b^3$ is H. In some variations of formula (25) described in the paragraphs above which $l_2$ is 3, $R_a^i$ and $R_b^i$ are \( \text{and} \), $R_a^2$ and $R_b^2$ are \( \text{and} \), and each of $R_a^3$ and $R_b^3$ is CH$_3$. In some variations of formula (25) described in the paragraphs above which $l_2$ is 3, $R_a^i$ and $R_b^i$ are \( \text{and} \), $R_a^2$ and $R_b^2$ are \( \text{and} \), $R_a^3$ is H, and $R_b^3$ is CH$_3$.

[659] In some variations of formula (25) described in the paragraphs above which $l_2$ is 3, $R_a^i$ and $R_b^i$ and $R_a^2$ and $R_b^2$ together are \( \text{and} \), and each of $R_a^3$ and $R_b^3$ is H. In some variations of formula (25) described in the paragraphs above which $l_2$ is 3, $R_a^i$ and $R_b^i$ and $R_a^2$ and $R_b^2$ together are \( \text{and} \), and each of $R_a^3$ and $R_b^3$ is CH$_3$. In some variations of formula (25) described in the paragraphs above which $l_2$ is 3, $R_a^i$ and $R_b^i$ and $R_a^2$ and $R_b^2$ together are \( \text{and} \), $R_a^3$ and $R_b^3$ are \( \text{and} \). In some variations of formula (25) described in the paragraphs above which $l_2$ is 3, $R_a^i$ and $R_b^i$ and $R_a^2$ and $R_b^2$ together are \( \text{and} \), and each of $R_a^3$ and $R_b^3$ is CH$_3$.

[660] In variations of formula (25) described in the paragraphs above which $l_2$ is 4, the three instances of $R_a$ and $R_b$ are indicated as $R_a^i$ and $R_b^i$; $R_a^2$ and $R_b^2$; $R_a^3$ and $R_b^3$; and $R_a^4$ and $R_b^4$, respectively. In some variations of formula (25) described in the paragraphs above in which $l_2$ is 4, each of $R_a^i$, $R_b^i$, $R_a^2$, $R_b^2$, $R_a^3$, $R_b^3$, $R_a^4$, and $R_b^4$ is H. In some variations of formula (25) described in the paragraphs above in which $l_2$ is 4, each of $R_a^i$, $R_b^i$, $R_a^2$, $R_b^2$, $R_a^3$, $R_b^3$, $R_a^4$, and $R_b^4$ is CH$_3$. In some variations of formula (25) described in the paragraphs above in which $l_2$ is 4, each of $R_a^i$, $R_b^i$, $R_a^2$, $R_b^2$, $R_a^3$, $R_b^3$, $R_a^4$, and $R_b^4$ is CH$_3$. In some variations of formula (25) described in the paragraphs above in which $l_2$ is 4, each of $R_a^i$, $R_b^i$, $R_a^2$, $R_b^2$, $R_a^3$, and $R_b^3$ is CH$_3$ and each of $R_a^4$ and $R_b^4$ is H.
In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \), each of \( R_{a1}, R_{a2}, \) and \( R_{a3} \) is \( H \) and each of \( R_{b1}, R_{b2}, \) and \( R_{b3} \) is \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4, R_{a1} = H, R_{b1} = CH_3 \), and each of \( R_{a2}, R_{a3}, R_{b3} \) is \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4, R_{a1} = H, R_{b1} = CH_3 \), and each of \( R_{a2}, R_{b2}, R_{a3}, R_{b3} \) is \( H \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4, R_{a1} \) and \( R_{a2} \) is \( H \), each of \( R_{b1} \) and \( R_{b2} \) is \( CH_3 \), and each of \( R_{a3} \) and \( R_{b3} \) is \( H \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4, \) each of \( R_{a1} \) and \( R_{a2} \) is \( H \), each of \( R_{b1} \) and \( R_{b2} \) is \( CH_3 \), and each of \( R_{a3} \) and \( R_{b3} \) is \( CH_3 \).

In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4, R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( H \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( H \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4, R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( H \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4, R_{a1} \) and \( R_{b1} \) are \( CH_3 \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( H \).
In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \frac{3}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \frac{3}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \frac{3}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are H, and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \frac{3}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) is H, \( R_{b1} \) is \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are
In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), \( R_{a4} \) and \( R_{b4} \) are \( H \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), \( R_{a4} \) and \( R_{b4} \) are \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), \( R_{a4} \) and \( R_{b4} \) are \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), \( R_{a4} \) and \( R_{b4} \) are \( CH_3 \). 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are \( \frac{3}{4}, R_a \) and \( \frac{3}{4}, R_b \) are \( \frac{3}{4}, R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \). \( R_a \) and \( R_b \) are \( \frac{3}{4}, R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \). \( R_a \) and \( R_b \) are \( \frac{3}{4}, R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \). \( R_a \) and \( R_b \) are \( \frac{3}{4}, R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \). \( R_a \) and \( R_b \) are \( \frac{3}{4}, R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \). \( R_a \) and \( R_b \) are \( \frac{3}{4}, R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \). \( R_a \) and \( R_b \) are \( \frac{3}{4}, R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \). \( R_a \) and \( R_b \) are \( \frac{3}{4}, R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \). \( R_a \) and \( R_b \) are \( \frac{3}{4}, R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \). \( R_a \) and \( R_b \) are \( \frac{3}{4}, R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \). \( R_a \) and \( R_b \) are \( \frac{3}{4}, R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \). \( R_a \) and \( R_b \) are \( \frac{3}{4}, R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \). \( R_a \) and \( R_b \) are \( \frac{3}{4}, R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \). \( R_a \) and \( R_b \) are \( \frac{3}{4}, R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \). \( R_a \) and \( R_b \) are \( \frac{3}{4}, R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \).
of formula (25) described in the paragraphs above in which \( l_2 = 4 \), \( R_{a1} \) and \( R_{b1} \) are \( \frac{\gamma}{\delta} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{\gamma}{\delta} \), \( R_{a3} \) and \( R_{b3} \) are CH\(_3\), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{\gamma}{\delta} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \), \( R_{a1} \) and \( R_{b1} \) are \( \frac{\gamma}{\delta} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{\gamma}{\delta} \), \( R_{a3} \) and \( R_{b3} \) are H, and \( R_{a4} \) and \( R_{b4} \) are \( \frac{\gamma}{\delta} \).

[674] In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \), \( R_{a1} \) and \( R_{b1} \) are \( \frac{\gamma}{\delta} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{\gamma}{\delta} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{\gamma}{\delta} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{\gamma}{\delta} \).

[675] In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \), \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are H, and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \frac{\gamma}{\delta} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \), \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are CH\(_3\), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \frac{\gamma}{\delta} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \), \( R_{a1} \) are H, \( R_{a2} \) and \( R_{b2} \) are CH\(_3\), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \frac{\gamma}{\delta} \).

[676] In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \), \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \frac{\gamma}{\delta} \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \frac{\gamma}{\delta} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \), \( R_{a1} \) and \( R_{b1} \) are \( \frac{\gamma}{\delta} \), \( R_{a2} \) and \( R_{b2} \) are CH\(_3\), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \frac{\gamma}{\delta} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \), \( R_{a1} \) is H, \( R_{b1} \) is CH\(_3\), \( R_{a2} \) and \( R_{b2} \) are \( \frac{\gamma}{\delta} \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \frac{\gamma}{\delta} \).

[677] In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \), \( R_{a1} \) and \( R_{b1} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \frac{\gamma}{\delta} \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \frac{\gamma}{\delta} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 = 4 \), \( R_{a1} \) and \( R_{b1} \) are \( \frac{\gamma}{\delta} \), \( R_{a2} \) and \( R_{b2} \) are CH\(_3\), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \frac{\gamma}{\delta} \). In some
variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) is H, \( R_{bi} \) is CH\(_3\), \( R_{a2} \) and \( R_{b2} \) are \( \ce{\text{O}} \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \ce{\text{O}} \).

[678] In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{bi} \) are \( \ce{\text{O}} \), \( R_{a2} \) and \( R_{b2} \) are \( \ce{\text{O}} \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \ce{\text{O}} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{bi} \) are \( \ce{\text{O}} \), \( R_{a2} \) and \( R_{b2} \) are \( \ce{\text{O}} \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \ce{\text{O}} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{bi} \) are \( \ce{\text{O}} \), \( R_{a2} \) and \( R_{b2} \) are \( \ce{\text{O}} \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \ce{\text{O}} \).

[679] In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{bi} \) are \( \ce{\text{O}} \), \( R_{a2} \) and \( R_{b2} \) are \( \ce{\text{O}} \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \ce{\text{O}} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{bi} \) are \( \ce{\text{O}} \), \( R_{a2} \) and \( R_{b2} \) are \( \ce{\text{O}} \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \ce{\text{O}} \). In some variations of formula (25) described in the paragraphs above in which \( l_2 \) is 4, \( R_{a1} \) and \( R_{bi} \) are \( \ce{\text{O}} \), \( R_{a2} \) and \( R_{b2} \) are \( \ce{\text{O}} \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \ce{\text{O}} \).

[680] In some variations of formula (25) described in the paragraphs above in which \( \theta \) is 1, \( R_{a1} \) and \( R_{bi} \) are both H. In some variations of formula (25) described in the paragraphs above in which \( \phi \) is 1, \( R_{a1} \) is H and \( R_{bi} \) is CH\(_3\). In some variations of formula (25) described in the paragraphs above in which \( \phi \) is 1, \( R_{a1} \) and \( R_{bi} \) are both CH\(_3\). In some variations of formula (25) described in the paragraphs above in which \( \phi \) is 1, \( R_{a1} \) and \( R_{bi} \) are \( \ce{\text{O}} \). In some variations of formula (25) described in the paragraphs above in which \( \phi \) is 1, \( R_{a1} \) and \( R_{bi} \) are \( \ce{\text{O}} \).

[682] In variations of formula (25) described in the paragraphs above in which \( \phi \) is 2, the two instances of \( R_{a1} \) and \( R_{b1} \) are indicated as \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \), respectively. In some variations of formula (25) described in the paragraphs above in which \( \phi \) is 2, each of \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) is H. In some variations of formula (25) described in the paragraphs above
in which \( o_i \) is 2, each of \( R_{a1} \) and \( R_{b1} \) and \( R_{a2} \) and \( R_{b2} \) is \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 2, each of \( R_{a1} \) and \( R_{b1} \) is \( H \) and each of \( R_{a2} \) and \( R_{b2} \) is \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 2, each of \( R_{a1} \), \( R_{a2} \), and \( R_{b1} \) is \( H \) and \( R_{b2} \) is \( CH_3 \).

[683] In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 2, each of \( R_{a1} \) and \( R_{b1} \) is \( H \) and \( R_{a2} \) and \( R_{b2} \) are \( O \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 2, each of \( R_{a1} \) and \( R_{b1} \) is \( CH_3 \) and \( R_{a2} \) and \( R_{b2} \) are \( O \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 2, each of \( R_{a1} \) and \( R_{b1} \) is \( CH_3 \) and \( R_{a2} \) and \( R_{b2} \) are \( O \).

In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 2, \( R_{a1} \) is \( H \), \( R_{b1} \) is \( CH_3 \), and \( R_{a2} \) and \( R_{b2} \) are \( O \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 2, \( R_{a1} \) is \( H \), \( R_{b1} \) is \( CH_3 \), and \( R_{a2} \) and \( R_{b2} \) are \( O \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 2, \( R_{a1} \) and \( R_{b1} \) are \( O \) and \( R_{a2} \) and \( R_{b2} \) are \( O \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 2, \( R_{a1} \) and \( R_{b1} \) are \( O \) and \( R_{a2} \) and \( R_{b2} \) are \( O \).

[684] In variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, the three instances of \( R_a \) and \( R_b \) are indicated as \( R_{a1} \) and \( R_{b1} \); \( R_{a2} \) and \( R_{b2} \); and \( R_{a3} \) and \( R_{b3} \) respectively. In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3. In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, each of \( R_{a1} \), \( R_{b1} \),
\( R_2, R_3, \) and \( R_3 \) is H. In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, each of \( R_1, R_9, R_2, R_3, R_3, \) and \( R_3 \) is CH\(_3\). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, each of \( R_1, R_9, R_2, R_3, \) and \( R_3 \) is H and each of \( R_3 \) and \( R_3 \) is CH\(_3\). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, each of \( R_1, R_9, R_2, R_3, \) and \( R_3 \) is H and each of \( R_3 \) and \( R_3 \) is CH\(_3\). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, each of \( R_1, R_9, R_2, R_3, \) and \( R_3 \) is H and each of \( R_3 \) and \( R_3 \) is CH\(_3\).

[665] In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, each of \( R_1, R_9, R_2, \) and \( R_3 \) is H and \( R_3 \) and \( R_3 \) are \( \text{ } \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, each of \( R_1, R_9, R_2, \) and \( R_3 \) is CH\(_3\) and \( R_3 \) and \( R_3 \) are \( \text{ } \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, each of \( R_1, R_9, R_2, \) and \( R_3 \) is H and each of \( R_3 \) and \( R_3 \) is CH\(_3\) and \( R_3 \) and \( R_3 \) are \( \text{ } \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, each of \( R_1, R_9, R_2, \) and \( R_3 \) is CH\(_3\) and \( R_3 \) and \( R_3 \) are \( \text{ } \).

[666] In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, each of \( R_1, R_9, R_2, \) and \( R_3 \) is H and \( R_3 \) and \( R_3 \) are \( \text{ } \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, each of \( R_1, R_9, R_2, \) and \( R_3 \) is CH\(_3\) and \( R_3 \) and \( R_3 \) are \( \text{ } \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, each of \( R_1, R_9, R_2, \) and \( R_3 \) is H and each of \( R_3 \) and \( R_3 \) is CH\(_3\) and \( R_3 \) and \( R_3 \) are \( \text{ } \).

\( o_i \) is 3, \( R_1 \) is H and each of \( R_9, R_2, \) and \( R_3 \) is CH\(_3\), and \( R_3 \) and \( R_3 \) are \( \text{ } \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, each of \( R_1, R_9, R_2, \) and \( R_3 \) is H and each of \( R_3 \) and \( R_3 \) is CH\(_3\), and \( R_3 \) and \( R_3 \) are \( \text{ } \).
In some variations of formula (25) described in the paragraphs above in which \( \alpha \iota \) is 3, \( \text{R}_{a} \iota \) and \( \text{R}_{b} \iota \) are \( \text{R}_{a2} \) and \( \text{R}_{b2} \) are \( \text{R}_{a3} \) and \( \text{R}_{b3} \) is H. In some variations of formula (25) described in the paragraphs above in which \( \alpha \iota \) is 3, \( \text{R}_{a} \iota \) and \( \text{R}_{b} \iota \) are \( \text{R}_{a2} \) and \( \text{R}_{b2} \) are \( \text{R}_{a3} \) and \( \text{R}_{b3} \) is H, and \( \text{R}_{a3} \) and \( \text{R}_{b3} \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( \alpha \iota \) is 3, \( \text{R}_{a} \iota \) and \( \text{R}_{b} \iota \) are \( \text{R}_{a2} \) and \( \text{R}_{b2} \) are \( \text{R}_{a3} \) and \( \text{R}_{b3} \) is H, and \( \text{R}_{a3} \) and \( \text{R}_{b3} \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( \alpha \iota \) is 3, \( \text{R}_{a} \iota \) and \( \text{R}_{b} \iota \) are \( \text{R}_{a2} \) and \( \text{R}_{b2} \) are \( \text{R}_{a3} \) and \( \text{R}_{b3} \) is H, and \( \text{R}_{a3} \) and \( \text{R}_{b3} \) is CH₃.

In some variations of formula (25) described in the paragraphs above in which \( \alpha \iota \) is 3, \( \text{R}_{a} \iota \) and \( \text{R}_{b} \iota \) are \( \text{R}_{a2} \) and \( \text{R}_{b2} \) are \( \text{R}_{a3} \) and \( \text{R}_{b3} \) is H. In some variations of formula (25) described in the paragraphs above in which \( \alpha \iota \) is 3, \( \text{R}_{a} \iota \) and \( \text{R}_{b} \iota \) are \( \text{R}_{a2} \) and \( \text{R}_{b2} \) are \( \text{R}_{a3} \) and \( \text{R}_{b3} \) is H, and \( \text{R}_{a3} \) and \( \text{R}_{b3} \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( \alpha \iota \) is 3, \( \text{R}_{a} \iota \) and \( \text{R}_{b} \iota \) are \( \text{R}_{a2} \) and \( \text{R}_{b2} \) are \( \text{R}_{a3} \) and \( \text{R}_{b3} \) is H, and \( \text{R}_{a3} \) and \( \text{R}_{b3} \) is CH₃.
described in the paragraphs above in which \( o_i \) is 3, \( R_a^i \) and \( R_b^i \) are \( \text{structure A} \), \( R_a^3 \) and \( R_b^3 \) are \( \text{structure B} \), \( R_a^3 \) is H, and \( R_b^3 \) is CH₃.

[689] In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \text{structure C} \), \( R_a^2 \) and \( R_b^2 \) are \( \text{structure D} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \text{structure E} \), \( R_a^2 \) and \( R_b^2 \) are \( \text{structure F} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \text{structure G} \), \( R_a^2 \) and \( R_b^2 \) are \( \text{structure H} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \text{structure I} \), \( R_a^2 \) and \( R_b^2 \) are \( \text{structure J} \), \( R_a^3 \) is H, and \( R_b^3 \) is CH₃.

[690] In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, \( R_{ai} \) and \( R_{bi} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \text{structure K} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, \( R_{ai} \) and \( R_{bi} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \text{structure L} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, \( R_{ai} \) and \( R_{bi} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \text{structure M} \), and \( R_{a3} \) is H, and \( R_{b3} \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 3, \( R_{ai} \) and \( R_{bi} \) and \( R_{a2} \) and \( R_{b2} \) together are \( \text{structure N} \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{structure O} \).
In variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, the three instances of \( R_a \) and \( R_b \) are indicated as \( R_{a1} \) and \( R_{b1} \); \( R_{a2} \) and \( R_{b2} \); \( R_{a3} \) and \( R_{b3} \); and \( R_{a4} \) and \( R_{b4} \), respectively. In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, in some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3}, R_{b3}, R_{a4}, \) and \( R_{b4} \) is \( H \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3}, R_{b3}, R_{a4}, \) and \( R_{b4} \) is \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3}, R_{b3}, R_{a4}, \) and \( R_{b4} \) is \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3}, R_{b3}, R_{a4}, \) and \( R_{b4} \) is \( H \).

In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, each of \( R_{a1}, R_{a2}, \) and \( R_{a3} \) is \( H \) and each of \( R_{b1}, R_{b2}, \) and \( R_{b3} \) is \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, R_{b2}, \) and \( R_{b3} \) is \( H \) and each of \( R_{a3}, R_{b3}, R_{a4}, \) and \( R_{b4} \) is \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, R_{b2}, R_{a3}, R_{b3}, \) and \( R_{b4} \) is \( CH_3 \) and each of \( R_{a4} \) and \( R_{b4} \) is \( H \).

In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, each of \( R_{a1}, R_{a2}, \) and \( R_{a3} \) is \( H \) and each of \( R_{b1}, R_{b2}, \) and \( R_{b3} \) is \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, each of \( R_{a1}, R_{b1}, R_{a2}, R_{b2}, \) and \( R_{b3} \) is \( H \) and each of \( R_{a3}, R_{b3}, R_{a4}, \) and \( R_{b4} \) is \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, each of \( R_{a1} \) and \( R_{a2} \) is \( H \), each of \( R_{b1} \) and \( R_{b2} \) is \( CH_3 \), and each of \( R_{a3} \) and \( R_{b3} \) is \( CH_3 \).

In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( H \), \( R_{a3} \) and \( R_{b3} \) are \( H \), and \( R_{a4} \) and \( R_{b4} \) are \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( H \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( CH_3 \).
In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{ai} \) and \( R_{bi} \) are H, \( R_{a2} \) and \( R_{b2} \) are H, \( R_{a3} \) and \( R_{b3} \) are \( \frac{X}{\phi} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{Y}{\phi} \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{ai} \) and \( R_{bi} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{X}{\phi} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{Y}{\phi} \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{ai} \) and \( R_{bi} \) are \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{X}{\phi} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{Y}{\phi} \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{ai} \) is H, \( R_{bi} \) is \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{X}{\phi} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{Y}{\phi} \).

In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{ai} \) and \( R_{bi} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \frac{X}{\phi} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{Y}{\phi} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{Y}{\phi} \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{ai} \) and \( R_{bi} \) are \( \text{CH}_3 \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{X}{\phi} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{Y}{\phi} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{Y}{\phi} \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{ai} \) and \( R_{bi} \) are \( \frac{X}{\phi} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{X}{\phi} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{Y}{\phi} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{Y}{\phi} \).

In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{ai} \) and \( R_{bi} \) are H, \( R_{a2} \) and \( R_{b2} \) are H, \( R_{a3} \) and \( R_{b3} \) are H, \( R_{a4} \) and \( R_{b4} \) are \( \frac{O}{\phi} \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{ai} \) and \( R_{bi} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{O}{\phi} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{O}{\phi} \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{ai} \) and \( R_{bi} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{O}{\phi} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{O}{\phi} \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{ai} \) and \( R_{bi} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{O}{\phi} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{O}{\phi} \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{ai} \) and \( R_{bi} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{O}{\phi} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{O}{\phi} \).
described in the paragraphs above in which \( o_i \) is 4, \( \text{R}_a^i \) and \( \text{R}_b^i \) are CH\(_3\), \( \text{R}_a^2 \) and \( \text{R}_b^2 \) are CH\(_3\), \( \text{R}_a^3 \) and \( \text{R}_b^3 \) are CH\(_3\), and \( \text{R}_a^4 \) and \( \text{R}_b^4 \) are CH\(_3\).

\[ \text{R}_a^3 \text{ and } \text{R}_b^3 \text{ are CH}_3, \text{ and } \text{R}_a^4 \text{ and } \text{R}_b^4 \text{ are } \text{CH}_3. \]

[697] In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( \text{R}_{ai} \) and \( \text{R}_{bi} \) are H, \( \text{R}_a^2 \) and \( \text{R}_b^2 \) are H, \( \text{R}_a^3 \) and \( \text{R}_b^3 \) are CH\(_3\), and \( \text{R}_a^4 \) and \( \text{R}_b^4 \) are CH\(_3\). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( \text{R}_a^2 \) and \( \text{R}_b^2 \) are CH\(_3\), and \( \text{R}_a^3 \) and \( \text{R}_b^3 \) are CH\(_3\), and \( \text{R}_a^4 \) and \( \text{R}_b^4 \) are CH\(_3\). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( \text{R}_a^1 \) is H, \( \text{R}_b^1 \) is CH\(_3\), \( \text{R}_a^2 \) and \( \text{R}_b^2 \) are CH\(_3\), \( \text{R}_a^3 \) and \( \text{R}_b^3 \) are CH\(_3\), and \( \text{R}_a^4 \) and \( \text{R}_b^4 \) are CH\(_3\).

[698] In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( \text{R}_a^1 \) and \( \text{R}_b^1 \) are H, \( \text{R}_a^2 \) and \( \text{R}_b^2 \) are CH\(_3\), \( \text{R}_a^3 \) and \( \text{R}_b^3 \) are CH\(_3\), and \( \text{R}_a^4 \) and \( \text{R}_b^4 \) are CH\(_3\). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( \text{R}_a^1 \) and \( \text{R}_b^1 \) are CH\(_3\), \( \text{R}_a^2 \) and \( \text{R}_b^2 \) are CH\(_3\), \( \text{R}_a^3 \) and \( \text{R}_b^3 \) are CH\(_3\), and \( \text{R}_a^4 \) and \( \text{R}_b^4 \) are CH\(_3\). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( \text{R}_a^1 \) and \( \text{R}_b^1 \) are CH\(_3\), \( \text{R}_a^2 \) and \( \text{R}_b^2 \) are CH\(_3\), \( \text{R}_a^3 \) and \( \text{R}_b^3 \) are CH\(_3\), and \( \text{R}_a^4 \) and \( \text{R}_b^4 \) are CH\(_3\). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( \text{R}_a^1 \) and \( \text{R}_b^1 \) are CH\(_3\), \( \text{R}_a^2 \) and \( \text{R}_b^2 \) are CH\(_3\), \( \text{R}_a^3 \) and \( \text{R}_b^3 \) are CH\(_3\), and \( \text{R}_a^4 \) and \( \text{R}_b^4 \) are CH\(_3\).
In some variations of formula (25) described in the paragraphs above in which \( \alpha_i \) is 4, \( R_{ai} \) and \( R_{bi} \) are \( \text{CH}_3 \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_i \) is 4, \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_i \) is 4, \( R_{ai} \) and \( R_{bi} \) are \( \text{CH}_3 \).
In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), and \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) together are \( \text{H} \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), and \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \text{H} \). In some variations of formula (25) described in the paragraphs above in which \( o_i \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), and \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \text{H} \).
[707] In some variations of formula (25) described in the paragraphs above in which $oi$ is 4, $R_{a1}$ and $R_{b1}$ are $H$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{C}_3$.

In some variations of formula (25) described in the paragraphs above in which $oi$ is 4, $R_{a1}$ and $R_{b1}$ are $H$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{C}_3$. In some variations of formula (25) described in the paragraphs above in which $oi$ is 4, $R_{a1}$ is $H$, $R_{b1}$ is $\text{CH}_3$, $R_{a2}$ and $R_{b2}$ are $\text{C}_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{C}_3$.

[708] In some variations of formula (25) described in the paragraphs above in which $oi$ is 4, $R_{a1}$ and $R_{b1}$ are $H$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{C}_3$. In some variations of formula (25) described in the paragraphs above in which $oi$ is 4, $R_{a1}$ is $H$, $R_{b1}$ is $\text{CH}_3$, $R_{a2}$ and $R_{b2}$ are $\text{C}_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{C}_3$.

[709] In some variations of formula (25) described in the paragraphs above in which $oi$ is 4, $R_{a1}$ and $R_{b1}$ are $H$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{C}_3$. In some variations of formula (25) described in the paragraphs above in which $oi$ is 4, $R_{a1}$ is $H$, $R_{b1}$ is $\text{CH}_3$, $R_{a2}$ and $R_{b2}$ are $\text{C}_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{C}_3$.

[710] In some variations of formula (25) described in the paragraphs above in which $oi$ is 4, $R_{a1}$ and $R_{b1}$ are $H$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{C}_3$. 

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In some variations of formula (25) described in the paragraphs above in which $\theta_i$ is 4, $R_{ai}$ and $R_{bi}$ and $R_{a2}$ and $R_{b2}$ together are $\text{C}_2$, and $R_{a3}$ and $R_{b3}$ and $R_{a4}$ and $R_{b4}$ together are $\text{C}_3$.

In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 1, $R_{ai}$ and $R_{bi}$ are both H. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 1, $R_{a1}$ is H and $R_{b1}$ is CH$_3$. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 1, $R_{a1}$ and $R_{b1}$ are both CH$_3$. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 1, $R_{a1}$ and $R_{b1}$ are $\text{C}_3$. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 1, $R_{a1}$ and $R_{b1}$ are $\text{C}_2$.

In variations of formula (25) described in the paragraphs above in which $\theta_2$ is 2, the two instances of $R_{a}$ and $R_{b}$ are indicated as $R_{a1}$ and $R_{b1}$ and $R_{a2}$ and $R_{b2}$, respectively. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 2, each of $R_{a1}$ and $R_{b1}$ and $R_{a2}$ and $R_{b2}$ is H. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 2, each of $R_{a1}$ and $R_{b1}$ and $R_{a2}$ and $R_{b2}$ is CH$_3$. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 2, each of $R_{a1}$ and $R_{a2}$ is H and each of $R_{b1}$ and $R_{b2}$ is CH$_3$. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 2, each of $R_{a1}$, $R_{a2}$, and $R_{b1}$ is H and $R_{b2}$ is CH$_3$.

In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 2, each of $R_{a1}$ and $R_{b1}$ is H and $R_{a2}$ and $R_{b2}$ are $\text{C}_3$. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 2, each of $R_{a1}$ and $R_{b1}$ is H and $R_{a2}$ and $R_{b2}$ are $\text{C}_2$. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 2, each of $R_{a1}$ and $R_{b1}$ is CH$_3$ and $R_{a2}$ and $R_{b2}$ are $\text{C}_3$. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 2, each of $R_{a1}$ and $R_{b1}$ is CH$_3$ and $R_{a2}$ and $R_{b2}$ are $\text{C}_2$.  

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In some variations of formula (25) described in the paragraphs above in which \( \theta_2 \) is 2, \( R_a \) is H, 
\( R_b \) is \( CH_3 \), and \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 2, \( R_a \) is H, \( R_b \) is \( CH_3 \), and \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, \( R_{a} \) and \( R_{b} \) are \( CH_3 \) and \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \) and \( R_{a3} \) and \( R_{b3} \) are H. In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \). In some variations of formula (25) described in the
paragraphs above in which \( \theta_2 \) is 3, each of \( R_{a1} \) and \( R_{b1} \) are \( CH_3 \).
and $R_{b3}$ are $\text{CH}_3$. In some variations of formula (25) described in the paragraphs above in which $\phi_2$ is 3, $R_{a2}$ is H and each of $R_{a1}$, Rbi, and $R_{b2}$ is CH$_3$, and $R_{a3}$ and $R_{b3}$ are $\text{CH}_3$. In some variations of formula (25) described in the paragraphs above in which $\phi_2$ is 3, each of $R_{a1}$ and $R_{b2}$ is H and each of $R_{b1}$ and $R_{b2}$ is CH$_3$, and $R_{a3}$ and $R_{b3}$ are $\text{CH}_3$.

[717] In some variations of formula (25) described in the paragraphs above in which $\phi_2$ is 3, each of $R_{a1}$, Rbi, $R_{a2}$, and $R_{b2}$ is H and $R_{a3}$ and $R_{b3}$ are $\text{CH}_3$. In some variations of formula (25) described in the paragraphs above in which $\phi_2$ is 3, each of $R_{a1}$, Rbi, $R_{a2}$, and $R_{b2}$ is CH$_3$ and $R_{a3}$ and $R_{b3}$ are $\text{CH}_3$. In some variations of formula (25) described in the paragraphs above in which $\phi_2$ is 3, each of $R_{a1}$ and $R_{b2}$ is H and each of $R_{b1}$ and $R_{b2}$ is CH$_3$, and $R_{a3}$ and $R_{b3}$ are $\text{CH}_3$.

[718] In some variations of formula (25) described in the paragraphs above in which $\phi_2$ is 3, $R_{a1}$ and $R_{b1}$ are $\text{CH}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and each of $R_{a3}$ and $R_{b3}$ is H. In some variations of formula (25) described in the paragraphs above in which $\phi_2$ is 3, each of $R_{a1}$ and $R_{b1}$ are $\text{CH}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and each of $R_{a3}$ and $R_{b3}$ is CH$_3$. In some variations of formula (25) described in the paragraphs above in which $\phi_2$ is 3, $R_{a1}$ and Rbi are $\text{CH}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and each of $R_{a3}$ and $R_{b3}$ is H. In some variations of formula (25) described in the paragraphs above in which $\phi_2$ is 3, each of $R_{a1}$ and $R_{b1}$ are $\text{CH}_3$, $R_{a2}$ and $R_{b2}$ are $\text{CH}_3$, and each of $R_{a3}$ and $R_{b3}$ is CH$_3$. In some variations of formula
(25) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{O}}}}} \), \( R_{a2} \) and \( R_{b2} \) are \( \overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{O}}}}} \), \( R_{a3} \) is H, and \( R_{b3} \) is CH₃.

[719] In some variations of formula (25) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{O}}}}} \), \( R_{a2} \) and \( R_{b2} \) are \( \overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{O}}}}} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (25) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{O}}}}} \), \( R_{a2} \) and \( R_{b2} \) are \( \overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{O}}}}} \), and each of \( R_{a3} \) and \( R_{b3} \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{O}}}}} \), \( R_{a2} \) and \( R_{b2} \) are \( \overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{O}}}}} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (25) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{O}}}}} \), \( R_{a2} \) and \( R_{b2} \) are \( \overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{O}}}}} \), \( R_{a3} \) is H, and \( R_{b3} \) is CH₃.

[720] In some variations of formula (25) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{O}}}}} \), \( R_{a2} \) and \( R_{b2} \) are \( \overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{O}}}}} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some variations of formula (25) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{O}}}}} \), \( R_{a2} \) and \( R_{b2} \) are \( \overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{O}}}}} \), \( R_{a3} \) is H, and \( R_{b3} \) is CH₃. In some variations of formula (25) described in the paragraphs above in which \( \theta_2 \) is 3, \( R_{ai} \) and \( R_{bi} \) are \( \overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{O}}}}} \), \( R_{a2} \) and \( R_{b2} \) are \( \overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{\overset{\cdot}{O}}}}} \), and each of \( R_{a3} \) and \( R_{b3} \) is H. In some
variations of formula (25) described in the paragraphs above in which $\theta_2$ is 3, $R_a$ and $R_b$ are $\frac{0}{0}$, $R_{a1}$ and $R_{b1}$ are $\frac{0}{0}$, and each of $R_{a3}$ and $R_{b3}$ is $\text{CH}_3$. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 3, $R_a$ and $R_b$ are $\frac{0}{0}$, $R_{a1}$ and $R_{b1}$ are $\frac{0}{0}$, and each of $R_{a3}$ and $R_{b3}$ is $\text{CH}_3$.

[721] In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 3, $R_a$ and $R_b$ and $R_{a2}$ and $R_{b2}$ together are $\frac{0}{0}$, and each of $R_{a3}$ and $R_{b3}$ is $\text{H}$. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 3, $R_a$ and $R_b$ and $R_{a2}$ and $R_{b2}$ together are $\frac{0}{0}$, and each of $R_{a3}$ and $R_{b3}$ is $\text{CH}_3$. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 3, $R_a$ and $R_b$, and $R_{a2}$ and $R_{b2}$ together are $\frac{0}{0}$, and $R_{a3}$ and $R_{b3}$ are $\frac{0}{0}$. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 3, $R_a$ and $R_b$ and $R_{a2}$ and $R_{b2}$ together are $\frac{0}{0}$, and $R_{a3}$ and $R_{b3}$ are $\frac{0}{0}$.

[722] In variations of formula (25) described in the paragraphs above in which $\theta_2$ is 4, the three instances of $R_a$ and $R_b$ are indicated as $R_a$, $R_b$, and $R_{a2}$; $R_{a3}$ and $R_{b3}$; and $R_{a4}$ and $R_{b4}$, respectively. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 4, each of $R_a, R_b, R_{a2}, R_{b2}, R_{a3}, R_{b3}, R_{a4}, R_{b4}$ is $\text{H}$. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 4, each of $R_a, R_b, R_{a2}, R_{b2}, R_{a3}, R_{b3}$ and $R_{b4}$ is $\text{CH}_3$. In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 4, each of $R_a, R_b, R_{a2}, R_{b2}, R_{a3}, R_{b3}$ and $R_{b4}$ is $\text{H}$.

[723] In some variations of formula (25) described in the paragraphs above in which $\theta_2$ is 4, each of $R_a, R_{a2}$, and $R_{a3}$ is $\text{H}$ and each of $R_{b1}, R_{b2}$, and $R_{b3}$ is $\text{CH}_3$. In some variations of
formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_a \) is \( H \), \( R_{bi} \) is \( CH_3 \), and each of \( R_{2a}, R_{b2}, R_{a3}, \) and \( R_{b3} \) is \( CH_3 \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{a2} \) is \( H \), \( R_{b1} \) is \( CH_3 \), and each of \( R_{a2}, R_{b2}, R_{a3}, \) and \( R_{b3} \) is \( H \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, each of \( R_{a1} \) and \( R_{a2} \) is \( H \), each of \( R_{b1} \) and \( R_{b2} \) is \( CH_3 \), and each of \( R_{a3} \) and \( R_{b3} \) is \( H \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, each of \( R_{a1} \) and \( R_{a2} \) is \( H \), each of \( R_{b1} \) and \( R_{b2} \) is \( CH_3 \), and each of \( R_{a3} \) and \( R_{b3} \) is \( CH_3 \).

[724] In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( H \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( 0^2 \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( H \), \( R_{a3} \) and \( R_{b3} \) are \( C^34 \), and \( R_{a4} \) and \( R_{b4} \) are \( 0^2 \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( 0^2 \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( 0^2 \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( 0^2 \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( 0^2 \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( H \), \( R_{a2} \) and \( R_{b2} \) are \( CH_3 \), \( R_{a3} \) and \( R_{b3} \) are \( CH_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( 0^2 \).
In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{ai} \) and \( R_{bi} \) are H, \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{ai} \) and \( R_{bi} \) are CH\(_3\), \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{ai} \) and \( R_{bi} \) are \( \frac{3}{4} \), \( R_{a2} \) and \( R_{b2} \) are \( \frac{3}{4} \), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \).

In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{a1} \) is H, \( R_{bi} \) is H, \( R_{a2} \) and \( R_{b2} \) are H, \( R_{a3} \) and \( R_{b3} \) are H, and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{ai} \) and \( R_{bi} \) are H, \( R_{a2} \) and \( R_{b2} \) are H, \( R_{a3} \) and \( R_{b3} \) are CH\(_3\), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{ai} \) and \( R_{bi} \) are H, \( R_{a2} \) and \( R_{b2} \) are CH\(_3\), \( R_{ao} \) and \( R_{b3} \) are CH\(_3\), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{a1} \) is H, \( R_{a2} \) and \( R_{b2} \) are CH\(_3\), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \).

In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{ai} \) and \( R_{bi} \) are H, \( R_{a2} \) and \( R_{b2} \) are H, \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are v. In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{ai} \) and \( R_{bi} \) are H, \( R_{a2} \) and \( R_{b2} \) are CH\(_3\), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{ai} \) and \( R_{bi} \) are CH\(_3\), \( R_{a2} \) and \( R_{b2} \) are CH\(_3\), \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \), and \( R_{a4} \) and \( R_{b4} \) are \( \frac{3}{4} \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_{a1} \) is H, \( R_{b4} \) is CH\(_3\), \( R_{a2} \) and \( R_{b2} \) are CH\(_3\), and \( R_{a3} \) and \( R_{b3} \) are \( \frac{3}{4} \).
CH₃, R₃ and R₄ are H, and R₄ and R₄ are O. In some variations of formula (25) described in the paragraphs above in which α₂ is 4, Rₐi and Rₐi is CH₃, Rₐ2 is H, Rₐ2 is CH₃, Rₐ3 and Rₐ3 are CH₃, and Rₐ4 and Rₐ4 are O.

[729] In some variations of formula (25) described in the paragraphs above in which α₂ is 4, Rₐi and Rₐi are H, Rₐ2 and Rₐ2 are CH₃, Rₐ3 and Rₐ3 are CH₃, and Rₐ4 and Rₐ4 are O. In some variations of formula (25) described in the paragraphs above in which α₂ is 4, Rₐi and Rₐi are CH₃, Rₐ2 and Rₐ2 are CH₃, Rₐ3 and Rₐ3 are CH₃, and Rₐ4 and Rₐ4 are O. In some variations of formula (25) described in the paragraphs above in which α₂ is 4, Rₐi and Rₐi are CH₃, Rₐ2 and Rₐ2 are CH₃, Rₐ3 and Rₐ3 are CH₃, and Rₐ4 and Rₐ4 are O. In some variations of formula (25) described in the paragraphs above in which α₂ is 4, Rₐi and Rₐi are CH₃, Rₐ2 and Rₐ2 are CH₃, Rₐ3 and Rₐ3 are CH₃, and Rₐ4 and Rₐ4 are O.

[730] In some variations of formula (25) described in the paragraphs above in which α₂ is 4, Rₐi and Rₐi are CH₃, Rₐ2 and Rₐ2 are CH₃, Rₐ3 and Rₐ3 are CH₃, and Rₐ4 and Rₐ4 are O. In some variations of formula (25) described in the paragraphs above in which α₂ is 4, Rₐi and Rₐi are CH₃, Rₐ2 and Rₐ2 are CH₃, Rₐ3 and Rₐ3 are CH₃, and Rₐ4 and Rₐ4 are O. In some variations of formula (25) described in the paragraphs above in which α₂ is 4, Rₐi and Rₐi are CH₃, Rₐ2 and Rₐ2 are CH₃, Rₐ3 and Rₐ3 are CH₃, and Rₐ4 and Rₐ4 are O.

[731] In some variations of formula (25) described in the paragraphs above in which α₂ is 4, Rₐi and Rₐi are CH₃, Rₐ2 and Rₐ2 are CH₃, Rₐ3 and Rₐ3 are CH₃, and Rₐ4 and Rₐ4 are O. In some variations of formula (25) described in the paragraphs above in which α₂ is 4, Rₐi and Rₐi are CH₃, Rₐ2 and Rₐ2 are CH₃, Rₐ3 and Rₐ3 are CH₃, and Rₐ4 and Rₐ4 are O.

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are \( R_a \) and \( R_{b1} \) are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{CH}_3 \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_a \) and \( R_{b1} \) are

\[ R_{a2} \text{ and } R_{b2} \text{ are } \text{CH}_3, \text{ and } R_{a3} \text{ and } R_{b3} \text{ are } \text{H}, \text{ and } R_{a4} \text{ and } R_{b4} \text{ are } \text{H}. \]

In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_a \) and \( R_{b1} \) are

\[ R_{a2} \text{ and } R_{b2} \text{ are } \text{CH}_3, \text{ and } R_{a3} \text{ and } R_{b3} \text{ are } \text{H}, \text{ and } R_{a4} \text{ and } R_{b4} \text{ are } \text{H}. \]

In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, \( R_a \) and \( R_{b1} \) are

\[ R_{a2} \text{ and } R_{b2} \text{ are } \text{CH}_3, \text{ and } R_{a3} \text{ and } R_{b3} \text{ are } \text{H}, \text{ and } R_{a4} \text{ and } R_{b4} \text{ are } \text{H}. \]
are \( \text{CH}_3 \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \). In some variations of formula (25) described in the paragraphs above in which \( o_2 \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{CH}_3 \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \).

[736] In some variations of formula (25) described in the paragraphs above in which \( \phi \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{CH}_3 \), and \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), and \( R_{a3} \) and \( R_{b3} \) are \( \text{H} \), and \( R_{a4} \) and \( R_{b4} \) are \( \text{H} \).

[737] In some variations of formula (25) described in the paragraphs above in which \( \phi \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), and \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \text{H} \). In some variations of formula (25) described in the paragraphs above in which \( \phi \) is 4, \( R_{a1} \) and \( R_{a2} \) are \( \text{H} \), \( R_{b1} \) and \( R_{b2} \) are \( \text{CH}_3 \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \text{H} \).

[738] In some variations of formula (25) described in the paragraphs above in which \( \phi \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), and \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \text{H} \). In some variations of formula (25) described in the paragraphs above in which \( \phi \) is 4, \( R_{a1} \) and \( R_{a2} \) are \( \text{H} \), \( R_{b1} \) and \( R_{b2} \) are \( \text{CH}_3 \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \text{H} \).

[739] In some variations of formula (25) described in the paragraphs above in which \( \phi \) is 4, \( R_{a1} \) and \( R_{b1} \) are \( \text{H} \), and \( R_{a2} \) and \( R_{b2} \) are \( \text{H} \), and \( R_{a3} \) and \( R_{b3} \) and \( R_{a4} \) and \( R_{b4} \) together are \( \text{H} \). In some variations of formula (25) described in the paragraphs above in which \( \phi \) is 4, \( R_{a1} \) and
R_{\text{a}1} and R_{\text{h}1} are \( \text{CH}_3 \), R_{\text{a}2} and R_{\text{b}2} are \( \text{CH}_3 \), and R_{\text{a}3} and R_{\text{a}4} and R_{\text{b}4} together are \( \text{CH}_3 \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, R_{\text{a}1} is \( \text{CH}_3 \), R_{\text{a}2} and R_{\text{b}2} are \( \text{CH}_3 \), and R_{\text{a}3} and R_{\text{b}3} and R_{\text{a}4} and R_{\text{b}4} together are \( \text{CH}_3 \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, R_{\text{a}1} and R_{\text{b}1} are \( \text{CH}_3 \), R_{\text{a}2} and R_{\text{b}2} are \( \text{CH}_3 \), and R_{\text{a}3} and R_{\text{b}3} and R_{\text{a}4} and R_{\text{b}4} together are \( \text{CH}_3 \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, R_{\text{a}1} and R_{\text{b}1} are \( \text{CH}_3 \), R_{\text{a}2} and R_{\text{b}2} are \( \text{CH}_3 \), and R_{\text{a}3} and R_{\text{b}3} and R_{\text{a}4} and R_{\text{b}4} together are \( \text{CH}_3 \). In some variations of formula (25) described in the paragraphs above in which \( \alpha_2 \) is 4, R_{\text{a}1} and R_{\text{b}1} are \( \text{CH}_3 \), R_{\text{a}2} and R_{\text{b}2} are \( \text{CH}_3 \), and R_{\text{a}3} and R_{\text{b}3} and R_{\text{a}4} and R_{\text{b}4} together are \( \text{CH}_3 \). In some variations of formula (25) described in the paragraphs above, ring A is

\[ \text{ring A is} \]

\[ \text{(a)} \]

\[ \text{optionally substituted with halo or C1-C6 linear or branched alkyl;} \]
optionally substituted with halo or C1-C6 linear or branched alkyl; or
optionally substituted with halo or C1-C6 linear or branched alkyl.

[745] In some variations of formula (25) described in the paragraphs above, \( n \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[746] In some variations of formula (25) described in the paragraphs above, **ring A** is substituted with halo. In some variations, the halo is F, Br, I, or Cl.

[747] In some variations of formula (25) described in the paragraphs above, **ring A** is substituted with C1-C6 linear or branched alkyl (*e.g.*, C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[748] In some variations of formula (25) described in the paragraphs above, **D1** is safranin-O. In some variations of formula (25) described in the paragraphs above, the first **D2** is safranin-O. In some variations of formula (25) described in the paragraphs above, the second **D2** is safranin-O. In some variations of formula (25) described in the paragraphs above, **D1** and the first **D2** are safranin-O. In some variations of formula (25) described in the paragraphs above, **D1** and the second **D2** are safranin-O. In some variations of formula (25) described in the paragraphs above, the first **D2** and the second **D2** are safranin-O.

[749] In some variations of formula (25) described in the paragraph above, the pendant phenyl ring of **D1** is unsubstituted. In some variations of formula (25) described in the paragraph above, the pendant phenyl ring of **D1** is substituted with 1-3 (*e.g.*, 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of **D1** is substituted, the substituents are selected independently from —NH\(_2\), —NHR, —NR\(_2\), —OH, —O\(^-\), —NHCOCH\(_3\), —NHCOR, —OCH\(_3\), —OR, —C\(_2\)H\(_5\), —R, and —C\(_6\)H\(_5\), wherein R is C1-C6.
linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3-C4, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —N0₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₂), —CN, —S0₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

In some variations of formula (25) described in the two paragraphs above, the pendant phenyl ring of the first D2 is unsubstituted. In some variations of formula (25) described in the paragraph above, the pendant phenyl ring of the first D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of the first D2 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —Oᵗ, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of the first D2 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₂), —CN, —S0₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

In some variations of formula (25) described in the three paragraphs above, the pendant phenyl ring of the second D2 is unsubstituted. In some variations of formula (25) described in the paragraph above, the pendant phenyl ring of the second D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of the second D2 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —Oᵗ, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of the second D2 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo
(e.g., F, Br, Cl, I), trihalide (e.g., —CF$_3$, —CCl$_3$, —CBr$_3$, —CI$_3$), —CN, —SO$_3$H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[752] In some of the variations of formula (25) described above, D1 and D2 are safranin-0 moieties, as shown in formula (25a):

![Diagram](image)

in which $m$, $n$, $I_1$, $I_2$, $O_1$, $O_2$, ring A, $R_{a_1}$, $R_{b_1}$, $R_{a_2}$, $R_{b_2}$, $R_{a_3}$, $R_{b_3}$, and $R_{a_4}$ are as defined in the paragraphs above, $R_i$, $R_2$, $R_3$, $R_4$, $R_5$, and $R_6$ independently are absent or independently are selected from —NH$_2$, —NHR, —NR$_2$, —OH, —O’, —NHCOC$_3$, —NHCOR, —OCH$_3$, —OR, —C$_2$H$_5$, —R, —C$_6$H$_5$, —N$O_2$, —NR$_3^+$, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF$_3$, —CCl$_3$, —CBr$_3$, —CI$_3$), —CN, —SO$_3$H, —COOH, —COOR, —CHO, and —COR), and R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[753] One of skill in the art can readily visualize and prepare other cationic multimers falling within formula (25) in which other cationic dye moieties are used in place of one or both of the safranin-0 moieties.
Some cationic dye multimers fall within formula (26), (27), (28), (29), (30), (31), or (32):

\[
\begin{align*}
(26) & \quad \begin{array}{c}
\text{D} \\
\text{H}_2\text{N} \\
\text{NH}_2
\end{array} \\
\text{ny} \\
(27) & \quad \begin{array}{c}
\text{H}_2\text{N} \\
\text{NH} \\
\text{L}
\end{array} \\
\text{ny} \\
(28) & \quad \begin{array}{c}
\text{D} \\
\text{L}
\end{array} \\
\text{ny} \\
(29) & \quad \begin{array}{c}
\text{O} \\
\text{L}
\end{array} \\
\text{ny} \\
(30) & \quad \begin{array}{c}
\text{D} \\
\text{L}
\end{array} \\
\text{ny} \\
(31) & \quad \begin{array}{c}
\text{D} \\
\text{L}
\end{array} \\
\text{ny} \\
(32) & \quad \begin{array}{c}
\text{D} \\
\text{L}
\end{array} \\
\text{ny}
\end{align*}
\]

wherein D is a cationic dye moiety, \( nx \) is 0-5, \( ny \) is 1-5, and L is absent or L is a linker selected from linker (a.l), linker (a.2), linker (b.l), linker (c.1), linker (c.2), linker (d), linker (e.l), linker (f.1), linker (f.2), linker (g.l), linker (g.2), linker (h.l), linker (h.2), linker (i.1), linker (i.2), linker (j.1), linker (j.2), linker (k), linker (l.1), linker (l.2), linker (m.l), linker (n.l), linker (n.2), linker (o), linker (p), linker (q), linker (r), and linker (s), described above.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32), L is linker (a.1):

\[
\begin{align*}
(\text{a.1}) & \quad \begin{array}{c}
\text{D} \\
\text{L}
\end{array} \\
\text{ny}
\end{align*}
\]

, in which \( n \) is 1-6, \( \# i \) is 1-4, and * is the attachment site for the cationic dye moiety D.
In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which L is linker (a.l), \( n \) is 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 1, 2, 3, 4, 5, or 6.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (a.l), \( n_f \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32), L is linker (a.2):

\[
\begin{align*}
\Box & \quad (a.2) \\
& \quad \text{in which } n \text{ is 1-6, } n_f \text{ is 1-4, and } * \text{ is the attachment site for the cationic dye moiety } D.
\end{align*}
\]

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which L is linker (a.2), \( n \) is 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 1, 2, 3, 4, 5, or 6.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (a.2), \( n_f \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32), L is linker (b.l):

\[
\begin{align*}
\Box & \quad (b.1) \\
& \quad \text{in which } n \text{ is 0-6, } n_i \text{ is 1-4, and } * \text{ is the attachment site for the cationic dye moiety } D.
\end{align*}
\]

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which L is linker (b.l), \( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (b.l), \( n_f \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32), L is linker (c.l):
\[
\begin{align*}
\text{(c.1)} & \quad \text{, in which } n \text{ is } 0-6, \ n_i \text{ is } 1-4, \text{ either (1) } R_a \text{ and } R_b \text{ independently are } H \text{ or CH}_3 \\
\quad \text{or (2) } R_a \text{ and } R_b \text{ are } \begin{array}{c}
\text{or} \\
\end{array} \quad \text{; or (3) two of } CR_aR_b \text{ are } \begin{array}{c}
\text{or} \\
\end{array} ; \text{ and } * \text{ is the attachment site for the cationic dye moiety D}.
\end{align*}
\]

[765] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which \( L \) is linker (c.1), \( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

[766] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (c.1), \( n \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[767] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (c.1), \( R_a \) is \( H \) and \( R_b \) is \( H \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (c.1), \( R_a \) is \( H \) and \( R_b \) is \( CH_3 \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (c.1), \( R_a \) and \( R_b \) are \( \begin{array}{c}
\text{or} \\
\end{array} \quad \text{. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which } L \text{ is linker (c.1), two of } CR_aR_b \text{ are } \begin{array}{c}
\text{or} \\
\end{array} .
\end{align*}
\]

[768] In some variations of formula (26), (27), (28), (29), (30), (31), or (32), \( L \) is linker (c.2):

\[
\begin{align*}
\text{(c.2)} & \quad \text{, in which } n \text{ is } 0-6, \ n_i \text{ is } 1-4, \text{ either (1) } R_a \text{ and } R_b \text{ independently are } H \text{ or CH}_3 \\
\quad \text{or (2) } R_a \text{ and } R_b \text{ are } \begin{array}{c}
\text{or} \\
\end{array} \quad \text{; or (3) two of } CR_aR_b \text{ are } \begin{array}{c}
\text{or} \\
\end{array} ; \text{ and } * \text{ is the attachment site for the cationic dye moiety D}.
\end{align*}
\]

\[243\]
In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which \( L \) is linker (c.2), \( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (c.2), \( n \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (c.2), \( R_a \) is \( H \) and \( R_b \) is \( H \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (c.2), \( R_a \) is \( H \) and \( R_b \) is \( CH_3 \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (c.2), \( R_a \) and \( R_b \) are \( \triangle \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (c.2), two of \( CR_aR_b \) are \( \triangle \).

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (c), \( L \) is

\[
\text{[Image of molecular structures]}
\]

In some variations of formula (26), (27), (28), (29), (30), (31), or (32), \( L \) is linker (d):
, where \( k \) is 2-10; (1) \( R_a \) and \( \frac{3}{4} \), independently are H or \( CH_3 \), or (2) \( R_a \) and \( \frac{3}{4} \), are

\[
\text{or } \begin{array}{c}
\text{or } \begin{array}{c}
\text{or } \begin{array}{c}
\end{array}
\end{array}
\end{array}
\]

; and * is the attachment site for the cationic dye moiety D

[774] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which \( L \) is linker (d), \( k \) is 2-10, 2-9, 2-8, 2-7, 2-6, 2-5, 2-4, 2-3, 3-10, 3-9, 3-8, 3-7, 3-6, 3-5, 3-4, 4-10, 4-9, 4-8, 4-7, 4-6, 4-5, 5-10, 5-9, 5-8, 5-7, 5-6, 6-10, 6-9, 6-8, 6-7, 7-10, 7-9, 7-8, 8-10, 8-9, 9-10, 2, 3, 4, 5, 6, 7, 8, 9, or 10.

[775] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (d), \( R_a \) is H and \( R_b \) is \( CH_3 \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (d), \( R_a \) is H and \( R_b \) is \( CH_3 \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (d), \( R_a \) is H and \( R_b \) is \( CH_3 \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (d), \( R_a \) and \( R_b \) are \( \text{or } \begin{array}{c}
\end{array}\). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (d), \( R_a \) and \( R_b \) are \( \text{or } \begin{array}{c}
\end{array}\). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (d), two of \( C R_a R_b \) are \( \text{or } \begin{array}{c}
\end{array}\).

[776] In some variations of formula (26), (27), (28), (29), (30), (31), or (32), \( L \) is linker (e.1):

\[
\text{or } \begin{array}{c}
\end{array}\]

, in which \( n \) is 0-6, \( n_1 \) is 1-4, and * is the attachment site for the cationic dye moiety D.

[777] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which \( L \) is linker (e.1), \( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.
In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (e.l), \( n_1 \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32), L is linker (f.l):

\[
\begin{align*}
\text{N} & \quad \text{N} \\
\text{H} & \quad \text{H} \\
\text{O} & \quad \text{O} \\
\text{\(*\)} & \quad \text{\(*\)} \\
\text{n}_1 & \quad \text{n}_1 \\
\text{n}_2 & \quad \text{n}_2
\end{align*}
\]

in which \( \text{\(*\)} \) is 0-5, 3-4 is 1-5, and * is the attachment site for the cationic dye moiety D.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which L is linker (f.l), \( n_1 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (f.l), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32), L is linker (f.2):

\[
\begin{align*}
\text{\(*\)} & \quad \text{\(*\)} \\
\text{N} & \quad \text{N} \\
\text{H} & \quad \text{H} \\
\text{O} & \quad \text{O} \\
\text{n}_1 & \quad \text{n}_1 \\
\text{n}_2 & \quad \text{n}_2
\end{align*}
\]

in which \( \text{\(*\)} \) is 0-5, \( \text{n}_2 \) is 1-5, and * is the attachment site for the cationic dye moiety D.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which L is linker (f.2), \( n_1 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (f.2), 3-4 is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32), L is linker (g.l):
In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which \( \mathbf{L} \) is linker (g.1), \( n_1 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( \mathbf{L} \) is linker (g.1), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32), \( \mathbf{L} \) is linker (g.2):

\[
\begin{array}{c}
\text{[786]} \quad \text{In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which } \mathbf{L} \text{ is linker (g.1), } n_1 \text{ is 0-5, } n_2 \text{ is 0-5, } n_3 \text{ is 1-5, and } * \text{ is the attachment site for the cationic dye moiety } \mathbf{D}. \\
\text{[787]} \quad \text{In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which } \mathbf{L} \text{ is linker (g.1), } n_1 \text{ is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.} \\
\text{[788]} \quad \text{In some variations of formula (26), (27), (28), (29), (30), (31), or (32), } \mathbf{L} \text{ is linker (g.2):} \\
\end{array}
\]

\[
\begin{array}{c}
\text{[789]} \quad \text{In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which } \mathbf{L} \text{ is linker (g.2), } n_1 \text{ is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.} \\
\text{[790]} \quad \text{In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which } \mathbf{L} \text{ is linker (g.2), } n_1 \text{ is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.} \\
\text{[791]} \quad \text{In some variations of formula (26), (27), (28), (29), (30), (31), or (32), } \mathbf{L} \text{ is linker (h.l):} 
\end{array}
\]
In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which $L$ is linker (h.1), $n_1$ is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which $L$ is linker (h.1), $\frac{3}{4}$ is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32), $L$ is linker (h.2):

\[ \text{in which } n_1 \text{ is 0-5, } n_2 \text{ is 1-5, and } * \text{ is the attachment site for the cationic dye moiety D.} \]

In some variations of formula (26), (27), (28), (29), (30), or (32) in which $L$ is linker (h.2), $n_1$ is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which $L$ is linker (h.2), $\frac{3}{4}$ is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32), $L$ is linker (i.l):
in which \( n_1 \) and \( n_2 \) independently are 1-5 and * is the attachment site for the cationic dye moiety D.

[798] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, L is linker (i.1), \( n_1 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[799] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (i.1), \( n_1 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[800] In some variations of formula (26), (27), (28), (29), (30), (31), or (32), L is linker (i.2):

, in which \( n_1 \) and \( n_2 \) independently are 1-5 and * is the attachment site for the cationic dye moiety D.

[801] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, L is linker (i.2), \( n_1 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[802] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (i.2), \( n_1 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[803] In some variations of formula (26), (27), (28), (29), (30), (31), or (32), L is linker (j.1):
In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which $L$ is linker (j.1), $n_2$ is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32), $L$ is linker (j.2):

, in which $n_2$ is 1-5 and * is the attachment site for the cationic dye moiety D.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which $L$ is linker (j.2), $n_2$ is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32), $L$ is linker (k):

, in which $l_1$ and $\frac{3}{4}$ independently are 1-4, $n$ is 1-4; ring A is aryl, heteroaryl, cycloalkyl, or heterocycl; (1) $R_{a1}$ and $R_{b1}$ independently are H or CH$_3$ or (2) $R_{a1}$ and $R_{b1}$ independently are $\bullet$ or $\bullet$; or (3) two of CR$_{a1}$R$_{b1}$ are $\bullet$; (1) $R_{a2}$ and $R_{b2}$
independently are H or CH₃ or (2) Rₐ₂ and Rₜ₂ independently are a and 1 / 3 or a and 1 / 3; or (3) two of CRₐ₂ Rₜ₂ are a and a; and * is the attachment site for the cationic dye moiety D.

[808] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which L is linker (k), I₁ is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[809] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (k), I₂ is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[810] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (k), Rₐ� and Rₜ� are H. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (k), Rₐ� is H and Rₜ� is CH₃. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (k), Rₐ� and Rₜ� are H. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (k), two of CRₐ� Rₜ� are H.

[811] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (k), Rₐ₂ is H and Rₜ₂ is H. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (k), Rₐ₂ is H and Rₜ₂ is CH₃. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (k), Rₐ₂ and Rₜ₂ are H. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (k), two of CRₐ₂ Rₜ₂ are H.

[812] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (k), ring A is
(a) optionally substituted with halo or C1-C6 linear or branched alkyl;

(b) optionally substituted with halo or C1-C6 linear or branched alkyl; or

(c) optionally substituted with halo or C1-C6 linear or branched alkyl; or
optionally substituted with halo or C1-C6 linear or branched alkyl.

[813] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (k), ring A is substituted with halo. In some variations, the halo is F, Br, I, or Cl.

[814] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (k), ring A is substituted with C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, CI, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[815] In some variations of formula (26), (27), (28), (29), (30), (31), or (32), L is linker (1.1):

\[ R_{a1} R_{d1} M_{o1} \text{(I.1)} \]

, in which \( I_1 \), \( I_2 \), \( n \), \( o_i \), and \( \theta_2 \) independently are 1-4; ring A is aryl, heteroaryl, cycloalkyl, or heterocyclic; for each independent instance of \( R_a \) and \( R_b \), independently are H or CH3, or (2) \( R_a \) and \( R_b \) independently are \( O \) or \( \text{C} \); for each independent instance of \( R_{a1} \), \( R_{a2} \), \( R_{b1} \), and \( R_{b2} \), independently are H or CH3, or (3) two of CRaiRbi are \( \text{C} \); for each independent instance of \( R_{a1} \), \( R_{a2} \), \( R_{b1} \), and \( R_{b2} \), independently are H or CH3, or (3) two of CRaiRbi are \( \text{C} \).
\[ \frac{7}{3} \] (1) independently are \( H \) or \( CH_3 \), or (2) \( R_{a2} \) and \( R_{b2} \) independently are \( \frac{7}{3} \) \( CH \), or (3) two of \( CR_{a2}Rb2 \) are \( \frac{7}{3} \); for each independent instance of \( R_{c1} \) and \( R_{d1} \), \( R_{c1} \) and \( R_{d1} \) (1)

independently are \( H \) or \( CH_3 \), or (2) \( R_{c1} \) and \( R_{d1} \) independently are \( \frac{7}{3} \); for each independent instance of \( R_{c2} \) and \( R_{d2} \), \( R_{c2} \) and \( R_{d2} \) (1)

independently are \( H \) or \( CH_3 \), or (2) \( R_{c2} \) and \( R_{d2} \) independently are \( \frac{7}{3} \); for each independent instance of \( R_{c2} \) and \( R_{d2} \), \( R_{c2} \) and \( R_{d2} \) (1)

\( CR_{c2}Rd2 \) are \( \frac{7}{3} \); and * is the attachment site for the cationic dye moiety D.

[816] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which \( L \) is

linker (1.1), \( l_i \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[817] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( l_i \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[818] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( \theta \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[819] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( \theta \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[820] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( R_{a1} \) is \( H \) and \( R_{b1} \) is \( H \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( R_{a1} \) is \( H \) and \( R_{b1} \) is \( CH_3 \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( R_{a1} \) and \( R_{b1} \) are \( \frac{7}{3} \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( R_{a1} \) and \( R_{b1} \) are \( \frac{7}{3} \).

[821] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( R_{a2} \) is \( H \) and \( R_{b2} \) is \( H \). In some variations of formula
(26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( R_{a2} \) is H and \( R_{b2} \) is \( \text{CH}_3 \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( R_{a2} \) and \( R_{b2} \) are \( \text{O} \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( R_{a2} \) and \( R_{b2} \) are \( \text{CH}_3 \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), two of \( \text{CR}_{a3}R_{b2} \) are \( \text{O} \).

[822] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( R_{i} \) and \( R_{j} \) are both H. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( R_{c1} \) is H and \( R_{di} \) is \( \text{CH}_3 \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( R_{ci} \) and \( R_{di} \) are both \( \text{CH}_3 \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( R_{i} \) and \( R_{di} \) are \( \text{O} \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), two of \( \text{CR}_{i}R_{di1} \) are \( \text{O} \).

[823] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( R_{c2} \) and \( R_{d2} \) are both H. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( R_{c2} \) is H and \( R_{d2} \) is \( \text{CH}_3 \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( R_{c2} \) and \( R_{d2} \) are both \( \text{CH}_3 \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( R_{c2} \) and \( R_{d2} \) are \( \text{O} \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), \( R_{c2} \) and \( R_{d2} \) are \( \text{O} \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (1.1), two of \( \text{CR}_{c2}R_{d2} \) are \( \text{O} \).
In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (1.1), ring A is

(a) optionally substituted with halo or C1-C6 linear or branched alkyl;

(b) optionally substituted with halo or C1-C6 linear or branched alkyl; or

(c)
optionally substituted with halo or C1-C6 linear or branched alkyl.

[825] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (1.1), ring A is substituted with halo. In some variations, the halo is F, Br, I, or Cl.

[826] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (1.1), ring A is substituted with C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[827] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (1.1), n is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[828] In some variations of formula (26), (27), (28), (29), (30), (31), or (32), L is linker (1.2):
ring A is aryl, heteroaryl, cycloalkyl, or heterocyclyl; for each independent instance of \( \text{R}_a^1 \) and \( \text{R}_b^1 \), \( \text{R}_b^i \), \( \text{R}_c^i \) and \( \text{R}_d^i \) independently are \( \text{H} \) or \( \text{CH}_3 \), or (2) \( \text{R}_a^1 \) and \( \text{R}_b^1 \) independently are \( \text{H} \) or \( \text{CH}_3 \), or (3) two of \( \text{CR}_a^i \text{R}_b^i \) are \( \text{H} \) or \( \text{CH}_3 \), or (2) \( \text{R}_a^2 \) and \( \text{R}_b^2 \) independently are \( \text{H} \) or \( \text{CH}_3 \), or (3) two of \( \text{CR}_a^2 \text{R}_b^2 \) are \( \text{H} \) or \( \text{CH}_3 \), or (2) \( \text{R}_c^i \) and \( \text{R}_d^i \) independently are \( \text{H} \) or \( \text{CH}_3 \), or (3) two of \( \text{CR}_c^i \text{R}_d^i \) are \( \text{H} \) or \( \text{CH}_3 \), or (2) \( \text{R}_c^2 \) and \( \text{R}_d^2 \) independently are \( \text{H} \) or \( \text{CH}_3 \), or (3) two of \( \text{CR}_c^2 \text{R}_d^2 \) are \( \text{H} \) or \( \text{CH}_3 \); and * is the attachment site for the cationic dye moiety D.

[829] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which L is linker (1.2), \( \text{I}_1 \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[830] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (1.2), \( \text{I}_2 \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[831] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (1.2), \( \text{I}_1 \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[832] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (1.2), \( \text{I}_2 \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[833] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (1.2), \( \text{R}_a^1 \) is \( \text{H} \) and \( \text{R}_b^1 \) is \( \text{H} \). In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker
(1.2), $R_a^i$ is $H$ and $R_{b^i}$ is $CH_3$. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which $L$ is linker (1.2), $R_{a^i}$ and $R_{b^i}$ are $\overset{\text{O}}{\underset{\text{C}}{\text{H}}}$.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which $L$ is linker (1.2), two of $CR_{a^i}R_{b^i}$ are $\overset{\text{O}}{\underset{\text{C}}{\text{H}}}$.

[834] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which $L$ is linker (1.2), $R_{a^2}$ is $H$ and $R_{b^2}$ is $H$. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which $L$ is linker (1.2), $R_{a^2}$ is $H$ and $R_{b^2}$ is $CH_3$. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which $L$ is linker (1.2), $R_{a^2}$ and $R_{b^2}$ are $\overset{\text{O}}{\underset{\text{C}}{\text{H}}}$.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which $L$ is linker (1.2), two of $CR_{a^2}R_{b^2}$ are $\overset{\text{O}}{\underset{\text{C}}{\text{H}}}$.

[835] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which $L$ is linker (1.2), $R_{1^i}$ and $R_{d^i}$ are both $H$. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which $L$ is linker (1.2), $R_{c^i}$ is $H$ and $R_{d^i}$ is $CH_3$. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which $L$ is linker (1.2), $R_{c^i}$ and $R_{d^i}$ are both $CH_3$. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which $L$ is linker (1.2), $R_{c^i}$ and $R_{d^i}$ are $\overset{\text{O}}{\underset{\text{C}}{\text{H}}}$.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which $L$ is linker (1.2), two of $CR_{c^i}R_{d^i}$ are $\overset{\text{O}}{\underset{\text{C}}{\text{H}}}$.
In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (1.2), R and R' are both H. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (1.2), R_e2 and R_d2 are both H. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (1.2), R_e and R_d are both C_H3. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (1.2), R_e2 and R_d2 are both C_H3. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (1.2), two of CR_e2R_d2 are optionally substituted with halo or C1-C6 linear or branched alkyl; optionally substituted with halo or C1-C6 linear or branched alkyl; or
optionally substituted with halo or C1-C6 linear or branched alkyl.

[838] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (1.2), ring A is substituted with halo. In some variations, the halo is F, Br, I, or Cl.

[839] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (1.2), ring A is substituted with C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, CI, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).
In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (1.2), \( n \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32), L is linker (m.1):

\[
\begin{align*}
\text{(m.1)} & \quad , \quad \text{in which} \quad n \quad \text{is} \quad 0-6, \quad ni \quad \text{is} \quad 1-4, \quad \text{and} \quad * \quad \text{is the attachment site for the cationic dye moiety D.}
\end{align*}
\]

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which L is linker (m.l), \( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (m.l), \( n \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32), L is linker (n.l):

\[
\begin{align*}
\text{(n.1)} & \quad , \quad \text{in which} \quad n_2 \quad \text{is} \quad 1-5 \quad \text{and} \quad * \quad \text{is the attachment site for the cationic dye moiety D.}
\end{align*}
\]

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which L is linker (n.l), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32), L is linker (n.2):
In which \( i_2 \) is 1-5 and * is the attachment site for the cationic dye moiety D.

[847] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which L is linker (n.2), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[848] In some variations of formula (26), (27), (28), (29), (30), (31), or (32), L is linker (o):

, in which \( i_i \) is 0-5, \( \eta_2 \) is 1-5, \( n_3 \) is 0-5, and * is the attachment site for the cationic dye moiety D.

[849] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which L is linker (o), \( n_1 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[850] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (o), \( \bar{n}_1 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[851] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which L is linker (o), \( n_3 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[852] In some variations of formula (26), (27), (28), (29), (30), (31), or (32), L is linker (p):
(p) \[ \text{in which } n_1 \text{ is 0-5, } n_2 \text{ is 1-5, } n_3 \text{ is 0-5, and } * \text{ is the attachment site for the cationic dye moiety D.} \]

[853] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described above in which \( L \) is linker (p), \( n_f \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[854] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described above in which \( L \) is linker (p), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[855] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described above in which \( L \) is linker (p), \( n_s \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[856] In some variations of formula (26), (27), (28), (29), (30), (31), or (32), \( L \) is linker (q):

(q) \[ \text{in which } \eta_q \text{ is 0-5, } n_2 \text{ is 1-5, and } * \text{ is the attachment site for the cationic dye moiety D.} \]

[857] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which \( L \) is linker (o), \( n_q \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[858] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described above in which \( L \) is linker (q), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[859] In some variations of formula (26), (27), (28), (29), (30), (31), or (32), \( L \) is linker (r):

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In which \( n_1 \) is 0-5, \( n_2 \) is 1-5, \( n_3 \) is 0-5, and * is the attachment site for the cationic dye moiety D.

[860] In some of variations of formula (26), (27), (28), (29), (30), (31), or (32) in which \( L \) is linker (r), \( n_1 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[861] In some of variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( L \) is linker (r), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[862] In some of variations of formula (26), (27), (28), (29), (30), (31), or (32) in which \( L \) is linker (r), \( n_3 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[863] In some variations of formula (26), (27), (28), (29), (30), (31), or (32), \( L \) is linker (s):

\[
\begin{array}{c}
\text{(s)} \\
\end{array}
\]

\[
\begin{array}{c}
\text{in which } n_1 \text{ is 0-5, } n_2 \text{ is 1-5, } n_3 \text{ is 0-5, and * is the attachment site for the cationic dye moiety D.}
\end{array}
\]

[864] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described above in which \( L \) is linker (s), \( n_1 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[865] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described above in which \( L \) is linker (s), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.
In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described above in which \( L \) is linker (s), \( n_x \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described above, \( n_y \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, \( D \) is selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_y \) is 2, \( D_1 \) and \( D_2 \) are the same cationic dye moiety. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which \( n_y \) is 2, \( D_1 \) and \( D_2 \) are different cationic dye moieties. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which \( n_y \) is 2, \( D_1 \) and \( D_2 \) independently are selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_y \) is 3, \( D_1 \), \( D_2 \), and \( D_3 \) are the same cationic dye moiety. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which \( n_y \) is 3, \( D_1 \), \( D_2 \), and \( D_3 \) are different cationic dye moieties. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which \( n_y \) is 3, \( D_1 \) and \( D_2 \) and the same cationic dye moiety and \( D_3 \) is a different cationic dye moiety. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which \( n_y \) is 3, \( D_1 \) and \( D_3 \) and the same cationic dye moiety and \( D_2 \) is a different cationic dye moiety. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which \( n_y \) is 3,
D 2 and D 3 are the same cationic dye moiety and D 1 is a different cationic dye moiety. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which n is 3, D 1, D 2, and D 3 independently are selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which n is 4, D 1, D 2, D 3, and D 4 are the same cationic dye moiety. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) in which n is 4, D 1, D 2, D 3, and D 4 are different cationic dye moieties. In some variations of formula (26), (27), (28), (29), (30), (31), or (32), D 1 is a first cationic dye moiety and each of D 2, D 3, and D 4 is the same second cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32), D 1 is a first cationic dye moiety, and each of D 2, D 3, and D 4 is a second cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32), each of D 1 and D 2 is the same first cationic dye moiety, and each of D 3 and D 4 is the same second cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32), each of D 1 and D 2 is the same first cationic dye moiety, D 3 is a second cationic dye moiety, and D 4 is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32), each of D 1 and D 3 is the same first cationic dye moiety, D 2 is a second cationic dye moiety, and D 4 is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32), each of D 1 and D 4 is the same first cationic dye moiety, and each of D 2 and D 3 is the same second cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32), each of D 1 and D 4 is the same first cationic dye moiety, D 2 is a different second cationic dye moiety, and D 3 is a different third cationic dye moiety, wherein the first, second, and third
cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32), each of \( D_2 \) and \( D_3 \) is the same first cationic dye moiety, and each of \( D_1 \) and \( D_4 \) is the same second cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32), described in the paragraphs above in which \( n_y \) is 5, \( D_1 \) and \( D_3 \) are a first cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32), independently are selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

[875] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_y \) is 5, \( D_1 \), \( D_2 \), \( D_3 \), \( D_4 \), and \( D_5 \) are different cationic dye moieties. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_y \) is 5, \( D_1 \) and \( D_2 \) are a first cationic dye moiety, \( D_3 \) is a second cationic dye moiety, \( D_4 \) is a third cationic dye moiety, and \( D_5 \) is a fourth cationic dye moiety, wherein the first, second, third, and fourth cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_y \) is 5, \( D_1 \) and \( D_2 \) are a first cationic dye moiety, \( D_3 \) is a second cationic dye moiety, \( D_4 \) and \( D_5 \) each are a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_y \) is 5, \( D_1 \) and \( D_2 \) are a first cationic dye moiety, \( D_3 \) and \( D_4 \) are a second cationic dye moiety, and \( D_5 \) is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_y \) is 5, \( D_1 \) and \( D_2 \) are a first cationic dye moiety, \( D_3 \) and \( D_4 \) are a second cationic dye moiety, \( D_5 \) is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_y \) is 5, \( D_1 \) and \( D_2 \) are a first cationic dye moiety, \( D_3 \) and \( D_4 \) are a second cationic dye moiety, \( D_5 \) is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different.
D 2 and D 5 are a second cationic dye moiety, and D 4 is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which ny is 5, D 1 and D 3 are a first cationic dye moiety, D 4 and D 5 are a second cationic dye moiety, and D 3 is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which ny is 5, D 1 and D 4 are a first cationic dye moiety, D 2 is a second cationic dye moiety, D 3 is a third cationic dye moiety, and D 5 is a fourth cationic dye moiety, wherein the first, second, third, and fourth cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which ny is 5, D 1 and D 2 are a first cationic dye moiety, D 3 is a second cationic dye moiety, and D 2 and D 5 each are a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which ny is 5, D 1 and D 4 are a first cationic dye moiety, D 3 and D 5 are a second cationic dye moiety, and D 2 is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which ny is 5, D 1 and D 5 are a first cationic dye moiety, D 2 is a second cationic dye moiety, D 3 is a third cationic dye moiety, and D 4 is a fourth cationic dye moiety, wherein the first, second, third, and fourth cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which ny is 5, D 1 and D 4 are a first cationic dye moiety, D 3 and D 5 are a second cationic dye moiety, and D 2 is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which ny is 5, D 1 and D 5 are a first cationic dye moiety, D 3 and D 4 are a second cationic dye moiety, and D 2 is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which ny is 5, D 1 and D 5 are a first cationic dye moiety, D 2 and D 4 are a second cationic dye moiety, and D 3 is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different.
In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_y \) is 5, \( D_2 \) and \( D_3 \) are a first cationic dye moiety, \( D_1 \) is a second cationic dye moiety, \( D_4 \) is a third cationic dye moiety, and \( D_5 \) is a fourth cationic dye moiety, wherein the first, second, third, and fourth cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_y \) is 5, \( D_2 \) and \( D_3 \) are a first cationic dye moiety, \( D_1 \) is a second cationic dye moiety, and \( D_4 \) and \( D_3 \) each are a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_y \) is 5, \( D_2 \) and \( D_4 \) are a first cationic dye moiety, \( D_1 \) is a second cationic dye moiety, \( D_3 \) is a third cationic dye moiety, and \( D_5 \) is a fourth cationic dye moiety, wherein the first, second, third, and fourth cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_y \) is 5, \( D_2 \) and \( D_4 \) are a first cationic dye moiety, \( D_1 \) is a second cationic dye moiety, and \( D_3 \) and \( D_5 \) each are a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_y \) is 5, \( D_2 \) and \( D_4 \) are a first cationic dye moiety, \( D_1 \) is a second cationic dye moiety, \( D_3 \) is a third cationic dye moiety, and \( D_4 \) is a fourth cationic dye moiety, wherein the first, second, third, and fourth cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_y \) is 5, \( D_2 \) and \( D_5 \) are a first cationic dye moiety, \( D_1 \) is a second cationic dye moiety, and \( D_3 \) and \( D_4 \) each are a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_y \) is 5, \( D_3 \) and \( D_4 \) are a first cationic dye moiety, \( D_1 \) is a second cationic dye moiety, \( D_2 \) is a third cationic dye moiety, and \( D_5 \) is a fourth cationic dye moiety, wherein the first, second, third, and fourth cationic dye moieties are different.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_y \) is 5, \( D_4 \) and \( D_5 \) are a first cationic dye moiety, \( D_1 \) is a second cationic dye moiety, \( D_2 \) is a third cationic dye moiety, and \( D_3 \) is a fourth cationic dye moiety, wherein the first, second, third, and fourth cationic dye moieties are different.
In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_2 \) is 5, \( D_1, D_2, \) and \( D_3 \) are a first cationic dye moiety, \( D_4 \) is a second cationic dye moiety, and \( D_5 \) is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_2 \) is 5, \( D_1, D_2, \) and \( D_3 \) are a first cationic dye moiety, and \( D_4 \) and \( D_5 \) are a second cationic dye moiety, wherein the first and second cationic dye moieties are different.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_2 \) is 5, \( D_2, D_3, \) and \( D_4 \) are a first cationic dye moiety, \( D_1 \) is a second cationic dye moiety, and \( D_5 \) is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_2 \) is 5, \( D_2, D_3, \) and \( D_4 \) are a first cationic dye moiety, and \( D_1 \) and \( D_5 \) are a second cationic dye moiety, wherein the first and second cationic dye moieties are different.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_2 \) is 5, \( D_3, D_4, \) and \( D_5 \) are a first cationic dye moiety, \( D_1 \) is a second cationic dye moiety, and \( D_2 \) is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_2 \) is 5, \( D_3, D_4, \) and \( D_5 \) are a first cationic dye moiety, and \( D_1 \) and \( D_2 \) are a second cationic dye moiety, wherein the first and second cationic dye moieties are different.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_2 \) is 5, \( D_1, D_4, \) and \( D_5 \) are a first cationic dye moiety, \( D_2 \) is a second cationic dye moiety, and \( D_3 \) is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_2 \) is 5, \( D_1, D_4, \) and \( D_5 \) are a first cationic dye moiety, and \( D_2 \) and \( D_3 \) are a second cationic dye moiety, wherein the first and second cationic dye moieties are different.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_2 \) is 5, \( D_1, D_2, \) and \( D_5 \) are a first cationic dye moiety, \( D_3 \) is a second cationic dye moiety, and \( D_4 \) is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which \( n_2 \) is 5, \( D_1, D_2, \) and \( D_5 \) are a first cationic dye moiety, and \( D_3 \) is a second cationic dye moiety, and \( D_4 \) is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different.
cationic dye moiety, and D3 and D4 are a second cationic dye moiety, wherein the first and second cationic dye moieties are different.

[889] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which nγ is 5, D1 is a first cationic dye moiety, and each of D2, D3, D4, and D5 is a second cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which nγ is 5, D2 is a first cationic dye moiety, and each of D1, D3, D4, and D5 is a second cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which nγ is 5, D3 is a first cationic dye moiety, and each of D1, D2, D4, and D5 is a second cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which nγ is 5, D4 is a first cationic dye moiety, and each of D1, D2, D3, and D5 is a second cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which nγ is 5, D5 is a first cationic dye moiety, and each of D1, D2, D3, and D4 is a second cationic dye moiety, wherein the first and second cationic dye moieties are different.

[890] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above in which nγ is 5, D1, D2, D3, D4, and D5 independently are selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

[891] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, D1 is safranin-O. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, D2 is safranin-O. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, D3 is safranin-O. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, D4 is safranin-O. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, D1 and D2 are safranin-O. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, D1 and D3 are safranin-O. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, D1 and D4 are safranin-O. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, D2 and D3 are safranin-O. In some
variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, 
D 2 and D 4 are safranin-O. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, D 3 and D 4 are safranin-O. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, D 3 and D 4 are safranin-O. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, D 1, D 2, and D 3 are safranin-O. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, D 1, D 2, and D 4 are safranin-O. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, D 2, D 3, and D 4 are safranin-O. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraphs above, D 2, D 3, and D 4 are safranin-O.

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraph above, the pendant phenyl ring of D 1 is unsubstituted. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraph above, the pendant phenyl ring of D 1 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D 1 is substituted, the substituents are selected independently from —NH 2, —NHR, —NR 2, —OH, —O —, —NHCOCH 3, —NHCOR, —OCH 3, —OR, —C 2H 5, —R, and —C 6H 5, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D 1 is substituted, the substituents are selected independently from —N0 2, —NR 3 +, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF 3, —CC1 3, —Br 3, —I 3), —CN, —SO 3H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the two paragraphs above, the pendant phenyl ring of D 2 is unsubstituted. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraph above, the pendant phenyl ring of D 2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D 2 is substituted, the substituents are selected independently from —NH 2, —NHR, —NR 2, —OH, —O —, —NHCOCH 3, —NHCOR, —OCH 3, —OR, —C 2H 4, —R, and —C 6H 4, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3,
C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —N02, —NR3+, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF3, —CCl3, —CBr3, —Cl3), —CN, —SO3H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, CI, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[894] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the three paragraphs above, the pendant phenyl ring of D3 is unsubstituted. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraph above, the pendant phenyl ring of D3 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —NH2, —NHR, —NR2, —OH, —O-, —NHOCH3, —NHCOR, —OCH3, —OR, —C2H5, —R, and —C6H5, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, Cl-C5, C1-C4, C1-C3, C1-C2, CI, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —N02, —NR3+, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF3, —CCl3, —CBr3, —Cl3), —CN, —SO3H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, CI, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[895] In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the three paragraphs above, the pendant phenyl ring of D4 is unsubstituted. In some variations of formula (26), (27), (28), (29), (30), (31), or (32) described in the paragraph above, the pendant phenyl ring of D4 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D4 is substituted, the substituents are selected independently from —NH2, —NHR, —NR2, —OH, —O-, —NHOCH3, —NHCOR, —OCH3, —OR, —C2H5, —R, and —C6H5, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, Cl-C5, C1-C4, C1-C3, C1-C2, CI, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D4 is substituted, the substituents are selected independently from —N02, —NR3+, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF3, —CCl3, —CBr3, —Cl3), —CN, —SO3H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, CI, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).
alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, CI, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[896] In some variations, cationic dye multimers are linear, as illustrated by formula (33):

\[
\text{[Diagram of formula (33)]}
\]

wherein each of D1, D2, D3, and D4 is a cationic dye moiety and one or more of L1, L2, L3, and L4 are absent or each of L1, L2, L3, and L4 is a linker independently selected from linker (a.1), linker (a.2), linker (b.1), linker (c.1), linker (c.2), linker (d), linker (e.1), linker (f.1), linker (f.2), linker (g.1), linker (g.2), linker (h.1), linker (h.2), linker (i.1), linker (i.2), linker (j.1), linker (j.2), linker (k), linker (l.1), linker (l.2), is linker (m.1), linker (n.1), linker (n.2), linker (o), linker (p), linker (q), linker (r), and linker (s), described above.

[897] In some variations of formula (33), each of D1, D2, D3, and D4 is a different cationic dye moiety. In some variations of formula (33), each of D1, D2, D3, and D4 is the same cationic dye moiety. In some variations of formula (33), D1 is a first cationic dye moiety and each of D2, D3, and D4 is the same second cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (33), D2 is a first cationic dye moiety, and each of D1, D3, and D4 is a second cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (33), D3 is a first cationic dye moiety, and each of D1, D2, and D4 is a second cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (33), D4 is a first cationic dye moiety, and each of D1, D2, and D3 is a second cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (33), each of D1 and
D2 is the same first cationic dye moiety, and each of D3 and D4 is the same second cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (33), each of D1 and D2 is the same first cationic dye moiety, D3 is a second cationic dye moiety, and D4 is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different. In some variations of formula (33), each of D1 and D3 is the same first cationic dye moiety, and each of D2 and D4 is the same second cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (33), each of D1 and D3 is the same first cationic dye moiety, D2 is a second cationic dye moiety, and D4 is a third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different. In some variations of formula (33), each of D1 and D4 is the same first cationic dye moiety, D2 is a different second cationic dye moiety, and D3 is a different third cationic dye moiety, wherein the first, second, and third cationic dye moieties are different. In some variations of formula (33), each of D2 and D3 is the same first cationic dye moiety, and each of D1 and D4 is the same second cationic dye moiety, wherein the first and second cationic dye moieties are different.

[898] In some variations of formula (33) described in the paragraphs above, each of D1, D2, D3, and D4 is independently are selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

[899] In some variations of formula (33) described in the paragraphs above, at least one of L1, L2, L3, and L4 is linker (a.l):

\[
\begin{array}{c}
\begin{array}{c}
\text{H} \\
\text{N} \\
\text{H}
\end{array}
\end{array}
\]

\(\text{a.1}\)

, in which \(n\) is 1-6, \(n'\) is 1-4, and * is the attachment site for the cationic dye moiety D.

[900] In some variations of formula (33) in which at least one of L1, L2, L3, and L4 is linker (a.l), \(n\) is 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 1, 2, 3, 4, 5, or 6.

[901] In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (a.l), \(n'\) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.
In some variations of formula (33) described in the paragraphs above, L1 is linker (a.1). In some variations of formula (33) described in the paragraphs above, L2 is linker (a.1). In some variations of formula (33) described in the paragraphs above, L3 is linker (a.1). In some variations of formula (33) described in the paragraphs above, L4 is linker (a.1). In some variations of formula (33) described in the paragraphs above, L1 and L2 are linker (a.1). In some variations of formula (33) described in the paragraphs above, L1 and L3 are linker (a.1). In some variations of formula (33) described in the paragraphs above, L1 and L4 are linker (a.1). In some variations of formula (33) described in the paragraphs above, L2 and L3 are linker (a.1). In some variations of formula (33) described in the paragraphs above, L2 and L4 are linker (a.1). In some variations of formula (33) described in the paragraphs above, L3 and L4 are linker (a.1). In some variations of formula (33) described in the paragraphs above, LI, L2, and L3 are linker (a.1). In some variations of formula (33) described in the paragraphs above, LI, L2, L3, and L4 are linker (a.1). In some variations of formula (33) described in the paragraphs above, LI, L3, and L4 are linker (a.1). In some variations of formula (33) described in the paragraphs above, L2, L3, and L4 are linker (a.1). In some variations of formula (33) described in the paragraphs above, LI, L2, L3, and L4 are linker (a.1).

In some variations of formula (33) described in the paragraphs above, at least one of L1, L2, L3, and L4 is linker (a.2):

\[ \text{attachment site for the cationic dye moiety D} \]

\[ \text{in which } n \text{ is } 1-6, \ n_j \text{ is } 1-4, \text{ and } * \text{ is the attachment site for the cationic dye moiety D.} \]

In some variations of formula (33) in which at least one of L1, L2, L3, and L4 is linker (a.2), n is 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 1, 2, 3, 4, 5, or 6.

In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (a.2), \( n_j \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (33) described in the paragraphs above, L1 is linker (a.2). In some variations of formula (33) described in the paragraphs above, L2 is linker (a.2). In some variations of formula (33) described in the paragraphs above, L3 is linker (a.2). In some variations of formula (33) described in the paragraphs above, L4 is linker (a.2). In some variations of formula (33) described in the paragraphs above, L1 and L2 are linker (a.2). In some variations of formula (33) described in the paragraphs above, L1 and L3 are linker (a.2). In some...
variations of formula (33) described in the paragraphs above, $L_1$ and $L_4$ are linker (a.2). In some
variations of formula (33) described in the paragraphs above, $L_2$ and $L_3$ are linker (a.2). In some
variations of formula (33) described in the paragraphs above, $L_2$ and $L_4$ are linker (a.2). In some
variations of formula (33) described in the paragraphs above, $L_3$ and $L_4$ are linker (a.2). In some
variations of formula (33) described in the paragraphs above, $L_1$, $L_2$, and $L_3$ are linker (a.2). In some
variations of formula (33) described in the paragraphs above, $L_1$, $L_2$, and $L_4$ are linker (a.2). In some
variations of formula (33) described in the paragraphs above, $L_1$, $L_3$, and $L_4$ are linker (a.2). In some
variations of formula (33) described in the paragraphs above, $L_2$, $L_3$, and $L_4$ are linker (a.2). In some
variations of formula (33) described in the paragraphs above, $L_1$, $L_2$, $L_3$, and $L_4$ are linker (a.2).

[907] In some variations of formula (33) described in the paragraphs above, at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (b.l):

\[ \text{[Diagram of a linker moiety]} \]

in which $n$ is 0-6, $n$ is 1-4, and * is the attachment site for the cationic dye moiety D.

[908] In some variations of formula (33) in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (b.l), $n$ is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

[909] In some variations of formula (33) described in the paragraphs above in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (b.l), $n$ is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[910] In some variations of formula (33) described in the paragraphs above, $L_1$ is linker (b.l). In some variations of formula (33) described in the paragraphs above, $L_2$ is linker (b.l). In some variations of formula (33) described in the paragraphs above, $L_3$ is linker (b.l). In some variations of formula (33) described in the paragraphs above, $L_4$ is linker (b.l). In some variations of formula (33) described in the paragraphs above, $L_1$ and $L_2$ are linker (b.l). In some variations of formula (33) described in the paragraphs above, $L_1$ and $L_3$ are linker (b.l). In some variations of formula (33) described in the paragraphs above, $L_1$ and $L_4$ are linker (b.l). In some variations of formula (33) described in the paragraphs above, $L_2$ and $L_3$ are linker (b.l). In some variations of formula (33) described in the paragraphs above, $L_2$ and $L_4$ are linker (b.l). In some variations of formula (33) described in the paragraphs above, $L_3$ and $L_4$ are linker (b.l). In some variations of formula (33) described in the paragraphs above, $L_1$, $L_2$, and $L_3$ are linker (b.l).
some variations of formula (33) described in the paragraphs above, L1, L2, and L4 are linker (b.l). In some variations of formula (33) described in the paragraphs above, L1, L3, and L4 are linker (b.l). In some variations of formula (33) described in the paragraphs above, L2, L3, and L4 are linker (b.l). In some variations of formula (33) described in the paragraphs above, L1, L2, L3, and L4 are linker (b.l).

[911] In some variations of formula (33) described in the paragraphs above, at least one of L1, L2, L3, and L4 is linker (c.l):

\[
\begin{align*}
\text{(c.1)} \quad \left[ \begin{array}{c}
R_a \\
R_b \\
\vdots \\
R_n \end{array} \right]_n^* \\
\end{align*}
\]

, in which \( n \) is 0-6, \( n_i \) is 1-4, either (1) \( R_a \) and \( R_b \) independently are H or CH₃ or (2) \( R_a \) and \( R_b \) are \( \overset{\text{\textbullet}}{\text{c}} \) or \( \overset{\text{\textbullet}}{\text{s}} \); or (3) two of \( \text{CR}_a \text{R}_b \) are \( \overset{\text{\textbullet}}{\text{c}} \); and \( * \) is the attachment site for the cationic dye moiety D.

[912] In some variations of formula (33) in which at least one of L1, L2, L3, and L4 is linker (c.l), \( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

[913] In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (c.l), \( n_i \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[914] In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (c.l), \( R_a \) is H and \( R_b \) is H. In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (c.l), \( R_a \) is H and \( R_b \) is CH₃. In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (c.l), \( R_a \) and \( R_b \) are \( \overset{\text{\textbullet}}{\text{c}} \). In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (c.l), \( R_a \) and \( R_b \) are \( \overset{\text{\textbullet}}{\text{s}} \). In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (c.l), two of \( \text{CR}_a \text{R}_b \) are \( \overset{\text{\textbullet}}{\text{c}} \).

[915] In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (c.l), \( L \) is \( \overset{\text{\textbullet}}{\text{c}} \), \( \overset{\text{\textbullet}}{\text{s}} \), \( \overset{\text{\textbullet}}{\text{c}} \), \( \overset{\text{\textbullet}}{\text{s}} \), \( \overset{\text{\textbullet}}{\text{c}} \).
In some variations of formula (33) described in the paragraphs above, \( L_1 \) is linker (c.l).
In some variations of formula (33) described in the paragraphs above, \( L_2 \) is linker (c.l).
In some variations of formula (33) described in the paragraphs above, \( L_3 \) is linker (c.l).
In some variations of formula (33) described in the paragraphs above, \( L_4 \) is linker (c.l).
In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_2 \) are linker (c.l).
In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_3 \) are linker (c.l).
In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_4 \) are linker (c.l).
In some variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_3 \) are linker (c.l).
In some variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_4 \) are linker (c.l).
In some variations of formula (33) described in the paragraphs above, \( L_3 \) and \( L_4 \) are linker (c.l).
In some variations of formula (33) described in the paragraphs above, \( L_1 \), \( L_2 \), and \( L_3 \) are linker (c.l).
In some variations of formula (33) described in the paragraphs above, \( L_1 \), \( L_2 \), and \( L_4 \) are linker (c.l).
In some variations of formula (33) described in the paragraphs above, \( L_1 \), \( L_3 \), and \( L_4 \) are linker (c.l).
In some variations of formula (33) described in the paragraphs above, \( L_2 \), \( L_3 \), and \( L_4 \) are linker (c.l).
In some variations of formula (33) described in the paragraphs above, \( L_1 \), \( L_2 \), \( L_3 \), and \( L_4 \) are linker (c.l).
[917] In some variations of formula (33) described in the paragraphs above, at least one of \( L_1 \), \( L_2 \), \( L_3 \), and \( L_4 \) is linker (c.2):

\[
\begin{align*}
\text{(c.2)} & \quad \bigotimes_{n} \bigoplus_{n} \\
& \quad \text{in which } n = 0-6, n_1 = 1-4, \text{either (1) } R_a \text{ and } R_b \text{ independently are } H \text{ or } CH_3 \\
& \quad \text{or (2) } R_a \text{ and } R_b \text{ are } \bigotimes \text{ or } \bigoplus; \text{ or (3) two of } CR_aR_b \text{ are } \bigotimes \text{ or } \bigoplus; \text{ and } ^* \text{ is the attachment site for the cationic dye moiety D.}
\end{align*}
\]

[918] In some variations of formula (33) in which at least one of \( L_1 \), \( L_2 \), \( L_3 \), and \( L_4 \) is linker (c.2), \( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

[919] In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1 \), \( L_2 \), \( L_3 \), and \( L_4 \) is linker (c.2), \( n_1 \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[920] In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1 \), \( L_2 \), \( L_3 \), and \( L_4 \) is linker (c.2), \( R_a \) is H and \( R_b \) is H. In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1 \), \( L_2 \), \( L_3 \), and \( L_4 \) is linker (c.2), \( R_a \) is H and \( R_b \) is \( CH_3 \). In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1 \), \( L_2 \), \( L_3 \), and \( L_4 \) is linker (c.2), \( R_a \) and \( R_b \) are \( \bigotimes \). In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1 \), \( L_2 \), \( L_3 \), and \( L_4 \) is linker (c.2), \( R_a \) and \( R_b \) are \( \bigoplus \). In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1 \), \( L_2 \), \( L_3 \), and \( L_4 \) is linker (c.2), two of \( CR_aR_b \) are \( \bigotimes \text{ or } \bigoplus \).

[921] In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1 \), \( L_2 \), \( L_3 \), and \( L_4 \) is linker (c.2), \( L \) is \( \bigotimes \text{ or } \bigoplus \).
In some variations of formula (33) described in the paragraphs above, L1 is linker (c.2). In some variations of formula (33) described in the paragraphs above, L2 is linker (c.2). In some variations of formula (33) described in the paragraphs above, L3 is linker (c.2). In some variations of formula (33) described in the paragraphs above, L4 is linker (c.2). In some variations of formula (33) described in the paragraphs above, L1 and L2 are linker (c.2). In some variations of formula (33) described in the paragraphs above, L1 and L3 are linker (c.2). In some variations of formula (33) described in the paragraphs above, L1 and L4 are linker (c.2). In some variations of formula (33) described in the paragraphs above, L2 and L3 are linker (c.2). In some variations of formula (33) described in the paragraphs above, L2 and L4 are linker (c.2). In some variations of formula (33) described in the paragraphs above, L3 and L4 are linker (c.2). In some variations of formula (33) described in the paragraphs above, L1, L2, and L3 are linker (c.2). In some variations of formula (33) described in the paragraphs above, L1, L2, and L4 are linker (c.2). In some variations of formula (33) described in the paragraphs above, L1, L3, and L4 are linker (c.2). In some variations of formula (33) described in the paragraphs above, L2, L3, and L4 are linker (c.2). In some variations of formula (33) described in the paragraphs above, L1, L2, L3, and L4 are linker (c.2).

In some variations of formula (33) described in the paragraphs above, at least one of L1, L2, L3, and L4 is linker (d):

\[
* \quad \begin{array}{c}
R_a \\
R_b \\
\hline
k \\
\end{array}
\]

(d), where \( k \) is 2-10; (1) \( R_a \) and \( 3/4 \), independently are H or CH₃, or (2) \( R_a \) and \( 3/4 \), are

\[
\begin{array}{c}
\text{or} \\
\text{or}
\end{array}
\]

of (3) two of \( \text{C} R_a R_b \) are \( \circledast \); and * is the attachment site for the cationic dye moiety D.

In some variations of formula (33) in which at least one of L1, L2, L3, and L4 is linker (d), \( k \) is 2-10, 2-9, 2-8, 2-7, 2-6, 2-5, 2-4, 2-3, 3-10, 3-9, 3-8, 3-7, 3-6, 3-5, 3-4, 4-10, 4-9, 4-8, 4-
In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (d), R_a is H and R_b is H. In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (d), R_a is H and R_b is CH_3. In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (d), R_a and R_b are \( \text{X} \). In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (d), R_a and R_b are \( \text{X} \). In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (d), two of \( \text{CR}_a \text{R}_b \) are \( \text{X} \).

In some variations of formula (33) described in the paragraphs above, L1 is linker (d). In some variations of formula (33) described in the paragraphs above, L2 is linker (d). In some variations of formula (33) described in the paragraphs above, L3 is linker (d). In some variations of formula (33) described in the paragraphs above, L4 is linker (d). In some variations of formula (33) described in the paragraphs above, L1 and L2 are linker (d). In some variations of formula (33) described in the paragraphs above, L1 and L3 are linker (d). In some variations of formula (33) described in the paragraphs above, L1 and L4 are linker (d). In some variations of formula (33) described in the paragraphs above, L2 and L3 are linker (d). In some variations of formula (33) described in the paragraphs above, L2 and L4 are linker (d). In some variations of formula (33) described in the paragraphs above, L3 and L4 are linker (d). In some variations of formula (33) described in the paragraphs above, L1, L2, and L3 are linker (d). In some variations of formula (33) described in the paragraphs above, L1, L2, and L4 are linker (d). In some variations of formula (33) described in the paragraphs above, L1, L3, and L4 are linker (d). In some variations of formula (33) described in the paragraphs above, L2, L3, and L4 are linker (d). In some variations of formula (33) described in the paragraphs above, L1, L2, L3, and L4 are linker (d).

In some variations of formula (33) described in the paragraphs above, at least one of L1, L2, L3, and L4 is linker (e.l):
In some variations of formula (33) in which at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (e.l), \( \bar{n} \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (e.l), \( \bar{n}_1 \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (33) described in the paragraphs above, \( L_1 \) is linker (e.l). In some variations of formula (33) described in the paragraphs above, \( L_2 \) is linker (e.l). In some variations of formula (33) described in the paragraphs above, \( L_3 \) is linker (e.l). In some variations of formula (33) described in the paragraphs above, \( L_4 \) is linker (e.l). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_2 \) are linker (e.l). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_3 \) are linker (e.l). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_4 \) are linker (e.l). In some variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_3 \) are linker (e.l). In some variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_4 \) are linker (e.l). In some variations of formula (33) described in the paragraphs above, \( L_3 \) and \( L_4 \) are linker (e.l). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, \) and \( L_3 \) are linker (e.l). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, \) and \( L_4 \) are linker (e.l). In some variations of formula (33) described in the paragraphs above, \( L_1, L_3, \) and \( L_4 \) are linker (e.l). In some variations of formula (33) described in the paragraphs above, \( L_2, L_3, \) and \( L_4 \) are linker (e.l). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, L_3, \) and \( L_4 \) are linker (e.l).

In some variations of formula (33) described in the paragraphs above, at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (f.l):

\[
\begin{align*}
\left[ \begin{array}{c}
\text{NH} \\
\text{O} \\
\text{NH}_2 \\
\end{array} \right]_{n_1}^{n_2} \\
\end{align*}
\]

, in which \( n \) is 0-6, \( \bar{n} \) is 1-4, and * is the attachment site for the cationic dye moiety D.
In some variations of formula (33) in which at least one of \( \text{L}_1, \text{L}_2, \text{L}_3, \) and \( \text{L}_4 \) is linker (f.l), \( n_1 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (33) described in the paragraphs above in which at least one of \( \text{L}_1, \text{L}_2, \text{L}_3, \) and \( \text{L}_4 \) is linker (f.l), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (33) described in the paragraphs above, \( \text{L}_1 \) is linker (f.l). In some variations of formula (33) described in the paragraphs above, \( \text{L}_2 \) is linker (f.l). In some variations of formula (33) described in the paragraphs above, \( \text{L}_3 \) is linker (f.l). In some variations of formula (33) described in the paragraphs above, \( \text{L}_4 \) is linker (f.l). In some variations of formula (33) described in the paragraphs above, \( \text{L}_1 \) and \( \text{L}_2 \) are linker (f.l). In some variations of formula (33) described in the paragraphs above, \( \text{L}_1 \) and \( \text{L}_3 \) are linker (f.l). In some variations of formula (33) described in the paragraphs above, \( \text{L}_1 \) and \( \text{L}_4 \) are linker (f.l). In some variations of formula (33) described in the paragraphs above, \( \text{L}_2 \) and \( \text{L}_3 \) are linker (f.l). In some variations of formula (33) described in the paragraphs above, \( \text{L}_2 \) and \( \text{L}_4 \) are linker (f.l). In some variations of formula (33) described in the paragraphs above, \( \text{L}_3 \) and \( \text{L}_4 \) are linker (f.l). In some variations of formula (33) described in the paragraphs above, \( \text{L}_1, \text{L}_2, \) and \( \text{L}_3 \) are linker (f.l). In some variations of formula (33) described in the paragraphs above, \( \text{L}_1, \text{L}_2, \) and \( \text{L}_4 \) are linker (f.l). In some variations of formula (33) described in the paragraphs above, \( \text{L}_1, \text{L}_3, \) and \( \text{L}_4 \) are linker (f.l). In some variations of formula (33) described in the paragraphs above, \( \text{L}_1, \text{L}_2, \text{L}_3, \) and \( \text{L}_4 \) are linker (f.l).

In some variations of formula (33) described in the paragraphs above, at least one of \( \text{L}_1, \text{L}_2, \text{L}_3, \) and \( \text{L}_4 \) is linker (f.2):

\[
* \begin{array}{c}
\text{NH}_2 \\
\text{L}_1 \\
\text{L}_2 \\
\text{L}_3 \\
\text{L}_4 \\
n_2 \\
\end{array}
\]

\[(\text{f.l})\]

, in which \( \text{NH}_2 \) is 0-5, \( n_2 \) is 1-5, and * is the attachment site for the cationic dye moiety D.

In some variations of formula (33) in which at least one of \( \text{L}_1, \text{L}_2, \text{L}_3, \) and \( \text{L}_4 \) is linker (f.2), \( n_1 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (33) described in the paragraphs above in which at least one of \( \text{L}_1, \text{L}_2, \text{L}_3, \) and \( \text{L}_4 \) is linker (f.2), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.
[938] In some variations of formula (33) described in the paragraphs above, L1 is linker (f.2). In some variations of formula (33) described in the paragraphs above, L2 is linker (f.2). In some variations of formula (33) described in the paragraphs above, L3 is linker (f.2). In some variations of formula (33) described in the paragraphs above, L4 is linker (f.2). In some variations of formula (33) described in the paragraphs above, L1 and L2 are linker (f.2). In some variations of formula (33) described in the paragraphs above, L1 and L3 are linker (f.2). In some variations of formula (33) described in the paragraphs above, L1 and L4 are linker (f.2). In some variations of formula (33) described in the paragraphs above, L2 and L3 are linker (f.2). In some variations of formula (33) described in the paragraphs above, L2 and L4 are linker (f.2). In some variations of formula (33) described in the paragraphs above, L3 and L4 are linker (f.2). In some variations of formula (33) described in the paragraphs above, L1, L2, and L3 are linker (f.2). In some variations of formula (33) described in the paragraphs above, L1, L2, and L4 are linker (f.2). In some variations of formula (33) described in the paragraphs above, L1, L3, and L4 are linker (f.2). In some variations of formula (33) described in the paragraphs above, L2, L3, and L4 are linker (f.2). In some variations of formula (33) described in the paragraphs above, L1, L2, L3, and L4 are linker (f.2).

[939] In some variations of formula (33) described in the paragraphs above, at least one of L1, L2, L3, and L4 is linker (g.1):

\[
\begin{array}{c}
\text{H-N} \\
\text{O} \\
\{n_1 \text{NH} \\
\text{H} \\
\text{NH}_2 \}
\end{array}
\quad \star
\]

(g.1), in which \(n_1\) is 0-5, \(n_2\) is 1-5, and \(\star\) is the attachment site for the cationic dye moiety D.

[940] In some variations of formula (33) in which at least one of L1, L2, L3, and L4 is linker (g.l), \(n_1\) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[941] In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (g.l), \(n_2\) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[942] In some variations of formula (33) described in the paragraphs above, L1 is linker (g.l). In some variations of formula (33) described in the paragraphs above, L2 is linker (g.l). In some variations of formula (33) described in the paragraphs above, L3 is linker (g.l). In some
variations of formula (33) described in the paragraphs above, L4 is linker (g.1). In some variations of formula (33) described in the paragraphs above, L1 and L2 are linker (g.1). In some variations of formula (33) described in the paragraphs above, L1 and L3 are linker (g.1). In some variations of formula (33) described in the paragraphs above, L1 and L4 are linker (g.1). In some variations of formula (33) described in the paragraphs above, L2 and L3 are linker (g.1). In some variations of formula (33) described in the paragraphs above, L2 and L4 are linker (g.1). In some variations of formula (33) described in the paragraphs above, L3 and L4 are linker (g.1). In some variations of formula (33) described in the paragraphs above, L1, L2, and L3 are linker (g.1). In some variations of formula (33) described in the paragraphs above, L1, L2, L3, and L4 are linker (g.1). In some variations of formula (33) described in the paragraphs above, L1, L2, L3, and L4 are linker (g.1). In some variations of formula (33) described in the paragraphs above, L1, L2, L3, and L4 are linker (g.1).

[943] In some variations of formula (33) described in the paragraphs above, at least one of L1, L2, L3, and L4 is linker (g.2):

\[ \text{[Diagram]} \]

, in which \( n_1 \) is 0-5, \( n_2 \) is 1-5, and * is the attachment site for the cationic dye moiety D.

[944] In some variations of formula (33) in which at least one of L1, L2, L3, and L4 is linker (g.2), \( n_1 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[945] In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (g.2), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[946] In some variations of formula (33) described in the paragraphs above, L1 is linker (g.2). In some variations of formula (33) described in the paragraphs above, L2 is linker (g.2). In some variations of formula (33) described in the paragraphs above, L3 is linker (g.2). In some variations of formula (33) described in the paragraphs above, L4 is linker (g.2). In some variations of formula (33) described in the paragraphs above, L1 and L2 are linker (g.2). In some variations of formula (33) described in the paragraphs above, L1 and L3 are linker (g.2). In some variations of formula (33) described in the paragraphs above, L1 and L4 are linker (g.2). In some
variations of formula (33) described in the paragraphs above, L1 and L4 are linker (g.2). In some variations of formula (33) described in the paragraphs above, L2 and L3 are linker (g.2). In some variations of formula (33) described in the paragraphs above, L2 and L4 are linker (g.2). In some variations of formula (33) described in the paragraphs above, L3 and L4 are linker (g.2). In some variations of formula (33) described in the paragraphs above, LI, L2, and L3 are linker (g.2). In some variations of formula (33) described in the paragraphs above, LI, L2, and L4 are linker (g.2). In some variations of formula (33) described in the paragraphs above, LI, L3, and L4 are linker (g.2). In some variations of formula (33) described in the paragraphs above, L2, L3, and L4 are linker (g.2). In some variations of formula (33) described in the paragraphs above, LI, L2, L3, and L4 are linker (g.2).

[947] In some variations of formula (33) described in the paragraphs above, at least one of LI, L2, L3, and L4 is linker (h.l):

\[
\begin{align*}
\text{Li} & \quad \text{L2} & \quad \text{L3} & \quad \text{L4} \\
\text{n1} & \quad \text{n2} & \quad \text{*} \\
\text{HN} & \quad \text{O} & \quad \text{NH}_2
\end{align*}
\]

(h.l) , in which \( n_1 \) is 0-5, \( n_2 \) is 1-5, and * is the attachment site for the cationic dye moiety D.

[948] In some variations of formula (33) in which at least one of LI, L2, L3, and L4 is linker (h.l), \( n_1 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[949] In some variations of formula (33) described in the paragraphs above in which at least one of LI, L2, L3, and L4 is linker (h.l), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[950] In some variations of formula (33) described in the paragraphs above, LI is linker (h.l). In some variations of formula (33) described in the paragraphs above, L2 is linker (h.l). In some variations of formula (33) described in the paragraphs above, L3 is linker (h.l). In some variations of formula (33) described in the paragraphs above, L4 is linker (h.l). In some variations of formula (33) described in the paragraphs above, LI and L2 are linker (h.l). In some variations of formula (33) described in the paragraphs above, LI and L3 are linker (h.l). In some variations of formula (33) described in the paragraphs above, LI and L4 are linker (h.l). In some variations of formula (33) described in the paragraphs above, L2 and L3 are linker (h.l). In some variations of formula (33) described in the paragraphs above, L2 and L4 are linker (h.l). In some
variations of formula (33) described in the paragraphs above, \( L_3 \) and \( L_4 \) are linker (h.1). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, \) and \( L_3 \) are linker (h.1). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, \) and \( L_4 \) are linker (h.1). In some variations of formula (33) described in the paragraphs above, \( L_1, L_3, \) and \( L_4 \) are linker (h.1). In some variations of formula (33) described in the paragraphs above, \( L_2, L_3, \) and \( L_4 \) are linker (h.1). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, L_3, \) and \( L_4 \) are linker (h.1).

[951] In some variations of formula (33) described in the paragraphs above, at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (h.2):

\[
\begin{array}{c}
\ast \\
\text{(h.2)} \\
\text{HN} \\
\text{NH}_2 \\
n_1 \\
n_2
\end{array}
\]

, in which \( n_1 \) is 0-5, \( n_2 \) is 1-5, and \( * \) is the attachment site for the cationic dye moiety D.

[952] In some variations of formula (33) in which at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (h.2), \( n_1 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[953] In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (h.2), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1. 2, 3, 4, or 5.

[954] In some variations of formula (33) described in the paragraphs above, \( L_1 \) is linker (h.2). In some variations of formula (33) described in the paragraphs above, \( L_2 \) is linker (h.2). In some variations of formula (33) described in the paragraphs above, \( L_3 \) is linker (h.2). In some variations of formula (33) described in the paragraphs above, \( L_4 \) is linker (h.2). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_2 \) are linker (h.2). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_3 \) are linker (h.2). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_4 \) are linker (h.2). In some variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_3 \) are linker (h.2). In some variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_4 \) are linker (h.2). In some variations of formula (33) described in the paragraphs above, \( L_3 \) and \( L_4 \) are linker (h.2). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, \) and \( L_3 \) are linker (h.2). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, \) and \( L_4 \) are linker (h.2).
In some variations of formula (33) described in the paragraphs above, \( L_1, L_3, \) and \( L_4 \) are linker (h.2). In some variations of formula (33) described in the paragraphs above, \( L_2, L_3, \) and \( L_4 \) are linker (h.2). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, L_3, \) and \( L_4 \) are linker (h.2).

In some variations of formula (33) described in the paragraphs above, at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (i.l):

![Diagram](image)

in which \( n_i \) and \( 3/4 \) independently are 1-5 and * is the attachment site for the cationic dye moiety D.

In some variations of formula (33) described in the paragraphs above, at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (i.l), \( n_i \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (i.l), \( n_i \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (33) described in the paragraphs above, \( L_1 \) is linker (i.l). In some variations of formula (33) described in the paragraphs above, \( L_2 \) is linker (i.l). In some variations of formula (33) described in the paragraphs above, \( L_3 \) is linker (i.l). In some variations of formula (33) described in the paragraphs above, \( L_4 \) is linker (i.l). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_2 \) are linker (i.l). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_3 \) are linker (i.l). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_4 \) are linker (i.l). In some variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_3 \) are linker (i.l). In some variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_4 \) are linker (i.l). In some variations of formula (33) described in the paragraphs above, \( L_3 \) and \( L_4 \) are linker (i.l). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, \) and \( L_3 \) are linker (i.l). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, \) and \( L_4 \) are linker (i.l). In some variations of formula (33) described in the paragraphs above, \( L_1, L_3, \) and \( L_4 \) are linker (i.l). In some variations of formula (33) described in the paragraphs above, \( L_2, L_3, \) and \( L_4 \) are linker (i.l). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, L_3, \) and \( L_4 \) are linker (i.l).
[959] In some variations of formula (33) described in the paragraphs above, at least one of \( \text{L}_1 \), \( \text{L}_2 \), \( \text{L}_3 \), and \( \text{L}_4 \) is linker (i.2):

\[
\begin{array}{c}
\text{H} \\
\text{N} \\
\text{H}
\end{array}
\] 

\( n_2 \), in which \( t_{ii} \) and \( n_2 \) independently are 1-5 and * is the attachment site for the cationic dye moiety D.

[960] In some variations of formula (33) described in the paragraphs above, at least one of \( \text{L}_1 \), \( \text{L}_2 \), \( \text{L}_3 \), and \( \text{L}_4 \) is linker (i.2), \( n_1 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[961] In some variations of formula (33) described in the paragraphs above in which at least one of \( \text{L}_1 \), \( \text{L}_2 \), \( \text{L}_3 \), and \( \text{L}_4 \) is linker (i.2), \( n_1 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[962] In some variations of formula (33) described in the paragraphs above, \( \text{L}_1 \) is linker (i.2). In some variations of formula (33) described in the paragraphs above, \( \text{L}_2 \) is linker (i.2). In some variations of formula (33) described in the paragraphs above, \( \text{L}_3 \) is linker (i.2). In some variations of formula (33) described in the paragraphs above, \( \text{L}_4 \) is linker (i.2). In some variations of formula (33) described in the paragraphs above, \( \text{L}_1 \) and \( \text{L}_2 \) are linker (i.2). In some variations of formula (33) described in the paragraphs above, \( \text{L}_1 \) and \( \text{L}_3 \) are linker (i.2). In some variations of formula (33) described in the paragraphs above, \( \text{L}_1 \) and \( \text{L}_4 \) are linker (i.2). In some variations of formula (33) described in the paragraphs above, \( \text{L}_2 \) and \( \text{L}_3 \) are linker (i.2). In some variations of formula (33) described in the paragraphs above, \( \text{L}_2 \) and \( \text{L}_4 \) are linker (i.2). In some variations of formula (33) described in the paragraphs above, \( \text{L}_3 \) and \( \text{L}_4 \) are linker (i.2). In some variations of formula (33) described in the paragraphs above, \( \text{L}_1 \), \( \text{L}_2 \), and \( \text{L}_3 \) are linker (i.2). In some variations of formula (33) described in the paragraphs above, \( \text{L}_1 \), \( \text{L}_2 \), and \( \text{L}_4 \) are linker (i.2). In some variations of formula (33) described in the paragraphs above, \( \text{L}_2 \), \( \text{L}_3 \), and \( \text{L}_4 \) are linker (i.2). In some variations of formula (33) described in the paragraphs above, \( \text{L}_1 \), \( \text{L}_3 \), and \( \text{L}_4 \) are linker (i.2). In some variations of formula (33) described in the paragraphs above, \( \text{L}_1 \), \( \text{L}_2 \), \( \text{L}_3 \), and \( \text{L}_4 \) are linker (i.2).
In some variations of formula (33) described in the paragraphs above, at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (j.l):

\[
\begin{array}{c}
H_2N \\
| \\
| \\
| \\
\text{CH} \quad \text{CH} \\
\text{NH}_2 \\
\end{array}
\]

\( (j.l) \)

, in which \( n_2 \) is 1-5 and * is the attachment site for the cationic dye moiety \( D \).

In some variations of formula (33) in which at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (j.l), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (33) described in the paragraphs above, \( L_1 \) is linker (j.l). In some variations of formula (33) described in the paragraphs above, \( L_2 \) is linker (j.l). In some variations of formula (33) described in the paragraphs above, \( L_3 \) is linker (j.l). In some variations of formula (33) described in the paragraphs above, \( L_4 \) is linker (j.l). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_2 \) are linker (j.l). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_3 \) are linker (j.l). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_4 \) are linker (j.l). In some variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_3 \) are linker (j.l). In some variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_4 \) are linker (j.l). In some variations of formula (33) described in the paragraphs above, \( L_3 \) and \( L_4 \) are linker (j.l). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, \) and \( L_3 \) are linker (j.l). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, \) and \( L_4 \) are linker (j.l). In some variations of formula (33) described in the paragraphs above, \( L_1, L_3, \) and \( L_4 \) are linker (j.l). In some variations of formula (33) described in the paragraphs above, \( L_2, L_3, \) and \( L_4 \) are linker (j.l). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, L_3, \) and \( L_4 \) are linker (j.l).
In some variations of formula (33) described in the paragraphs above, at least one of \( L_1 \), \( L_2 \), \( L_3 \), and \( L_4 \) is linker (j.2):

\[
\begin{align*}
&\text{in which } n_2 \text{ is 1-5 and } * \text{ is the attachment site for the cationic dye moiety D.}
\end{align*}
\]

In some variations of formula (33) described in the paragraphs above, \( L_1 \) is linker (j.2).

In some variations of formula (33) described in the paragraphs above, \( L_2 \) is linker (j.2).

In some variations of formula (33) described in the paragraphs above, \( L_3 \) is linker (j.2).

In some variations of formula (33) described in the paragraphs above, \( L_4 \) is linker (j.2).

In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_2 \) are linker (j.2).

In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_3 \) are linker (j.2).

In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_4 \) are linker (j.2).

In some variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_3 \) are linker (j.2).

In some variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_4 \) are linker (j.2).

In some variations of formula (33) described in the paragraphs above, \( L_3 \) and \( L_4 \) are linker (j.2).

In some variations of formula (33) described in the paragraphs above, \( L_1 \), \( L_2 \), and \( L_3 \) are linker (j.2).

In some variations of formula (33) described in the paragraphs above, \( L_1 \), \( L_2 \), and \( L_4 \) are linker (j.2).

In some variations of formula (33) described in the paragraphs above, \( L_1 \), \( L_3 \), and \( L_4 \) are linker (j.2).

In some variations of formula (33) described in the paragraphs above, \( L_2 \), \( L_3 \), and \( L_4 \) are linker (j.2).

In some variations of formula (33) described in the paragraphs above, \( L_1 \), \( L_2 \), \( L_3 \), and \( L_4 \) are linker (j.2).
In some variations of formula (33) described in the paragraphs above, at least one of \(L_1\), \(L_2\), \(L_3\), and \(L_4\) is linker (k):

![Diagram](image)

, in which \(I_f\) and \(\frac{3}{4}\) independently are 1-4, \(n\) is 1-4; ring A is aryl, heteroaryl, cycloalkyl, or heterocycl; (1) \(R_{a1}\) and \(R_{b1}\) independently are H or CH\(_3\) or (2) \(R_{a1}\) and \(R_{b1}\) independently are H or CH\(_3\) or (2) \(R_{a1}\) and \(R_{b1}\) independently are H or CH\(_3\) or (2) \(R_{a1}\) and \(R_{b1}\) independently are H or CH\(_3\) or (2) \(R_{a1}\) and \(R_{b1}\) independently are H or CH\(_3\) or (2) \(R_{a1}\) and \(R_{b1}\) independently are H or CH\(_3\); and \(R_{b2}\) and \(R_{b2}\) independently are H or CH\(_3\); or (3) two of \(CR_{a1}\) and \(R_{b1}\) are independently H or CH\(_3\); or (3) two of \(CR_{a1}\) and \(R_{b1}\) are independently H or CH\(_3\); or (3) two of \(CR_{a1}\) and \(R_{b1}\) are independently H or CH\(_3\); and \(*\) is the attachment site for the cationic dye moiety D.

In some variations of formula (33) in which at least one of \(L_1\), \(L_2\), \(L_3\), and \(L_4\) is linker (k), \(I_f\) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (33) described in the paragraphs above in which at least one of \(L_1\), \(L_2\), \(L_3\), and \(L_4\) is linker (k), \(I_f\) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (33) described in the paragraphs above in which at least one of \(L_1\), \(L_2\), \(L_3\), and \(L_4\) is linker (k), \(R_{a1}\) is H and \(R_{b1}\) is H. In some variations of formula (33) described in the paragraphs above in which at least one of \(L_1\), \(L_2\), \(L_3\), and \(L_4\) is linker (k), \(R_{a1}\) is H and \(R_{b1}\) is CH\(_3\). In some variations of formula (33) described in the paragraphs above in which at least one of \(L_1\), \(L_2\), \(L_3\), and \(L_4\) is linker (k), \(R_{a1}\) and \(R_{b1}\) are \(\uparrow\). In some variations of formula (33) described in the paragraphs above in which at least one of \(L_1\), \(L_2\), \(L_3\), and \(L_4\) is linker (k), \(R_{a1}\) and \(R_{b1}\) are \(\uparrow\). In some variations of formula (33) described in the paragraphs above in which at least one of \(L_1\), \(L_2\), \(L_3\), and \(L_4\) is linker (k), two of \(CR_{a1}\) and \(R_{b1}\) are \(\uparrow\).

In some variations of formula (33) described in the paragraphs above in which at least one of \(L_1\), \(L_2\), \(L_3\), and \(L_4\) is linker (k), \(R_{a2}\) is H and \(R_{b2}\) is H. In some variations of formula (33) described in the paragraphs above in which at least one of \(L_1\), \(L_2\), \(L_3\), and \(L_4\) is linker (k), \(R_{a2}\) is H and \(R_{b2}\) is CH\(_3\). In some variations of formula (33) described in the paragraphs above in which
at least one of \( \text{L}_1, \text{L}_2, \text{L}_3, \) and \( \text{L}_4 \) is linker (k), \( \text{R}_{a2} \) and \( \text{R}_{b2} \) are \( \text{O} \). In some variations of formula (33) described in the paragraphs above in which at least one of \( \text{L}_1, \text{L}_2, \text{L}_3, \) and \( \text{L}_4 \) is linker (k), \( \text{R}_{a2} \) and \( \text{R}_{b2} \) are \( \text{O} \). In some variations of formula (33) described in the paragraphs above in which at least one of \( \text{L}_1, \text{L}_2, \text{L}_3, \) and \( \text{L}_4 \) is linker (k), two of \( \text{C} \text{R}_{a2}\text{R}_{b2} \) are \( \text{O} \).

[974] In some variations of formula (33) described in the paragraphs above in which at least one of \( \text{L}_1, \text{L}_2, \text{L}_3, \) and \( \text{L}_4 \) is linker (k), \textbf{ring A} is

\[
\text{(a)} \quad \text{\[974\]}
\]

 \( \text{optionally substituted with halo or C1-C6 linear or branched alkyl;} \)

\[
\text{(b)} \quad \text{\[974\]}
\]

 \( \text{optionally substituted with halo or C1-C6 linear or branched alkyl;} \) or

\[
\text{(c)} \quad \text{\[974\]}
\]
optionally substituted with halo or C1-C6 linear or branched alkyl.

[975] In some variations of formula (33) described in the paragraphs above in which \( L \) is linker (k), ring A is substituted with halo. In some variations, the halo is F, Br, I, or Cl.

[976] In some variations of formula (33) described in the paragraphs above in which \( L \) is linker (k), ring A is substituted with C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, Cl-C3, C1-C2, CI, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[977] In some variations of formula (33) described in the paragraphs above, \( L_1 \) is linker (k). In some variations of formula (33) described in the paragraphs above, \( L_2 \) is linker (k). In some variations of formula (33) described in the paragraphs above, \( L_3 \) is linker (k). In some variations of formula (33) described in the paragraphs above, \( L_4 \) is linker (k). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_2 \) are linker (k). In some variations of formula
(33) described in the paragraphs above, L1 and L3 are linker (k). In some variations of formula (33) described in the paragraphs above, L1 and L4 are linker (k). In some variations of formula (33) described in the paragraphs above, L2 and L3 are linker (k). In some variations of formula (33) described in the paragraphs above, L2 and L4 are linker (k). In some variations of formula (33) described in the paragraphs above, L3 and L4 are linker (k). In some variations of formula (33) described in the paragraphs above, L1, L2, and L3 are linker (k). In some variations of formula (33) described in the paragraphs above, L1, L2, and L4 are linker (k). In some variations of formula (33) described in the paragraphs above, L1, L3, and L4 are linker (k). In some variations of formula (33) described in the paragraphs above, L2, L3, and L4 are linker (k). In some variations of formula (33) described in the paragraphs above, L1, L2, L3, and L4 are linker (k).

[978] In some variations of formula (33) described in the paragraphs above, at least one of L1, L2, L3, and L4 is linker (1.1):

![Diagram](image)

, in which I1, I2, n, o, i, and θ2 independently are 1-4;

ring A is aryl, heteroaryl, cycloalkyl, or heterocycyl; for each independent instance of R_a₁ and R_b₁, R_a and R_b (l) independently are H or CH₃, or (2) R_a₁ and R_b₁ independently are or , or (3) two of of for each independent instance of R_a₂ and R_b₂, R_a₂ and R_b₂ (1) independently are H or CH₃, or (2) R_a₂ and R_b₂ independently are or , or (3) two of of for each independent instance of R_a and R_d; R_a and R_d (1)

independently are H or CH₃, or (2) R_a and R_d independently are or , or (3) two of of for each independent instance of R_c and R_d; R_c and R_d (1)

independently are H or CH₃, or (2) R_c and R_d independently are or , or (3) two of of for each independent instance of R_c and R_d; R_c and R_d (1)

independently are H or CH₃, or (2) R_c and R_d independently are or , or (3) two of of for each independent instance of R_c and R_d; R_c and R_d (1)

and * is the attachment site for the cationic dye moiety D.
In some variations of formula (33) in which at least one of LI, L2, L3, and L4 is linker (1.1), \( I_i \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (33) described in the paragraphs above in which at least one of LI, L2, L3, and L4 is linker (1.1), \( I_j \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (33) described in the paragraphs above in which at least one of LI, L2, L3, and L4 is linker (1.1), \( \theta_j \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (33) described in the paragraphs above in which at least one of LI, L2, L3, and L4 is linker (1.1), \( o_j \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (33) described in the paragraphs above in which at least one of LI, L2, L3, and L4 is linker (1.1), \( R_{ai} \) and \( R_{b1} \) are H and \( R_{bi} \) is CH₃. In some variations of formula (33) described in the paragraphs above in which at least one of LI, L2, L3, and L4 is linker (1.1), \( R_{ai} \) and \( R_{b1} \) are H and \( R_{bi} \) is CH₃. In some variations of formula (33) described in the paragraphs above in which at least one of LI, L2, L3, and L4 is linker (1.1), \( R_{ai} \) and \( R_{b1} \) are H and \( R_{bi} \) is CH₃. In some variations of formula (33) described in the paragraphs above in which at least one of LI, L2, L3, and L4 is linker (1.1), \( R_{ai} \) and \( R_{b1} \) are H and \( R_{bi} \) is CH₃. In some variations of formula (33) described in the paragraphs above in which at least one of LI, L2, L3, and L4 is linker (1.1), two of \( CR_{ai} \)Rbi are...
In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (1.1), \( R_{c1} \) is \( H \) and \( R_{d1} \) is \( H \). In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (1.1), \( R_{c1} \) is \( H \) and \( R_{d1} \) is \( \text{CH}_3 \). In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (1.1), \( R_{c1} \) and \( R_{d1} \) are optionally substituted with halo or C1-C6 linear or branched alkyl; optionally substituted with halo or C1-C6 linear or branched alkyl; or

In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (1.1), \( R_{c2} \) is \( H \) and \( R_{d2} \) is \( H \). In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (1.1), \( R_{c2} \) is \( H \) and \( R_{d2} \) is \( \text{CH}_3 \). In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (1.1), \( R_{c2} \) and \( R_{d2} \) are optionally substituted with halo or C1-C6 linear or branched alkyl; optionally substituted with halo or C1-C6 linear or branched alkyl; or

In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (1.1), \( \text{ring A} \) is

(a) \[
\begin{align*}
\text{\includegraphics[width=2cm]{structure1.png}}
\end{align*}
\]

(b) \[
\begin{align*}
\text{\includegraphics[width=2cm]{structure2.png}}
\end{align*}
\]

optionally substituted with halo or C1-C6 linear or branched alkyl; or

optionally substituted with halo or C1-C6 linear or branched alkyl; or
optionally substituted with halo or C1-C6 linear or branched alkyl.

[988] In some variations of formula (33) described in the paragraphs above in which \( L \) is linker (1.1), ring \( A \) is substituted with halo. In some variations, the halo is \( \text{F}, \text{Br}, \text{I}, \) or \( \text{Cl} \).

[989] In some variations of formula (33) described in the paragraphs above in which \( L \) is linker (1.1), ring \( A \) is substituted with C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[990] In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (1.1), \( n \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[991] In some variations of formula (33) described in the paragraphs above, \( L_1 \) is linker (1.1). In some variations of formula (33) described in the paragraphs above, \( L_2 \) is linker (1.1). In some variations of formula (33) described in the paragraphs above, \( L_3 \) is linker (1.1). In some variations of formula (33) described in the paragraphs above, \( L_4 \) is linker (1.1). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_2 \) are linker (1.1). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_3 \) are linker (1.1). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_4 \) are linker (1.1). In some variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_3 \) are linker (1.1). In some variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_4 \) are linker (1.1). In some variations of formula (33) described in the paragraphs above, \( L_3 \) and \( L_4 \) are linker (1.1). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, \) and \( L_3 \) are linker (1.1). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, \) and \( L_4 \) are linker (1.1). In some variations of formula (33) described in the paragraphs above, \( L_1, L_3, \) and \( L_4 \) are linker (1.1). In some variations of formula (33) described in the paragraphs above, \( L_2, L_3, \) and \( L_4 \) are linker (1.1). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, L_3, \) and \( L_4 \) are linker (1.1).

[992] In some variations of formula (33) described in the paragraphs above, at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (1.2):
ring A is aryl, heteroaryl, cycloalkyl, or heterocyclyl; for each independent instance of R\(a_i\) and R\(b_i\), \(\frac{3}{4}\) i and Rbi(1) independently are H or CH\(_3\), or (2) R\(a_i\) and R\(b_i\) independently are \(\chi\) or \(\chi\), or (3) two of CR\(a_i\)R\(b_i\) are \(\chi\); for each independent instance of R\(a_2\) and R\(b_2\), R\(a_2\) and R\(b_2\) (1) independently are H or CH\(_3\), or (2) R\(c_i\) and R\(d_i\) independently are \(\chi\) or \(\chi\), or (3) two of CR\(c_i\)R\(d_i\) are \(\chi\); for each independent instance of R\(c_2\) and R\(d_2\), R\(c_2\) and R\(d_2\) (1) independently are H or CH\(_3\), or (2) R\(e_2\) and R\(d_2\) independently are \(\chi\) or \(\chi\), or (3) two of CR\(e_2\)R\(d_2\) are \(\chi\); and * is the attachment site for the cationic dye moiety D.

[993] In some variations of formula (33) in which at least one of LI, L2, L3, and L4 is linker (1.2), \(I_i\) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[994] In some variations of formula (33) described in the paragraphs above in which at least one of LI, L2, L3, and L4 is linker (1.2), \(I_2\) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[995] In some variations of formula (33) described in the paragraphs above in which at least one of LI, L2, L3, and L4 is linker (1.2), \(\theta_j\) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[996] In some variations of formula (33) described in the paragraphs above in which at least one of LI, L2, L3, and L4 is linker (1.2), \(o_2\) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[997] In some variations of formula (33) described in the paragraphs above in which at least one of LI, L2, L3, and L4 is linker (1.2), R\(a_i\) is H and R\(b_i\) is H. In some variations of formula (33) described in the paragraphs above in which at least one of LI, L2, L3, and L4 is linker (1.2),
R_{a} is H and R_{b} is CH_{3}. In some variations of formula (33) described in the paragraphs above in which at least one of L_{1}, L_{2}, L_{3}, and L_{4} is linker (1.2), R_{a} and R_{b} are \( \text{[Diagram]} \). In some variations of formula (33) described in the paragraphs above in which at least one of L_{1}, L_{2}, L_{3}, and L_{4} is linker (1.2), R_{a} and R_{b} are \( \text{[Diagram]} \). In some variations of formula (33) described in the paragraphs above in which at least one of L_{1}, L_{2}, L_{3}, and L_{4} is linker (1.2), two of CR_{a} and CR_{b} are \( \text{[Diagram]} \). In some variations of formula (33) described in the paragraphs above in which at least one of L_{1}, L_{2}, L_{3}, and L_{4} is linker (1.2), R_{a} and R_{b} are \( \text{[Diagram]} \). In some variations of formula (33) described in the paragraphs above in which at least one of L_{1}, L_{2}, L_{3}, and L_{4} is linker (1.2), two of CR_{a} and CR_{b} are \( \text{[Diagram]} \). In some variations of formula (33) described in the paragraphs above in which at least one of L_{1}, L_{2}, L_{3}, and L_{4} is linker (1.2), R_{a} and R_{b} are \( \text{[Diagram]} \). In some variations of formula (33) described in the paragraphs above in which at least one of L_{1}, L_{2}, L_{3}, and L_{4} is linker (1.2), two of CR_{a} and CR_{b} are \( \text{[Diagram]} \). In some variations of formula (33) described in the paragraphs above in which at least one of L_{1}, L_{2}, L_{3}, and L_{4} is linker (1.2), R_{a} and R_{b} are \( \text{[Diagram]} \). In some variations of formula (33) described in the paragraphs above in which at least one of L_{1}, L_{2}, L_{3}, and L_{4} is linker (1.2), two of CR_{a} and CR_{b} are \( \text{[Diagram]} \). In some variations of formula (33) described in the paragraphs above in which at least one of L_{1}, L_{2}, L_{3}, and L_{4} is linker (1.2), R_{a} and R_{b} are \( \text{[Diagram]} \). In some variations of formula (33) described in the paragraphs above in which at least one of L_{1}, L_{2}, L_{3}, and L_{4} is linker (1.2), two of CR_{a} and CR_{b} are \( \text{[Diagram]} \). In some variations of formula (33) described in the paragraphs above in which at least one of L_{1}, L_{2}, L_{3}, and L_{4} is linker (1.2), R_{a} and R_{b} are \( \text{[Diagram]} \). In some variations of formula (33) described in the paragraphs above in which at least one of L_{1}, L_{2}, L_{3}, and L_{4} is linker (1.2), two of CR_{a} and CR_{b} are \( \text{[Diagram]} \). In some variations of formula (33) described in the paragraphs above in which at least one of L_{1}, L_{2}, L_{3}, and L_{4} is linker (1.2), R_{a} and R_{b} are \( \text{[Diagram]} \). In some variations of formula (33) described in the paragraphs above in which at least one of L_{1}, L_{2}, L_{3}, and L_{4} is linker (1.2), two of CR_{a} and CR_{b} are \( \text{[Diagram]} \). In some variations of formula (33) described in the paragraphs above in which at least one of L_{1}, L_{2}, L_{3}, and L_{4} is linker (1.2), R_{a} and R_{b} are \( \text{[Diagram]} \). In some variations of formula (33) described in the paragraphs above in which at least one of L_{1}, L_{2}, L_{3}, and L_{4} is linker (1.2), two of CR_{a} and CR_{b} are \( \text{[Diagram]} \).
described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (1.2). R_{e2} is H and R_{d2} is CH₃. In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (1.2), R_{e2} and R_{d2} are \( \text{CH}_3 \). In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (1.2), two of CR_{e2}R_{d2} are \( \text{CH}_3 \).

\[ \text{[1001]} \] In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (1.2), ring A is \( \text{\includegraphics{image}} \), optionally substituted with halo or C1-C6 linear or branched alkyl;

\[ \text{[b]} \] optionally substituted with halo or C1-C6 linear or branched alkyl; or

\[ \text{[c]} \] optionally substituted with halo or C1-C6 linear or branched alkyl; or
optionally substituted with halo or C1-C6 linear or branched alkyl.

[1002] In some variations of formula (33) described in the paragraphs above in which \( L \) is linker (1.2), \( \text{ring} A \) is substituted with halo. In some variations, the halo is F, Br, I, or Cl.

[1003] In some variations of formula (33) described in the paragraphs above in which \( L \) is linker (1.2), \( \text{ring} A \) is substituted with C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[1004] In some variations of formula (33) described in the paragraphs above in which at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (1.2), \( n \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.
In some variations of formula (33) described in the paragraphs above, L₁ is linker (1.2). In some variations of formula (33) described in the paragraphs above, L₂ is linker (1.2). In some variations of formula (33) described in the paragraphs above, L₃ is linker (1.2). In some variations of formula (33) described in the paragraphs above, L₄ is linker (1.2). In some variations of formula (33) described in the paragraphs above, L₁ and L₂ are linker (1.2). In some variations of formula (33) described in the paragraphs above, L₁ and L₃ are linker (1.2). In some variations of formula (33) described in the paragraphs above, L₁ and L₄ are linker (1.2). In some variations of formula (33) described in the paragraphs above, L₂ and L₃ are linker (1.2). In some variations of formula (33) described in the paragraphs above, L₂ and L₄ are linker (1.2). In some variations of formula (33) described in the paragraphs above, L₃ and L₄ are linker (1.2). In some variations of formula (33) described in the paragraphs above, L₁, L₂, and L₃ are linker (1.2). In some variations of formula (33) described in the paragraphs above, L₁, L₂, and L₄ are linker (1.2). In some variations of formula (33) described in the paragraphs above, L₁, L₃, and L₄ are linker (1.2). In some variations of formula (33) described in the paragraphs above, L₂, L₃, and L₄ are linker (1.2). In some variations of formula (33) described in the paragraphs above, L₁, L₂, L₃, and L₄ are linker (1.2).

In some variations of formula (33) described in the paragraphs above, at least one of L₁, L₂, L₃, and L₄ is linker (m.l):

\[
\begin{array}{c}
\text{HN} \\
\text{N}
\end{array}
\] 

\[n\] 

\[\star\]

(m.l) , in which \(n\) is 0-6, \(n₁\) is 1-4, and \(\star\) is the attachment site for the cationic dye moiety D.

In some variations of formula (33) in which at least one of L₁, L₂, L₃, and L₄ is linker (m.l), \(n\) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

In some variations of formula (33) described in the paragraphs above in which at least one of L₁, L₂, L₃, and L₄ is linker (m.l), \(n₁\) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (33) described in the paragraphs above, L₁ is linker (m.l). In some variations of formula (33) described in the paragraphs above, L₂ is linker (m.l). In some variations of formula (33) described in the paragraphs above, L₃ is linker (m.l). In some variations of formula (33) described in the paragraphs above, L₄ is linker (m.l). In some
variations of formula (33) described in the paragraphs above, L1 and L2 are linker (m.l). In some variations of formula (33) described in the paragraphs above, L1 and L3 are linker (m.l). In some variations of formula (33) described in the paragraphs above, L1 and L4 are linker (m.l). In some variations of formula (33) described in the paragraphs above, L2 and L3 are linker (m.l). In some variations of formula (33) described in the paragraphs above, L2 and L4 are linker (m.l). In some variations of formula (33) described in the paragraphs above, L3 and L4 are linker (m.l). In some variations of formula (33) described in the paragraphs above, L1, L2, and L3 are linker (m.l). In some variations of formula (33) described in the paragraphs above, L1, L2, and L4 are linker (m.l). In some variations of formula (33) described in the paragraphs above, L1, L3, and L4 are linker (m.l). In some variations of formula (33) described in the paragraphs above, L2, L3, and L4 are linker (m.l). In some variations of formula (33) described in the paragraphs above, L1, L2, L3, and L4 are linker (m.l).

[1010] In some variations of formula (33) described in the paragraphs above, at least one of L1, L2, L3, and L4 is linker (n.l):

![Diagram of L1, L2, L3, and L4](image)

in which \( n_2 \) is 1-5 and * is the attachment site for the cationic dye moiety D.

[1011] In some variations of formula (33) in which at least one of L1, L2, L3, and L4 is linker (n.l), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[1012] In some variations of formula (33) described in the paragraphs above, L1 is linker (n.l). In some variations of formula (33) described in the paragraphs above, L2 is linker (n.l). In some variations of formula (33) described in the paragraphs above, L3 is linker (n.l). In some variations of formula (33) described in the paragraphs above, L4 is linker (n.l). In some variations of formula (33) described in the paragraphs above, L1 and L2 are linker (n.l). In some variations of formula (33) described in the paragraphs above, L1 and L3 are linker (n.l). In some variations of formula (33) described in the paragraphs above, L1 and L4 are linker (n.l). In some
variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_3 \) are linker (n.1). In some variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_4 \) are linker (n.1). In some variations of formula (33) described in the paragraphs above, \( L_3 \) and \( L_4 \) are linker (n.1). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, \) and \( L_3 \) are linker (n.1). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, \) and \( L_4 \) are linker (n.1). In some variations of formula (33) described in the paragraphs above, \( L_2, L_3, \) and \( L_4 \) are linker (n.1). In some variations of formula (33) described in the paragraphs above, \( L_1, L_2, L_3, \) and \( L_4 \) are linker (n.1).

[1013] In some variations of formula (33) described in the paragraphs above, at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (n.2):

![Diagram](image)

, in which \( n_2 \) is 1-5 and * is the attachment site for the cationic dye moiety D.

[1014] In some variations of formula (33) in which at least one of \( L_1, L_2, L_3, \) and \( L_4 \) is linker (n.2), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[1015] In some variations of formula (33) described in the paragraphs above, \( L_1 \) is linker (n.2). In some variations of formula (33) described in the paragraphs above, \( L_2 \) is linker (n.2). In some variations of formula (33) described in the paragraphs above, \( L_3 \) is linker (n.2). In some variations of formula (33) described in the paragraphs above, \( L_4 \) is linker (n.2). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_2 \) are linker (n.2). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_3 \) are linker (n.2). In some variations of formula (33) described in the paragraphs above, \( L_1 \) and \( L_4 \) are linker (n.2). In some variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_3 \) are linker (n.2). In some variations of formula (33) described in the paragraphs above, \( L_2 \) and \( L_4 \) are linker (n.2). In some variations of formula (33) described in the paragraphs above, \( L_3 \) and \( L_4 \) are linker (n.2). In some
variations of formula (33) described in the paragraphs above, L1, L2, and L3 are linker (n.2). In some variations of formula (33) described in the paragraphs above, L1, L2, and L4 are linker (n.2). In some variations of formula (33) described in the paragraphs above, L1, L3, and L4 are linker (n.2). In some variations of formula (33) described in the paragraphs above, L2, L3, and L4 are linker (n.2). In some variations of formula (33) described in the paragraphs above, L1, L2, L3, and L4 are linker (n.2).

[1016] In some variations of formula (33) described in the paragraphs above, at least one of L1, L2, L3, and L4 is linker (o):

\[
\begin{array}{c}
\text{HN} \\
\text{O} \\
\text{n} \\
\end{array}
\]

\(n_2\) in which \(n_2\) is 1-5, \(n_3\) is 0-5, and * is the attachment site for the cationic dye moiety D.

[1017] In some variations of formula (33) in which at least one of L1, L2, L3, and L4 is linker (o), \(n_1\) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[1018] In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (o), \(n_2\) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[1019] In some variations of formula (33) described in the paragraphs above in which at least one of L1, L2, L3, and L4 is linker (o), \(n_3\) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[1020] In some variations of formula (33) described in the paragraphs above, L1 is linker (o). In some variations of formula (33) described in the paragraphs above, L2 is linker (o). In some variations of formula (33) described in the paragraphs above, L3 is linker (o). In some variations of formula (33) described in the paragraphs above, L4 is linker (o). In some variations of formula (33) described in the paragraphs above, L1 and L2 are linker (o). In some variations of formula (33) described in the paragraphs above, L1 and L3 are linker (o). In some variations of formula (33) described in the paragraphs above, L1 and L4 are linker (o). In some variations of formula (33) described in the paragraphs above, L2 and L3 are linker (o). In some variations of formula...
(33) described in the paragraphs above, L2 and L4 are linker (o). In some variations of formula (33) described in the paragraphs above, L3 and L4 are linker (o). In some variations of formula (33) described in the paragraphs above, L1, L2, and L3 are linker (o). In some variations of formula (33) described in the paragraphs above, L1, L2, and L4 are linker (o). In some variations of formula (33) described in the paragraphs above, L1, L3, and L4 are linker (o). In some variations of formula (33) described in the paragraphs above, L2, L3, and L4 are linker (o). In some variations of formula (33) described in the paragraphs above, L1, L2, L3, and L4 are linker (o).

[1021] In some variations of formula (33) described in the paragraphs above, at least one of L1, L2, L3, and L4 is linker (p):

\[ \text{Diagram} \]

in which \( n_{1} \) is 0-5, \( n_{2} \) is 1-5, \( n_{3} \) is 0-5, and * is the attachment site for the cationic dye moiety D.

[1022] In some variations of formula (33) described above in which at least one of L1, L2, L3, and L4 is linker (p), \( n_{1} \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[1023] In some variations of formula (33) described above in which at least one of L1, L2, L3, and L4 is linker (p), \( n_{2} \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[1024] In some variations of formula (33) described above in which at least one of L1, L2, L3, and L4 is linker (p), \( n_{3} \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[1025] In some variations of formula (33) described in the paragraphs above, L1 is linker (p). In some variations of formula (33) described in the paragraphs above, L2 is linker (p). In some variations of formula (33) described in the paragraphs above, L3 is linker (p). In some variations of formula (33) described in the paragraphs above, L4 is linker (p). In some variations of formula (33) described in the paragraphs above, L1 and L2 are linker (p). In some variations of formula (33) described in the paragraphs above, L1 and L3 are linker (p). In some variations of formula
(33) described in the paragraphs above, L1 and L4 are linker (p). In some variations of formula (33) described in the paragraphs above, L2 and L3 are linker (p). In some variations of formula (33) described in the paragraphs above, L2 and L4 are linker (p). In some variations of formula (33) described in the paragraphs above, L3 and L4 are linker (p). In some variations of formula (33) described in the paragraphs above, L1, L2, and L3 are linker (p). In some variations of formula (33) described in the paragraphs above, L1, L2, and L4 are linker (p). In some variations of formula (33) described in the paragraphs above, L1, L3, and L4 are linker (p). In some variations of formula (33) described in the paragraphs above, L2, L3, and L4 are linker (p). In some variations of formula (33) described in the paragraphs above, L1, L2, L3, and L4 are linker (P).

[1026] In some variations of formula (33) described in the paragraphs above, at least one of L1, L2, L3, and L4 is linker (q):

![Diagram](image)

, in which \( n_4 \) is 0-5, \( n_2 \) is 1-5, and * is the attachment site for the cationic dye moiety D.

[1027] In some variations of formula (33) in which at least one of L1, L2, L3, and L4 is linker (o), \( n_4 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[1028] In some variations of formula (33) described above in which at least one of L1, L2, L3, and L4 is linker (q), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[1029] In some variations of formula (33) described in the paragraphs above, L1 is linker (q). In some variations of formula (33) described in the paragraphs above, L2 is linker (q). In some variations of formula (33) described in the paragraphs above, L3 is linker (q). In some variations of formula (33) described in the paragraphs above, L4 is linker (q). In some variations of formula (33) described in the paragraphs above, L1 and L2 are linker (q). In some variations of formula (33) described in the paragraphs above, L1 and L3 are linker (q). In some variations of formula (33) described in the paragraphs above, L1 and L4 are linker (q). In some variations of formula (33) described in the paragraphs above, L2 and L3 are linker (q). In some variations of formula (33) described in the paragraphs above, L2 and L4 are linker (q). In some variations of formula (33) described in the paragraphs above, L3 and L4 are linker (q). In some variations of formula (33) described in the paragraphs above, L2 and L4 are linker (q). In some variations of formula (33) described in the paragraphs above, L3 and L4 are linker (q). In some variations of formula (33) described in the paragraphs above, L3 and L4 are linker (q).
(33) described in the paragraphs above, \textbf{L1, L2,} and \textbf{L3} are linker (q). In some variations of formula (33) described in the paragraphs above, \textbf{L1, L2,} and \textbf{L4} are linker (q). In some variations of formula (33) described in the paragraphs above, \textbf{L1, L3,} and \textbf{L4} are linker (q). In some variations of formula (33) described in the paragraphs above, \textbf{L2, L3,} and \textbf{L4} are linker (q). In some variations of formula (33) described in the paragraphs above, \textbf{L1, L2, L3,} and \textbf{L4} are linker (q).

[1030] In some variations of formula (33) described in the paragraphs above, at least one of \textbf{L1, L2, L3,} and \textbf{L4} is linker (r):

\[
\text{\textbf{L}}_{\text{\textbf{1}}}, \text{\textbf{L}}_{\text{\textbf{2}}}, \text{\textbf{L}}_{\text{\textbf{3}}}, \text{\textbf{L}}_{\text{\textbf{4}}} \quad (r)
\]

\[
\text{\textbf{L}}_{\text{\textbf{1}}}, \text{\textbf{L}}_{\text{\textbf{2}}}, \text{\textbf{L}}_{\text{\textbf{3}}}, \text{\textbf{L}}_{\text{\textbf{4}}} \quad (r)
\]

, in which \( \eta \) is 0-5, \( \eta_{2} \) is 1-5, \( n_{3} \) is 0-5, and * is the attachment site for the cationic dye moiety D.

[1031] In some variations of formula (33) in which at least one of \textbf{L1, L2, L3,} and \textbf{L4} is linker (r), \( n_{4} \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[1032] In some variations of formula (33) described in the paragraphs above in which at least one of \textbf{L1, L2, L3,} and \textbf{L4} is linker (r), \( n_{2} \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[1033] In some variations of formula (33) in which at least one of \textbf{L1, L2, L3,} and \textbf{L4} is linker (r), \( n_{3} \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

[1034] In some variations of formula (33) described in the paragraphs above, \textbf{L1} is linker (r). In some variations of formula (33) described in the paragraphs above, \textbf{L2} is linker (r). In some variations of formula (33) described in the paragraphs above, \textbf{L3} is linker (r). In some variations of formula (33) described in the paragraphs above, \textbf{L4} is linker (r). In some variations of formula (33) described in the paragraphs above, \textbf{L1} and \textbf{L2} are linker (r). In some variations of formula (33) described in the paragraphs above, \textbf{L1} and \textbf{L3} are linker (r). In some variations of formula (33) described in the paragraphs above, \textbf{L1} and \textbf{L4} are linker (r). In some variations of formula (33) described in the paragraphs above, \textbf{L2} and \textbf{L3} are linker (r). In some variations of formula (33) described in the paragraphs above, \textbf{L2} and \textbf{L4} are linker (r). In some variations of formula (33) described in the paragraphs above, \textbf{L3} and \textbf{L4} are linker (r).
In some variations of formula (33) described in the paragraphs above, L2 and L4 are linker (r). In some variations of formula (33) described in the paragraphs above, L3 and L4 are linker (r). In some variations of formula (33) described in the paragraphs above, L1, L2, and L3 are linker (r). In some variations of formula (33) described in the paragraphs above, L1, L2, and L4 are linker (r). In some variations of formula (33) described in the paragraphs above, L1, L3, and L4 are linker (r). In some variations of formula (33) described in the paragraphs above, L2, L3, and L4 are linker (r). In some variations of formula (33) described in the paragraphs above, L1, L2, L3, and L4 are linker (r).

[1035] In some variations of formula (33) described in the paragraphs above, at least one of L1, L2, L3, and L4 is linker (s):

\[
\begin{array}{c}
\text{NH} \\
(\text{s})
\end{array}
\]

, in which \( n_1 \) is 0-5, \( n_2 \) is 1-5, \( n_3 \) is 0-5, and * is the attachment site for the cationic dye moiety D.

[1036] In some variations of formula (33) described in the paragraphs above, L1 is linker (s). In some variations of formula (33) described in the paragraphs above, L2 is linker (s). In some variations of formula (33) described in the paragraphs above, L3 is linker (s). In some variations of formula (33) described in the paragraphs above, L4 is linker (s). In some variations of formula (33) described in the paragraphs above, L1 and L2 are linker (s). In some variations of formula (33) described in the paragraphs above, L1 and L3 are linker (s). In some variations of formula (33) described in the paragraphs above, L1 and L4 are linker (s). In some variations of formula (33) described in the paragraphs above, L2 and L3 are linker (s). In some variations of formula (33) described in the paragraphs above, L2 and L4 are linker (s). In some variations of formula (33) described in the paragraphs above, L3 and L4 are linker (s). In some variations of formula (33) described in the paragraphs above, L1, L2, and L3 are linker (s). In some variations of formula (33) described in the paragraphs above, L1, L2, and L4 are linker (s). In some variations of formula (33) described in the paragraphs above, L1, L3, and L4 are linker (s). In some variations of formula (33) described in the paragraphs above, L2, L3, and L4 are linker (s).
some variations of formula (33) described in the paragraphs above, \(L_1, L_2, L_3, \) and \(L_4\) are linker(s).

[1037] In some variations of formula (33) described in the paragraphs above, \(L_1\) is absent. In some variations of formula (33) described in the paragraphs above, \(L_2\) is absent. In some variations of formula (33) described in the paragraphs above, \(L_3\) is absent. In some variations of formula (33) described in the paragraphs above, \(L_4\) is absent. In some variations of formula (33) described in the paragraphs above, \(L_1\) and \(L_2\) are absent. In some variations of formula (33) described in the paragraphs above, \(L_1\) and \(L_3\) are absent. In some variations of formula (33) described in the paragraphs above, \(L_1\) and \(L_4\) are absent. In some variations of formula (33) described in the paragraphs above, \(L_2\) and \(L_3\) are absent. In some variations of formula (33) described in the paragraphs above, \(L_2\) and \(L_4\) are absent. In some variations of formula (33) described in the paragraphs above, \(L_3\) and \(L_4\) are absent. In some variations of formula (33) described in the paragraphs above, \(L_1, L_2, L_3, \) and \(L_4\) are absent.

[1038] In some variations of formula (33), each of \(L_1, L_2, L_3, \) and \(L_4\) is a different linker. In some variations of formula (33), each of \(L_1, L_2, L_3, \) and \(L_4\) is the same linker. In some variations of formula (33), \(L_1\) is a first linker and each of \(L_2, L_3, \) and \(L_4\) is the same second linker, wherein the first and second linkers are different. In some variations of formula (33), \(L_2\) is a first linker, and each of \(L_1, L_3, \) and \(L_4\) is a second linker, wherein the first and second linkers are different. In some variations of formula (33), \(L_3\) is a first linker, and each of \(L_1, L_2, \) and \(L_4\) is a second linker, wherein the first and second linkers are different. In some variations of formula (33), \(L_4\) is a first linker, and each of \(L_1, L_2, \) and \(L_3\) is a second linker, wherein the first and second linkers are different. In some variations of formula (33), each of \(L_1\) and \(L_2\) is the same first linker, and each of \(L_3\) and \(L_4\) is the same second linker, wherein the first and second linkers are different. In some variations of formula (33), each of \(L_1\) and \(L_2\) is the same first linker, \(L_3\) is a second linker, and \(L_4\) is a third linker, wherein the first, second, and third linkers are different. In some variations of formula (33), each of \(L_1\) and \(L_3\) is the same first linker, \(L_2\) is a second linker, and \(L_4\) is a third linker, wherein the first, second, and third linkers are different. In some variations of formula (33), each of \(L_1\) and \(L_4\) is the same first linker, and each of \(L_2\) and \(L_3\) is
the same second linker, wherein the first and second linkers are different. In some variations of
formula (33), each of \textbf{L1} and \textbf{L4} is the same first linker, \textbf{L2} is a different second linker, and \textbf{L3} is a different third linker, wherein the first, second, and third linkers are different. In some variations of formula (33), each of \textbf{L2} and \textbf{L3} is the same first linker, and each of \textbf{L1} and \textbf{L4} is the same second linker, wherein the first and second linkers are different.

\[1039\] In some variations of formula (33) described in the paragraphs above, \textbf{D1} is safranin-O. In some variations of formula (33) described in the paragraphs above, \textbf{D2} is safranin-O. In some variations of formula (33) described in the paragraphs above, \textbf{D3} is safranin-O. In some variations of formula (33) described in the paragraphs above, \textbf{D4} is safranin-O. In some variations of formula (33) described in the paragraphs above, \textbf{D1} and \textbf{D2} are safranin-O. In some variations of formula (33) described in the paragraphs above, \textbf{D1} and \textbf{D3} are safranin-O. In some variations of formula (33) described in the paragraphs above, \textbf{D1} and \textbf{D4} are safranin-O. In some variations of formula (33) described in the paragraphs above, \textbf{D2} and \textbf{D3} are safranin-O. In some variations of formula (33) described in the paragraphs above, \textbf{D2} and \textbf{D4} are safranin-O. In some variations of formula (33) described in the paragraphs above, \textbf{D3} and \textbf{D4} are safranin-O. In some variations of formula (33) described in the paragraphs above, \textbf{D1}, \textbf{D2}, and \textbf{D3} are safranin-O. In some variations of formula (33) described in the paragraphs above, \textbf{D1}, \textbf{D2}, and \textbf{D4} are safranin-O. In some variations of formula (33) described in the paragraphs above, \textbf{D1}, \textbf{D3}, and \textbf{D4} are safranin-O. In some variations of formula (33) described in the paragraphs above, \textbf{D2}, \textbf{D3}, and \textbf{D4} are safranin-O. In some variations of formula (33) described in the paragraphs above, \textbf{D1}, \textbf{D2}, \textbf{D3}, and \textbf{D4} are safranin-O.

\[1040\] In some variations of formula (33) described in the paragraph above, the pendant phenyl ring of \textbf{D1} is unsubstituted. In some variations of formula (33) described in the paragraph above, the pendant phenyl ring of \textbf{D1} is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of \textbf{D1} is substituted, the substituents are selected independently from \(-\text{NH}_2, -\text{NHR}, -\text{NR}_2, -\text{OH}, -\text{O}^-, \)

\(-\text{NCOCH}_3, -\text{NHCOR}, -\text{OCH}_3, -\text{OR}, -\text{C}_2\text{H}_5, -\text{R}, \) and \(-\text{C}_6\text{H}_5, \) wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of \textbf{D1} is substituted, the substituents are selected independently from \(-\text{NO}_2, -\text{NR}_3^+, \) halo (e.g., F, Br, Cl, I), trihalide (e.g., -\text{CF}_3, -\text{CCl}_3, -\text{CBr}_3, -\text{Cl}_3), -\text{CN}, -\text{SO}_2\text{H}, -\text{COOH}, -\text{COOR}, -\text{CHO}, and -\text{COR}, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-
C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[1041] In some variations of formula (33) described in the two paragraphs above, the pendant phenyl ring of D2 is unsubstituted. In some variations of formula (33) described in the paragraph above, the pendant phenyl ring of D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NH2, —NHR, —NR2, —OH, —O’, —NHCOCH3, —NHCOR, —OCH3, —OR, —C2H5, —R, and —C6H5, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NO2, —NR3+, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF3, —CCl3, —CBr3, —Cl3), —CN, —SO2H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[1042] In some variations of formula (33) described in the three paragraphs above, the pendant phenyl ring of D3 is unsubstituted. In some variations of formula (33) described in the paragraph above, the pendant phenyl ring of D3 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —NH2, —NHR, —NR2, —OH, —O’, —NHCOCH3, —NHCOR, —OCH3, —OR, —C2H5, —R, and —C6H5, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, Cl, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —NO2, —NR3+, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF3, —CCl3, —CBr3, —Cl3), —CN, —SO2H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).
In some variations of formula (33) described in the three paragraphs above, the pendant phenyl ring of D4 is unsubstituted. In some variations of formula (33) described in the paragraph above, the pendant phenyl ring of D4 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D4 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D4 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —S₀₂₃H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

In some variations, cationic dye multimers are cyclic, as illustrated by formula (34):

![Diagram](image)

(34)

, wherein at least one of D₁, D₂, and D₃ is a cationic dye moiety and one or more of L₁, L₂, and L₃ are absent or each of L₁, L₂, and L₃ is a linker independently selected from linker (a.1), linker (a.2), linker (b.1), linker (c.1), linker (c.2), linker (d), linker (e.1), linker (f.1), linker (f.2), linker (g.1), linker (g.2), linker (h.1), linker (h.2), linker (i.1), linker (i.2), linker (j.1), linker (j.2), linker (k), linker (1.1), linker (1.2), is linker (m.1), linker (n.1), linker (n.2), linker (o), linker (p), linker (q), linker (r), and linker (s), described above.
In some variations of formula (34) described in the paragraphs above, at least one of D1, D2, and D3 is a different cationic dye moiety. In some variations of formula (34) described in the paragraphs above, at least one of D1, D2, and D3 is the same cationic dye moiety. In some variations of formula (34) described in the paragraphs above, at least one of D1 and D2 is the same first cationic dye moiety and D3 is a second cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (34) described in the paragraphs above, at least one of D1 and D3 is the same first cationic dye moiety and D2 is a second cationic dye moiety, wherein the first and second cationic dye moieties are different. In some variations of formula (34) described in the paragraphs above, at least one of D2 and D3 is the same first cationic dye moiety and D1 is a second cationic dye moiety, wherein the first and second cationic dye moieties are different.

In some variations of formula (34) described in the paragraphs above, at least one of D1, D2, and D3 is independently are selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

In some variations of formula (34) described in the paragraphs above, at least one of L1, L2, and L3 is linker (a.l):

\[
\text{[N=n_1]} \quad \text{[1045]} \quad \text{[1046]}
\]

\[
, \text{ in which } n \text{ is 1-6, } n_1 \text{ is 1-4, and } * \text{ is the attachment site for the cationic dye moiety } D. \]

In some variations of formula (34) in which at least one of L1, L2, and L3 is linker (a.l), \( n \) is 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 1, 2, 3, 4, 5, or 6.

In some variations of formula (34) described in the paragraphs above in which at least one of L1, L2, and L3 is linker (a.l), \( n_1 \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (34) described in the paragraphs above, L1 is linker (a.l). In some variations of formula (34) described in the paragraphs above, L2 is linker (a.l). In some variations of formula (34) described in the paragraphs above, L3 is linker (a.l). In some variations of formula (34) described in the paragraphs above, L1 and L2 are linker (a.l). In some variations of formula (34) described in the paragraphs above, L1 and L3 are linker (a.l). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (a.l). In some variations of formula (34) described in the paragraphs above, L1, L2, and L3 are linker (a.l).
In some variations of formula (34) described in the paragraphs above, at least one of LI, L2, and L3 is linker (a.2):

\[
\begin{array}{c}
\text{N} \\
\text{H} \\
\text{H} \\
\text{H} \\
n \\
\end{array}
\]

\[(a.2)\]

, in which \( n \) is 1-6, \( n_I \) is 1-4, and ∗ is the attachment site for the cationic dye moiety D.

In some variations of formula (34) in which at least one of LI, L2, and L3 is linker (a.2), \( n \) is 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 1, 2, 3, 4, 5, or 6.

In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (a.2), \( n_I \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (34) described in the paragraphs above, LI is linker (a.2). In some variations of formula (34) described in the paragraphs above, L2 is linker (a.2). In some variations of formula (34) described in the paragraphs above, L3 is linker (a.2). In some variations of formula (34) described in the paragraphs above, LI and L2 are linker (a.2). In some variations of formula (34) described in the paragraphs above, LI and L3 are linker (a.2). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (a.2). In some variations of formula (34) described in the paragraphs above, LI, L2, and L3 are linker (a.2).

In some variations of formula (34) described in the paragraphs above, at least one of LI, L2, and L3 is linker (b.1):

\[
\begin{array}{c}
\text{N} \\
\text{H} \\
\text{H} \\
\text{N} \\
n \\
\end{array}
\]

\[(b.1)\]

, in which \( n \) is 0-6, \( n_I \) is 1-4, and ∗ is the attachment site for the cationic dye moiety D.

In some variations of formula (34) in which at least one of LI, L2, and L3 is linker (b.1), \( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (b.1), \( n_I \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (34) described in the paragraphs above, at least one of LI, L2, and L3 is linker (c.1):
\[
\begin{align*}
\text{(c.1)} & \quad \bullet
\end{align*}
\]

, in which \( n \) is 0-6, \( \kappa \) is 1-4, either (1) \( R_a \) and \( R_b \) independently are H or CH\(_3\)
or (2) \( R_a \) and \( R_b \) are or (3) two of \( CR_aR_b \) are and \( \bullet \) is the attachment site for the cationic dye moiety D.

[1059] In some variations of formula (34) in which at least one of LI, L2, and L3 is linker (c.l), \( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

[1060] In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (c.l), \( n_l \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[1061] In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (c.l), \( R_a \) is H and \( R_b \) is H. In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (c.l), \( R_a \) is H and \( R_b \) is CH\(_3\). In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (c.l), \( R_a \) and \( R_b \) are. In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (c.l), \( R_a \) and \( R_b \) are. In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (c.l), two of \( CR_aR_b \) are.

[1062] In some variations of formula (34) described in the paragraphs above, LI is linker (c.l). In some variations of formula (34) described in the paragraphs above, L2 is linker (c.l). In some variations of formula (34) described in the paragraphs above, L3 is linker (c.l). In some variations of formula (34) described in the paragraphs above, LI and L2 are linker (c.l). In some variations of formula (34) described in the paragraphs above, LI and L3 are linker (c.l). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (c.l). In some variations of formula (34) described in the paragraphs above, LI, L2, and L3 are linker (c.l).

[1063] In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (c.l), LI is 

\[\text{\begin{align*}
\text{\( L \)} \quad & \quad \bullet
\end{align*}\]
In some variations of formula (34) described in the paragraphs above, LI is linker (c.l).

In some variations of formula (34) described in the paragraphs above, L2 is linker (c.l). In some variations of formula (34) described in the paragraphs above, L3 is linker (c.l). In some variations of formula (34) described in the paragraphs above, LI and L2 are linker (c.l). In some variations of formula (34) described in the paragraphs above, LI and L3 are linker (c.l). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (c.l). In some variations of formula (34) described in the paragraphs above, LI, L2, and L3 are linker (c.l).

In some variations of formula (34) described in the paragraphs above, at least one of LI, L2, and L3 is linker (c.2):

\[
\begin{array}{c}
\ast \\
\text{(c.2)}
\end{array}
\]

\[
\left[ R_a \quad R_b \right]_n, \quad \text{in which } n \text{ is } 0-6, \quad \text{or (2) } R_a \quad \text{and } R_b \quad \text{are } H \text{ or } \text{CH}_3
\]

or (2) \( R_a \) and \( R_b \) are \( \bigtriangleup \) or \( \bigtriangledown \); or (3) two of \( CR_a \;R_b \) are \( \times \) or \( \times \); and * is the attachment site for the cationic dye moiety D.

In some variations of formula (34) in which at least one of LI, L2, and L3 is linker (c.2),

\( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (c.2), \( n_1 \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.
In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (c.2), R_a is H and \( \frac{1}{2} \), is H. In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (c.2), R_a is H and R_b is CH_3. In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (c.2), R_a and R_b are \( \text{structure image} \). In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (c.2), two of CR_a R_b are \( \text{structure image} \).

In some variations of formula (34) described in the paragraphs above, LI is linker (b.l). In some variations of formula (34) described in the paragraphs above, L2 is linker (b.l). In some variations of formula (34) described in the paragraphs above, L3 is linker (b.l). In some variations of formula (34) described in the paragraphs above, LI and L2 are linker (b.l). In some variations of formula (34) described in the paragraphs above, LI and L3 are linker (b.l). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (b.l). In some variations of formula (34) described in the paragraphs above, LI, L2, and L3 are linker (b.l).

In some variations of formula (34) described in the paragraphs above in which at least one of L1, L2, and L3 is linker (c.2), L is \( \text{structure image} \), or \( \text{structure image} \).
variations of formula (34) described in the paragraphs above, \( L_1 \) and \( L_2 \) are linker (c.2). In some variations of formula (34) described in the paragraphs above, \( L_1 \) and \( L_3 \) are linker (c.2). In some variations of formula (34) described in the paragraphs above, \( L_2 \) and \( L_3 \) are linker (c.2). In some variations of formula (34) described in the paragraphs above, \( L_1, L_2, \) and \( L_3 \) are linker (c.2).

[1072] In some variations of formula (34) described in the paragraphs above, at least one of \( L_1, L_2, \) and \( L_3 \) is linker (d):

\[
\begin{align*}
\text{(d)} & \\
\begin{array}{c}
\text{\begin{tikzpicture}
\node (a) at (0,0) {$R_a$};
\node (b) at (1,0) {$R_b$};
\node (c) at (0.5,0.5) {$R_k$};
\draw (a) -- (c);
\draw (b) -- (c);
\end{tikzpicture}}
\end{array}
\end{align*}
\]

where \( k \) is 2-10; (1) \( R_a \) and \( \frac{3}{4} \), independently are H or CH\(_3\), or (2) \( R_a \) and \( \frac{3}{4} \), are \( \begin{tikzpicture}
\node (a) at (0,0) {$R_a$};
\node (b) at (1,0) {$R_b$};
\node (c) at (0.5,0.5) {$R_k$};
\draw (a) -- (c);
\draw (b) -- (c);
\end{tikzpicture} \). (3) two of \( CR_a R_b \) are \( \begin{tikzpicture}
\node (a) at (0,0) {$R_a$};
\node (b) at (1,0) {$R_b$};
\node (c) at (0.5,0.5) {$R_k$};
\draw (a) -- (c);
\draw (b) -- (c);
\end{tikzpicture} \); and \( * \) is the attachment site for the cationic dye moiety D

[1073] In some variations of formula (34) in which at least one of \( L_1, L_2, \) and \( L_3 \) is linker (d), \( k \) is 2-10, 2-9, 2-8, 2-7, 2-6, 2-5, 2-4, 2-3, 3-10, 3-9, 3-8, 3-7, 3-6, 3-5, 3-4, 4-10, 4-9, 4-8, 4-7, 4-6, 4-5, 5-10, 5-9, 5-8, 5-7, 5-6, 6-10, 6-9, 6-8, 6-7, 7-10, 7-9, 7-8, 8-10, 8-9, 9-10, 2, 3, 4, 5, 6, 7, 8, 9, or 10.

[1074] In some variations of formula (34) described in the paragraphs above in which at least one of \( L_1, L_2, \) and \( L_3 \) is linker (d), \( R_a \) is H and \( R_b \) is H. In some variations of formula (34) described in the paragraphs above in which at least one of \( L_1, L_2, \) and \( L_3 \) is linker (d), \( R_a \) is H and \( R_b \) is CH\(_3\). In some variations of formula (34) described in the paragraphs above in which at least one of \( L_1, L_2, \) and \( L_3 \) is linker (d), \( R_a \) and \( R_b \) are \( \begin{tikzpicture}
\node (a) at (0,0) {$R_a$};
\node (b) at (1,0) {$R_b$};
\node (c) at (0.5,0.5) {$R_k$};
\draw (a) -- (c);
\draw (b) -- (c);
\end{tikzpicture} \). In some variations of formula (34) described in the paragraphs above in which at least one of \( L_1, L_2, \) and \( L_3 \) is linker (d), \( R_a \) and \( R_b \) are \( \begin{tikzpicture}
\node (a) at (0,0) {$R_a$};
\node (b) at (1,0) {$R_b$};
\node (c) at (0.5,0.5) {$R_k$};
\draw (a) -- (c);
\draw (b) -- (c);
\end{tikzpicture} \). In some variations of formula (34) described in the paragraphs above in which at least one of \( L_1, L_2, \) and \( L_3 \) is linker (d), two of \( CR_a R_b \) are \( \begin{tikzpicture}
\node (a) at (0,0) {$R_a$};
\node (b) at (1,0) {$R_b$};
\node (c) at (0.5,0.5) {$R_k$};
\draw (a) -- (c);
\draw (b) -- (c);
\end{tikzpicture} \).

[1075] In some variations of formula (34) described in the paragraphs above, \( L_1 \) is linker (d). In some variations of formula (34) described in the paragraphs above, \( L_2 \) is linker (d). In some variations of formula (34) described in the paragraphs above, \( L_3 \) is linker (d). In some variations of formula (34) described in the paragraphs above, \( L_1 \) and \( L_2 \) are linker (d). In some variations of formula (34) described in the paragraphs above, \( L_1 \) and \( L_3 \) are linker (d). In some variations...
of formula (34) described in the paragraphs above, L2 and L3 are linker (d). In some variations of formula (34) described in the paragraphs above, L1, L2, and L3 are linker (d).

[1076] In some variations of formula (34) described in the paragraphs above, at least one of L1, L2, and L3 is linker (e):

\[
\begin{array}{c}
\text{N} \\
\text{O} \\
\text{NH}
\end{array}
\]

(e.1)

, in which \( n \) is 0-6, \( \bar{n} \) is 1-4, and * is the attachment site for the cationic dye moiety D.

[1077] In some variations of formula (34) in which at least one of L1, L2, and L3 is linker (e.l), \( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

[1078] In some variations of formula (34) described in the paragraphs above in which at least one of L1, L2, and L3 is linker (e.l), \( \bar{n} \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[1079] In some variations of formula (34) described in the paragraphs above, L1 is linker (e.l). In some variations of formula (34) described in the paragraphs above, L2 is linker (e.l). In some variations of formula (34) described in the paragraphs above, L3 is linker (e.l). In some variations of formula (34) described in the paragraphs above, L1 and L2 are linker (e.l). In some variations of formula (34) described in the paragraphs above, L1 and L3 are linker (e.l). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (e.l). In some variations of formula (34) described in the paragraphs above, L1, L2, and L3 are linker (e.l).

[1080] In some variations of formula (34) described in the paragraphs above, at least one of L1, L2, and L3 is linker (f.l):

\[
\begin{array}{c}
\text{N} \\
\text{O} \\
\text{NH}
\end{array}
\]

(f.1)

, in which \( \bar{\bar{n}} \) is 0-5, \( \bar{n} \) is 1-5, and * is the attachment site for the cationic dye moiety D.

[1081] In some variations of formula (34) in which at least one of L1, L2, and L3 is linker (f.l), \( n \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.
In some variations of formula (34) described in the paragraphs above in which at least one of L1, L2, and L3 is linker (f.l), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above, L1 is linker (f.l). In some variations of formula (34) described in the paragraphs above, L2 is linker (f.l). In some variations of formula (34) described in the paragraphs above, L3 is linker (f.l). In some variations of formula (34) described in the paragraphs above, L1 and L2 are linker (f.l). In some variations of formula (34) described in the paragraphs above, L1 and L3 are linker (f.l). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (f.l). In some variations of formula (34) described in the paragraphs above, L1, L2, and L3 are linker (f.l).

In some variations of formula (34) described in the paragraphs above, at least one of L1, L2, and L3 is linker (f.2):

\[
\begin{array}{c}
\text{\ast} \\
\text{\( \text{NH} \)} \\
\text{\( \text{f.2} \)} \\
\text{\( \text{NH}_2 \)} \\
\end{array}
\]

in which \( \text{\( ii \)} \) is 0-5, \( n_2 \) is 1-5, and \( \ast \) is the attachment site for the cationic dye moiety D.

In some variations of formula (34) in which at least one of L1, L2, and L3 is linker (f.2), \( \text{\( ii \)} \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above in which at least one of L1, L2, and L3 is linker (f.2), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above, L1 is linker (f.2). In some variations of formula (34) described in the paragraphs above, L2 is linker (f.2). In some variations of formula (34) described in the paragraphs above, L3 is linker (f.2). In some variations of formula (34) described in the paragraphs above, L1 and L2 are linker (f.2). In some variations of formula (34) described in the paragraphs above, L1 and L3 are linker (f.2). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (f.2). In some variations of formula (34) described in the paragraphs above, L1, L2, and L3 are linker (f.2).

In some variations of formula (34) described in the paragraphs above, at least one of L1, L2, and L3 is linker (g.l):
In some variations of formula (34) in which at least one of L1, L2, and L3 is linker (g.l), \( n_i \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above in which at least one of L1, L2, and L3 is linker (g.l), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above, L1 is linker (g.l). In some variations of formula (34) described in the paragraphs above, L2 is linker (g.l). In some variations of formula (34) described in the paragraphs above, L3 is linker (g.l). In some variations of formula (34) described in the paragraphs above, L1 and L2 are linker (g.l). In some variations of formula (34) described in the paragraphs above, L1 and L3 are linker (g.l). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (g.l). In some variations of formula (34) described in the paragraphs above, L1, L2, and L3 are linker (g.l).

In some variations of formula (34) described in the paragraphs above, at least one of L1, L2, and L3 is linker (g.2):

\[
\begin{array}{c}
\text{HN} \\
\end{array}
\begin{array}{c}
\text{O} \\
\end{array}
\begin{array}{c}
\{n_1, \text{NH} \\
\text{NH}_2 \\
\}
\end{array}
\begin{array}{c}
\text{n}_2
\end{array}
\begin{array}{c}
\text* \\
\end{array}
\]

(9-2) , in which \( n_i \) is 0-5, \( n_2 \) is 1-5, and * is the attachment site for the cationic dye moiety D.

In some variations of formula (34) in which at least one of L1, L2, and L3 is linker (g.2), \( n_i \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.
In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (g.2), $n_2$ is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above, LI is linker (g.2). In some variations of formula (34) described in the paragraphs above, L2 is linker (g.2). In some variations of formula (34) described in the paragraphs above, L3 is linker (g.2). In some variations of formula (34) described in the paragraphs above, LI and L2 are linker (g.2). In some variations of formula (34) described in the paragraphs above, LI and L3 are linker (g.2). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (g.2). In some variations of formula (34) described in the paragraphs above, LI, L2, and L3 are linker (g.2).

In some variations of formula (34) described in the paragraphs above, at least one of LI, L2, and L3 is linker (h.l):

![Diagram](image)

, in which $n_1$ is 0-5, $n_2$ is 1-5, and * is the attachment site for the cationic dye moiety D.

In some variations of formula (34) in which at least one of LI, L2, and L3 is linker (h.l), $n_1$ is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (h.l), $n_2$ is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above, LI is linker (h.l). In some variations of formula (34) described in the paragraphs above, L2 is linker (h.l). In some variations of formula (34) described in the paragraphs above, L3 is linker (h.l). In some variations of formula (34) described in the paragraphs above, LI and L2 are linker (h.l). In some variations of formula (34) described in the paragraphs above, LI and L3 are linker (h.l). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (h.l). In some variations of formula (34) described in the paragraphs above, LI, L2, and L3 are linker (h.l).
In some variations of formula (34) described in the paragraphs above, at least one of LI, L2, and L3 is linker (h.2):

\[ \text{[Diagram]} \]

, in which \( n_1 \) is 0-5, \( n_2 \) is 1-5, and \( * \) is the attachment site for the cationic dye moiety D.

In some variations of formula (34) in which at least one of LI, L2, and L3 is linker (h.2), \( n_1 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (h.2), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above, LI is linker (h.2). In some variations of formula (34) described in the paragraphs above, L2 is linker (h.2). In some variations of formula (34) described in the paragraphs above, L3 is linker (h.2). In some variations of formula (34) described in the paragraphs above, LI and L2 are linker (h.2). In some variations of formula (34) described in the paragraphs above, LI and L3 are linker (h.2). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (h.2). In some variations of formula (34) described in the paragraphs above, LI, L2, and L3 are linker (h.2).

In some variations of formula (34) described in the paragraphs above, at least one of LI, L2, and L3 is linker (i.l):

\[ \text{[Diagram]} \]

, in which \( n_1 \) and \( n_2 \) independently are 1-5 and \( * \) is the attachment site for the cationic dye moiety D.

In some variations of formula (34) described in the paragraphs above, at least one of LI, L2, and L3 is linker (i.l), \( n_1 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.
In some variations of formula (34) described in the paragraphs above in which at least one of L1, L2, and L3 is linker (i.l), $n_j$ is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above, L1 is linker (i.l). In some variations of formula (34) described in the paragraphs above, L2 is linker (i.l). In some variations of formula (34) described in the paragraphs above, L3 is linker (i.l). In some variations of formula (34) described in the paragraphs above, L1 and L2 are linker (i.l). In some variations of formula (34) described in the paragraphs above, L1 and L3 are linker (i.l). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (i.l). In some variations of formula (34) described in the paragraphs above, L1, L2, and L3 are linker (i.l).

In some variations of formula (34) described in the paragraphs above, at least one of L1, L2, and L3 is linker (i.2):

$\begin{align*}
\text{[Image]}
\end{align*}$

, in which $n_{i1}$ and $n_{i2}$ independently are 1-5 and * is the attachment site for the cationic dye moiety D.

In some variations of formula (34) described in the paragraphs above, at least one of L1, L2, and L3 is linker (i.2), $n_j$ is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above in which at least one of L1, L2, and L3 is linker (i.2), $n_j$ is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above, L1 is linker (i.2). In some variations of formula (34) described in the paragraphs above, L2 is linker (i.2). In some variations of formula (34) described in the paragraphs above, L3 is linker (i.2). In some variations of formula (34) described in the paragraphs above, L1 and L2 are linker (i.2). In some variations of formula (34) described in the paragraphs above, L1 and L3 are linker (i.2). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (i.2). In some variations of formula (34) described in the paragraphs above, L1, L2, and L3 are linker (i.2).

In some variations of formula (34) described in the paragraphs above, at least one of L1, L2, and L3 is linker (j.l):
In some variations of formula (34) in which at least one of L1, L2, and L3 is linker (j.1), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[1114] In some variations of formula (34) described in the paragraphs above, L1 is linker (j.1). In some variations of formula (34) described in the paragraphs above, L2 is linker (j.1). In some variations of formula (34) described in the paragraphs above, L3 is linker (j.1). In some variations of formula (34) described in the paragraphs above, L1 and L2 are linker (j.1). In some variations of formula (34) described in the paragraphs above, L1 and L3 are linker (j.1). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (j.1). In some variations of formula (34) described in the paragraphs above, L1, L2, and L3 are linker (j.1).

[1115] In some variations of formula (34) described in the paragraphs above, at least one of L1, L2, and L3 is linker (j.2):

\[
\text{, in which } n_2 \text{ is 1-5 and } * \text{ is the attachment site for the cationic dye moiety D.}
\]

[1116] In some variations of formula (34) in which at least one of L1, L2, and L3 is linker (j.2), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[1117] In some variations of formula (34) described in the paragraphs above, L1 is linker (j.2). In some variations of formula (34) described in the paragraphs above, L2 is linker (j.2). In some
variations of formula (34) described in the paragraphs above, \( L_3 \) is linker (j.2). In some variations of formula (34) described in the paragraphs above, \( L_1 \) and \( L_2 \) are linker (j.2). In some variations of formula (34) described in the paragraphs above, \( L_1 \) and \( L_3 \) are linker (j.2). In some variations of formula (34) described in the paragraphs above, \( L_2 \) and \( L_3 \) are linker (j.2). In some variations of formula (34) described in the paragraphs above, \( L_1, L_2, \) and \( L_3 \) are linker (j.2).

[1118] In some variations of formula (34) described in the paragraphs above, at least one of \( L_1, L_2, \) and \( L_3 \) is linker (k):

\[
R_{a_1}^1 \quad \begin{array}{c} \text{A} \end{array} \quad R_{a_1}^2 \\
R_{b_1}^1 \quad \begin{array}{c} i \end{array} \quad R_{b_1}^2
\]

(k) , in which \( i_1 \) and \( i_2 \) independently are 1-4, \( n \) is 1-4; ring A is aryl, heteroaryl, cycloalkyl, or heterocyclyl; (1) \( R_{a_1}^i \) and \( R_{b_1}^i \) independently are \( H \) or \( \text{CH}_3 \) or (2) \( R_{a_1}^i \) and \( R_{b_1}^i \) independently are \( \text{aryl} \) or \( \text{cycloalkyl} \); or (3) two of \( \text{CR}_{a_1}^i \text{R}_{b_1}^i \) are \( \text{aryl} \) or \( \text{cycloalkyl} \); (1) \( R_{a_2}^i \) and \( R_{b_2}^i \) independently are \( H \) or \( \text{CH}_3 \) or (2) \( R_{a_2}^i \) and \( R_{b_2}^i \) independently are \( \text{aryl} \) or \( \text{cycloalkyl} \); or (3) two of \( \text{CR}_{a_2}^i \text{R}_{b_2}^i \) are \( \text{aryl} \) or \( \text{cycloalkyl} \); and * is the attachment site for the cationic dye moiety D.

[1119] In some variations of formula (34) in which at least one of \( L_1, L_2, \) and \( L_3 \) is linker (k), \( i_1 \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4; \( i_2 \) is 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[1120] In some variations of formula (34) described in the paragraphs above in which at least one of \( L_1, L_2, \) and \( L_3 \) is linker (k), \( i_2 \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[1121] In some variations of formula (34) described in the paragraphs above in which at least one of \( L_1, L_2, \) and \( L_3 \) is linker (k), \( R_{a_1}^i \) is \( H \) and \( R_{b_1}^i \) is \( H \). In some variations of formula (34) described in the paragraphs above in which at least one of \( L_1, L_2, \) and \( L_3 \) is linker (k), \( R_{a_1}^i \) is \( H \) and \( R_{b_1}^i \) is \( \text{CH}_3 \). In some variations of formula (34) described in the paragraphs above in which at least one of \( L_1, L_2, \) and \( L_3 \) is linker (k), \( R_{a_1}^i \) and \( R_{b_1}^i \) are \( \text{aryl} \). In some variations of formula (34) described in the paragraphs above in which at least one of \( L_1, L_2, \) and \( L_3 \) is linker (k), \( R_{a_1}^i \) and \( R_{b_1}^i \) are \( \text{cycloalkyl} \). In some variations of formula (34) described in the paragraphs above in which at least one of \( L_1, L_2, \) and \( L_3 \) is linker (k), two of \( \text{CR}_{a_1}^i \text{R}_{b_1}^i \) are \( \text{aryl} \) or \( \text{cycloalkyl} \).
In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (k), Rₐ2 is H and Rₜ₂ is H. In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (k), Rₐ2 is H and Rₜ₂ is CH₃. In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (k), Rₐ2 and Rₜ₂ are \( \text{O} \). In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (k), two of CRₐ₂Rₜ₂ are \( \text{\text{C}} \). In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (k), ring A is

\[
\begin{align*}
(a) & \quad , \quad , \quad , \quad , \quad \text{or} \quad , \quad \text{optionally substituted} \\
(b) & \quad , \quad , \quad , \quad , \quad , \quad \text{optionally substituted} \\
(c) & \quad , \quad , \quad , \quad , \quad , \quad , \quad , \quad \text{or} \quad , \quad \text{or}
\end{align*}
\]

optionally substituted with halo or C1-C6 linear or branched alkyl; or
optionally substituted with halo or C1-C6 linear or branched alkyl.

[1124] In some variations of formula (34) described in the paragraphs above in which L is linker (k), **ring** A is substituted with halo. In some variations, the halo is F, Br, I, or Cl.

[1125] In some variations of formula (34) described in the paragraphs above in which L is linker (k), **ring** A is substituted with C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, Cl-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[1126] In some variations of formula (34) described in the paragraphs above, **L1** is linker (k). In some variations of formula (34) described in the paragraphs above, **L2** is linker (k). In some variations of formula (34) described in the paragraphs above, **L3** is linker (k). In some variations...
of formula (34) described in the paragraphs above, \( L_1 \) and \( L_2 \) are linker \((k)\). In some variations of formula (34) described in the paragraphs above, \( L_1 \) and \( L_3 \) are linker \((k)\). In some variations of formula (34) described in the paragraphs above, \( L_2 \) and \( L_3 \) are linker \((k)\). In some variations of formula (34) described in the paragraphs above, \( L_1, L_2, \) and \( L_3 \) are linker \((k)\).

[1127] In some variations of formula (34) described in the paragraphs above, at least one of \( L_1, L_2, \) and \( L_3 \) is linker \((1.1)\):
[1131] In some variations of formula (34) described in the paragraphs above in which at least
one of LI, L2, and L3 is linker (1.1), \( a_2 \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[1132] In some variations of formula (34) described in the paragraphs above in which at least
one of LI, L2, and L3 is linker (1.1), \( R_{a1} \) is H and \( R_{b1} \) is H. In some variations of formula (34)
described in the paragraphs above in which at least one of LI, L2, and L3 is linker (1.1), \( R_{a1} \) is H
and \( R_{b1} \) is \( CH_3 \). In some variations of formula (34) described in the paragraphs above in which at
least one of LI, L2, and L3 is linker (1.1), \( R_{a1} \) and \( R_{b1} \) are \( \equiv \). In some variations of formula
(34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (1.1), \( R_{a1} \)
and \( R_{b1} \) are \( \equiv \). In some variations of formula (34) described in the paragraphs above in which at
least one of LI, L2, and L3 is linker (1.1), two of \( CR_{a1} R_{b1} \) are \( \equiv \).

[1133] In some variations of formula (34) described in the paragraphs above in which at least
one of LI, L2, and L3 is linker (1.1), \( R_{a2} \) is H and \( R_{b2} \) is H. In some variations of formula (34)
described in the paragraphs above in which at least one of LI, L2, and L3 is linker (1.1), \( R_{a2} \) is H
and \( R_{b2} \) is \( CH_3 \). In some variations of formula (34) described in the paragraphs above in which at
least one of LI, L2, and L3 is linker (1.1), \( R_{a2} \) and \( R_{b2} \) are \( \equiv \). In some variations of formula
(34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (1.1), \( R_{a2} \)
and \( R_{b2} \) are \( \equiv \). In some variations of formula (34) described in the paragraphs above in which at
least one of LI, L2, and L3 is linker (1.1), two of \( CR_{a2} R_{b2} \) are \( \equiv \).

[1134] In some variations of formula (34) described in the paragraphs above in which at least
one of LI, L2, L3, and L4 is linker (1.1), \( R_{a1} \) is H and \( R_{d1} \) is H. In some variations of formula
(34) described in the paragraphs above in which at least one of LI, L2, L3, and L4 is linker (1.1),
\( R_{a1} \) is H and \( R_{d1} \) is \( CH_3 \). In some variations of formula (34) described in the paragraphs above in
which at least one of LI, L2, L3, and L4 is linker (1.1), \( R_{a1} \) and \( R_{d1} \) are \( \equiv \). In some variations
of formula (34) described in the paragraphs above in which at least one of LI, L2, L3,
and L4 is linker (1.1), \( R_{c1} \) and \( R_{d1} \) are \( \equiv \). In some variations of formula (34) described in the
In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (1.1), two of $CR_iR_d$ are.

In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (1.1), $R_{c2}$ and $R_{d2}$ are $H$. In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (1.1), $R_{c2}$ is $H$ and $R_{d2}$ is $CH_3$. In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (1.1), $R_i$ and $R_d$ are $H$.

In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (1.1), two of $CR_iR_d$ are.

In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (1.1), $R_i$ and $R_d$ are $H$ and $R_d$ is $C_3H_5$.

In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (1.1), $R_i$ and $R_d$ are $H$ and $R_d$ is $H$.

In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (1.1), ring $A$ is

(a) optionally substituted with halo or C1-C6 linear or branched alkyl;

(b) optionally substituted with halo or C1-C6 linear or branched alkyl; or

(c) optionally substituted with halo or C1-C6 linear or branched alkyl; or


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optionally substituted with halo or C1-C6 linear or branched alkyl.

[1137] In some variations of formula (34) described in the paragraphs above in which L is linker (1.1), ring A is substituted with halo. In some variations, the halo is F, Br, I, or Cl.

[1138] In some variations of formula (34) described in the paragraphs above in which L is linker (1.1), ring A is substituted with C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-
In some variations of formula (34) described in the paragraphs above in which at least one of L1, L2, and L3 is linker (1.1), \( n \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

In some variations of formula (34) described in the paragraphs above, L1 is linker (1.1). In some variations of formula (34) described in the paragraphs above, L2 is linker (1.1). In some variations of formula (34) described in the paragraphs above, L3 is linker (1.1). In some variations of formula (34) described in the paragraphs above, L1 and L2 are linker (1.1). In some variations of formula (34) described in the paragraphs above, L1 and L3 are linker (1.1). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (1.1). In some variations of formula (34) described in the paragraphs above, L1, L2, and L3 are linker (1.1).

In some variations of formula (34) described in the paragraphs above, at least one of L1, L2, and L3 is linker (1.2):

![Diagram](image)

, in which \( l_1, l_2, n, o_1 \), and \( o_2 \) independently are 1-4; ring A is aryl, heteroaryl, cycloalkyl, or heterocyclyl; for each independent instance of \( R_{a1} \) and \( R_{b1} \), \( R_{a1} \) and \( R_{b1} \) independently are \( -\text{H} \) or \( -\text{CH}_3 \), or (2) \( R_{a1} \) and \( R_{b1} \) independently are \( -\text{H} \) or \( -\text{CH}_3 \), or (3) two of \( \text{CR}_{a1} R_{b1} \) are \( \equiv \equiv \equiv \); for each independent instance of \( R_{a2} \) and \( R_{b2} \), \( R_{a2} \) and \( R_{b2} \) (1) independently are \( -\text{H} \) or \( -\text{CH}_3 \), or (2) \( R_{a2} \) and \( R_{b2} \) independently are \( -\text{H} \) or \( -\text{CH}_3 \), or (3) two of \( \text{CR}_{a2} R_{b2} \) are \( \equiv \equiv \equiv \); for each independent instance of \( R_{c1} \) and \( R_{d1} \), \( R_{c1} \) and \( R_{d1} \) (1) independently are \( -\text{H} \) or \( -\text{CH}_3 \), or (2) \( R_{c1} \) and \( R_{d1} \) independently are \( -\text{H} \) or \( -\text{CH}_3 \), or (3) two of \( \text{CR}_{c1} R_{d1} \) are \( \equiv \equiv \equiv \); for each independent instance of \( R_{c2} \) and \( R_{d2} \), \( R_{c2} \) and \( R_{d2} \) (1)
independently are H or CH₃, or (2) R₁ and R₂ independently are \( \text{CH}_2 \) or \( \text{CH}_2 \), or (3) two of CR₁R₂ are \( \text{CH}_2 \) and \( \text{CH}_2 \); and * is the attachment site for the cationic dye moiety D.

[1142] In some variations of formula (34) in which at least one of LI, L₂, and L₃ is linker (1.2), \( I \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[1143] In some variations of formula (34) described in the paragraphs above in which at least one of LI, L₂, and L₃ is linker (1.2), \( I \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[1144] In some variations of formula (34) described in the paragraphs above in which at least one of LI, L₂, and L₃ is linker (1.2), \( \theta \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[1145] In some variations of formula (34) described in the paragraphs above in which at least one of LI, L₂, and L₃ is linker (1.2), \( \sigma \) is 1-4, 1-3, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[1146] In some variations of formula (34) described in the paragraphs above in which at least one of LI, L₂, and L₃ is linker (1.2), \( R_1 \) is H and \( R_2 \) is H. In some variations of formula (34) described in the paragraphs above in which at least one of LI, L₂, and L₃ is linker (1.2), \( R_1 \) is H and \( R_2 \) is CH₃. In some variations of formula (34) described in the paragraphs above in which at least one of LI, L₂, and L₃ is linker (1.2), \( R_1 \) and \( R_2 \) are \( \text{CH}_2 \). In some variations of formula (34) described in the paragraphs above in which at least one of LI, L₂, and L₃ is linker (1.2), two of \( CR_1 R_2 \) are \( \text{CH}_2 \).

[1147] In some variations of formula (34) described in the paragraphs above in which at least one of LI, L₂, and L₃ is linker (1.2), \( R_1 \) is H and \( R_2 \) is H. In some variations of formula (34) described in the paragraphs above in which at least one of LI, L₂, and L₃ is linker (1.2), \( R_1 \) is H and \( R_2 \) is CH₃. In some variations of formula (34) described in the paragraphs above in which at least one of LI, L₂, and L₃ is linker (1.2), \( R_1 \) and \( R_2 \) are \( \text{CH}_2 \). In some variations of formula (34) described in the paragraphs above in which at least one of LI, L₂, and L₃ is linker (1.2), \( R_1 \) and \( R_2 \) are \( \text{CH}_2 \).
and $R_{b2}$ are $\text{CH}_3$. In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, and $L_3$ is linker (1.2), two of $CR_{a2}R_{b2}$ are $\text{CH}_3$.

[1148] In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (1.2), $R_i$ is H and $R_{d1}$ is H. In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (1.2), $R_i$ is H and $R_{d1}$ is $\text{CH}_3$. In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (1.2), $R_{c1}$ and $R_{d1}$ are $\text{CH}_3$. In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (1.2), two of $CR_{d}R_{d}$ are $\text{CH}_3$.

[1149] In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (1.2), $R_{c2}$ is H and $R_{d2}$ is H. In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (1.2), $R_{c2}$ is H and $R_{d2}$ is $\text{CH}_3$. In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (1.2), $R_{c2}$ and $R_{d2}$ are $\text{CH}_3$. In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, $L_3$, and $L_4$ is linker (1.2), two of $CR_{c2}R_{d2}$ are $\text{CH}_3$.

[1150] In some variations of formula (34) described in the paragraphs above in which at least one of $L_1$, $L_2$, and $L_3$ is linker (1.2), ring A is

\begin{center}
(a) \hspace{2cm} (b) \hspace{2cm} (c) \hspace{2cm} (d) \hspace{2cm} or \hspace{2cm}
\end{center}
wherein \( R_i \) is C1-C6 linear or branched alkyl, aryl, or a five-membered nitrogen-containing heteroaromatic; or
optionally substituted with halo or C1-C6 linear or branched alkyl.

[1151] In some variations of formula (34) described in the paragraphs above in which at least one of L1, L2, and L3 is linker (1.2), \( n \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.

[1152] In some variations of formula (34) described in the paragraphs above, L1 is linker (1.2). In some variations of formula (34) described in the paragraphs above, L2 is linker (1.2). In some variations of formula (34) described in the paragraphs above, L3 is linker (1.2). In some variations of formula (34) described in the paragraphs above, L1 and L2 are linker (1.2). In some variations of formula (34) described in the paragraphs above, L1 and L3 are linker (1.2). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (1.2). In some variations of formula (34) described in the paragraphs above, L1, L2, and L3 are linker (1.2).

[1153] In some variations of formula (34) described in the paragraphs above, at least one of L1, L2, and L3 is linker (m.l):

\[
\begin{align*}
&\text{HN} \\
&\text{HN} \\
&\text{HN} \\
&\text{HN} \\
\end{align*}
\]

(m.1) * , in which \( n \) is 0-6, \( \tilde{n} \) is 1-4, and * is the attachment site for the cationic dye moiety D.

[1154] In some variations of formula (34) in which at least one of L1, L2, and L3 is linker (m.l), \( n \) is 0-6, 0-5, 0-4, 0-3, 0-2, 0-1, 1-6, 1-5, 1-4, 1-3, 1-2, 2-6, 2-5, 2-4, 2-3, 3-6, 3-5, 3-4, 4-6, 4-5, 5-6, 0, 1, 2, 3, 4, 5, or 6.

[1155] In some variations of formula (34) described in the paragraphs above in which at least one of L1, L2, and L3 is linker (m.l), \( n_j \) is 1-4, 1-3, 1-2, 2-4, 2-3, 3-4, 1, 2, 3, or 4.
[1156] In some variations of formula (34) described in the paragraphs above, LI is linker (m.l). In some variations of formula (34) described in the paragraphs above, L2 is linker (m.l). In some variations of formula (34) described in the paragraphs above, L3 is linker (m.l). In some variations of formula (34) described in the paragraphs above, LI and L2 are linker (m.l). In some variations of formula (34) described in the paragraphs above, LI and L3 are linker (m.l). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (m.l). In some variations of formula (34) described in the paragraphs above, LI, L2, and L3 are linker (m.l).

[1157] In some variations of formula (34) described in the paragraphs above, at least one of LI, L2, and L3 is linker (n.l):

\[
\begin{align*}
\text{(n.1)} & \quad \text{, in which } \eta_2 \text{ is } 1-5 \text{ and } * \text{ is the attachment site for the cationic dye moiety D.}
\end{align*}
\]

[1158] In some variations of formula (34) in which at least one of LI, L2, and L3 is linker (n.l), \( \eta_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[1159] In some variations of formula (34) described in the paragraphs above, LI is linker (n.l). In some variations of formula (34) described in the paragraphs above, L2 is linker (n.l). In some variations of formula (34) described in the paragraphs above, L3 is linker (n.l). In some variations of formula (34) described in the paragraphs above, LI and L2 are linker (n.l). In some variations of formula (34) described in the paragraphs above, LI and L3 are linker (n.l). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (n.l). In some variations of formula (34) described in the paragraphs above, LI, L2, and L3 are linker (n.l).

[1160] In some variations of formula (34) described in the paragraphs above, at least one of LI, L2, and L3 is linker (n.2):

343
In which $n_2$ is 1-5 and * is the attachment site for the cationic dye moiety D.

[1161] In some variations of formula (34) in which at least one of $L_1$, $L_2$, and $L_3$ is linker (n.2), $n_2$ is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

[1162] In some variations of formula (34) described in the paragraphs above, $L_1$ is linker (n.2). In some variations of formula (34) described in the paragraphs above, $L_2$ is linker (n.2). In some variations of formula (34) described in the paragraphs above, $L_3$ is linker (n.2). In some variations of formula (34) described in the paragraphs above, $L_1$ and $L_2$ are linker (n.2). In some variations of formula (34) described in the paragraphs above, $L_1$ and $L_3$ are linker (n.2). In some variations of formula (34) described in the paragraphs above, $L_2$ and $L_3$ are linker (n.2). In some variations of formula (34) described in the paragraphs above, $L_1$, $L_2$, and $L_3$ are linker (n.2).

[1163] In some variations of formula (34) described in the paragraphs above, at least one of $L_1$, $L_2$, and $L_3$ is linker (o):

, in which in which $n_1$ is 0-5, $n_2$ is 1-5, $n_3$ is 0-5, and * is the attachment site for the cationic dye moiety D.

[1164] In some variations of formula (34) in which at least one of $L_1$, $L_2$, and $L_3$ is linker (o), $n_1$ is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.
In some variations of formula (34) described in the paragraphs above in which at least one of L1, L2, and L3 is linker (o), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above in which at least one of L1, L2, and L3 is linker (o), \( n_3 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above, L1 is linker (o). In some variations of formula (34) described in the paragraphs above, L2 is linker (o). In some variations of formula (34) described in the paragraphs above, L3 is linker (o). In some variations of formula (34) described in the paragraphs above, L1 and L2 are linker (o). In some variations of formula (34) described in the paragraphs above, L1 and L3 are linker (o). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (o). In some variations of formula (34) described in the paragraphs above, L1, L2, and L3 are linker (o).

In some variations of formula (34) described in the paragraphs above, at least one of L1, L2, and L3 is linker (p):

\[
\begin{align*}
\text{(p)} & \quad \text{, in which } n_1 \text{ is 0-5, } n_2 \text{ is 1-5, } n_3 \text{ is 0-5, and } * \text{ is the attachment site for the cationic dye moiety D.}
\end{align*}
\]

In some variations of formula (34) described above in which at least one of L1, L2, L3, and L4 is linker (p), \( n_1 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (34) described above in which at least one of L1, L2, L3, and L4 is linker (p), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.
In some variations of formula (34) described above in which at least one of LI, L2, L3, and L4 is linker (p), \( n_3 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above, LI is linker (p). In some variations of formula (34) described in the paragraphs above, L2 is linker (p). In some variations of formula (34) described in the paragraphs above, L3 is linker (p). In some variations of formula (34) described in the paragraphs above, LI and L2 are linker (p). In some variations of formula (34) described in the paragraphs above, LI and L3 are linker (p). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (p). In some variations of formula (34) described in the paragraphs above, LI, L2, and L3 are linker (p).

In some variations of formula (34) described in the paragraphs above, at least one of LI, L2, and L3 is linker (q):

![Diagram](attachment.png)

, in which \( \hat{n}_4 \) is 0-5, \( n_2 \) is 1-5, and * is the attachment site for the cationic dye moiety D.

In some variations of formula (34) in which at least one of LI, L2, and L3 is linker (o), \( \hat{n}_4 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (34) described above in which at least one of LI, L2, L3, and L4 is linker (q), \( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above, LI is linker (q). In some variations of formula (34) described in the paragraphs above, L2 is linker (q). In some variations of formula (34) described in the paragraphs above, L3 is linker (q). In some variations of formula (34) described in the paragraphs above, LI and L2 are linker (q). In some variations of formula (34) described in the paragraphs above, LI and L3 are linker (q). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (q). In some variations of formula (34) described in the paragraphs above, LI, L2, and L3 are linker (q).
In some variations of formula (34) described in the paragraphs above, at least one of LI, L2, and L3 is linker (r):

\[
\begin{array}{c}
\text{attachment site for the cationic dye moiety D.}
\end{array}
\]

In some variations of formula (34) in which at least one of LI, L2, and L3 is linker (r), 
\( n_1 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above in which at least one of LI, L2, and L3 is linker (r), 
\( n_2 \) is 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 1, 2, 3, 4, or 5.

In some variations of formula (34) in which at least one of LI, L2, and L3 is linker (r), 
\( n_3 \) is 0-5, 0-4, 0-3, 0-2, 0-1, 1-5, 1-4, 1-3, 1-2, 2-5, 2-4, 2-3, 3-5, 3-4, 4-5, 0, 1, 2, 3, 4, or 5.

In some variations of formula (34) described in the paragraphs above, LI is linker (r). In some variations of formula (34) described in the paragraphs above, L2 is linker (r). In some variations of formula (34) described in the paragraphs above, L3 is linker (r). In some variations of formula (34) described in the paragraphs above, LI and L2 are linker (r). In some variations of formula (34) described in the paragraphs above, LI and L3 are linker (r). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (r). In some variations of formula (34) described in the paragraphs above, LI, L2, and L3 are linker (r).

In some variations of formula (34) described in the paragraphs above, at least one of LI, L2, and L3 is linker (s):
, in which $n_1$ is 0-5, $n_2$ is 1-5, $n_3$ is 0-5, and * is the attachment site for the cationic dye moiety D.

[1183] In some variations of formula (34) described in the paragraphs above, L1 is linker (s). In some variations of formula (34) described in the paragraphs above, L2 is linker (s). In some variations of formula (34) described in the paragraphs above, L3 is linker (s). In some variations of formula (34) described in the paragraphs above, L1 and L2 are linker (s). In some variations of formula (34) described in the paragraphs above, L1 and L3 are linker (s). In some variations of formula (34) described in the paragraphs above, L2 and L3 are linker (s). In some variations of formula (34) described in the paragraphs above, L1, L2, and L3 are linker (s).

[1184] In some variations of formula (34) described in the paragraphs above, L1 is absent. In some variations of formula (34) described in the paragraphs above, L2 is absent. In some variations of formula (34) described in the paragraphs above, L3 is absent. In some variations of formula (34) described in the paragraphs above, L1 and L2 are absent. In some variations of formula (34) described in the paragraphs above, L1 and L3 are absent. In some variations of formula (34) described in the paragraphs above, L2 and L3 are absent. In some variations of formula (34) described in the paragraphs above, L1, L2, and L3 are absent.

[1185] In some variations of formula (34), each of L1, L2, and L3 is a different linker. In some variations of formula (34), each of L1, L2, and L3 is the same linker. In some variations of formula (34), L1 is a first linker and each of L2 and L3 is the same second linker, wherein the first and second linkers are different. In some variations of formula (34), L2 is a first linker, and each of L1 and L3 is the same second linker, wherein the first and second linkers are different. In some variations of formula (34), L3 is a first linker and each of L1 and L2 is the same second linker, wherein the first and second linkers are different.

[1186] In some variations of formula (34) described in the paragraphs above, D1 is safranin-O. In some variations of formula (34) described in the paragraphs above, D2 is safranin-O. In some variations of formula (34) described in the paragraphs above, D3 is safranin-O. In some variations of formula (34) described in the paragraphs above, D1 and D2 are safranin-O. In some
variations of formula (34) described in the paragraphs above, D1 and D3 are safranin-O. In some variations of formula (34) described in the paragraphs above, D2 and D4 are safranin-O.

[1187] In some variations of formula (34) described in the paragraph above, the pendant phenyl ring of D1 is unsubstituted. In some variations of formula (34) described in the paragraph above, the pendant phenyl ring of D1 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D1 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

[1188] In some variations of formula (34) described in the two paragraphs above, the pendant phenyl ring of D2 is unsubstituted. In some variations of formula (34) described in the paragraph above, the pendant phenyl ring of D2 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D2 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).
In some variations of formula (34) described in the three paragraphs above, the pendant phenyl ring of D3 is unsubstituted. In some variations of formula (34) described in the paragraph above, the pendant phenyl ring of D3 is substituted with 1-3 (e.g., 1-3, 1-2, 1, 2, or 3) electron-donating or electron-withdrawing groups, which may be at any available position on the pendant phenyl ring. In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —NH₂, —NHR, —NR₂, —OH, —O⁻, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, and —C₆H₅, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl). In some embodiments in which the pendant phenyl ring of D3 is substituted, the substituents are selected independently from —NO₂, —NR₃⁺, halo (e.g., F, Br, Cl, I), trihalide (e.g., —CF₃, —CCl₃, —CBr₃, —Cl₃), —CN, —SO₂H, —COOH, —COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl (e.g., C1-C6, C1-C5, C1-C4, C1-C3, C1-C2, C1, C2-C6, C2-C5, C2-C4, C2-C3, C2, C3-C6, C3-C5, C3-C4, C3, C4-C6, C4-C5, C4, C5-C6, C5, or C6 linear or branched alkyl).

Examples of cationic dye dimers and trimers comprising safranin-0 are provided below in Table 1. One of skill in the art can readily visualize and prepare other cationic dye multimers in which other cationic dye moieties are used in place of one or more of the safranin-0 moieties.

Table 1.

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[1190] Each reference cited in this disclosure is incorporated herein in its entirety. The following examples illustrate but do not limit the scope of the disclosure set forth above.
EXAMPLE 1. Schematic synthesis plan for preparing a cationic dye dimer

This example provides a synthesis plan for assembling a cationic dye dimer using safranin-O.
EXAMPLE 2. Methods for preparing safranin-O derivatives

This example provides schematic synthesis plans for safranin-O derivatives.

\[
\text{H}_2\text{N} + \text{H}_2\text{N} + \text{Na}_2\text{Cr}_2\text{O}_7 \xrightarrow{60 \text{ deg C}} \text{H}_2\text{N} + \text{NH}_2
\]

\[
\text{H}_2\text{N} + \text{H}_2\text{N} + \text{Na}_2\text{Cr}_2\text{O}_7 \xrightarrow{60 \text{ deg C}} \text{H}_2\text{N} + \text{NH}_2
\]

\[
\text{H}_2\text{N} + \text{H}_2\text{N} + \text{Na}_2\text{Cr}_2\text{O}_7 \xrightarrow{100 \text{ deg C}} \text{Cl} + \text{NH}_2
\]

\[
\text{H}_2\text{N} + \text{H}_2\text{N} + \text{Na}_2\text{Cr}_2\text{O}_7 \xrightarrow{100 \text{ deg C}} \text{Cl} + \text{NH}_2
\]

\[
\text{H}_2\text{N} + \text{H}_2\text{N} + \text{Na}_2\text{Cr}_2\text{O}_7 \xrightarrow{100 \text{ deg C}} \text{Cl} + \text{NH}_2
\]
EXAMPLE 3. Examples of linking cationic dye moieties using diamino linkers

[1193] Cationic dye moieties can be linked using acetamido groups through diamino linkers, as illustrated below:

[1194] Linkers which can be used include linkers incorporating alkyl chains, such as

; linkers incorporating ethylene glycol moieties, such as

; linkers containing amines which can be positively charged,

such as

; and linkers incorporating alkyl chains which contain positively charged amino acids such as Lys (illustrated below), His, or Arg:

(in this instance, the ε-amino group would initially be in a protected state).
EXAMPLE 4. Preparation of Linear Cationic Dye Multimers

[1195] Cationic dye moieties can be linked linearly using the scheme below, which illustrates preparation of a linear trimer comprising safranin-0 moieties. The same process can be repeated as desired to prepare a cationic dye multimer comprising e.g., 4, 5, or 6, cationic dye moieties.
EXAMPLE 5. Preparation of Branched Cationic Dye Multimers

[1196] Cationic dye moieties can be linked to form branched multimers using the scheme below, which illustrates preparation of a branched trimer comprising safranin-0 moieties. The same process can be repeated as desired to prepare a cationic dye multimer comprising, e.g., 4, or 5 cationic dye moieties.

[1197] Tetramers can be prepared using a similar scheme and, for example, biphenyl-3,3',5,5'-tetracarboxylic acid, as used in the scheme above. Higher multimers can be prepared similarly, using the appropriate polycarboxylate linker.
**EXAMPLE 6. Synthesis of Compound 1**

Synthesis of 7,7'-(hexane-1,6-diylbis(azanediyl))bis(3-amino-2,8-dimethyl-5-phenylphenazin-5-ium) chloride

Step-1: Synthesis of 3-amino-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride

[1198] To a solution of Safranin-'O' (5.2 g, 14.8 mmol) in DMF (50 mL), cooled to -40 °C, was added sodium hydride (1.18 g, 29.5 mmol) and the reaction mass was stirred at the same temperature for 1 h. Boc anhydride (2.91 g, 13.97 mmol) was added at the same temperature and the reaction mass was stirred at the same temperature for another 1 h. The progress of the reaction was monitored by LCMS and TLC (System: 10% MeOH in DCM). The reaction was quenched by adding water (20 mL) and the solid obtained was filtered and purified by column chromatography (silica gel 100-200 mesh, eluent system- 10 % MeOH:DCM) to obtain 3-amino-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride (1 g).

[1199] To a solution of 3-amino-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-iium chloride (225 mg, 0.5 mmol) in DMF (2.5 mL), cooled to -30 °C, was added sodium hydride (40 mg, 1.0 mmol) and the reaction mass was stirred at the same temperature for 1h. 1,6-Diiodohexane (85 mg, 0.25 mmol) was added and the reaction was stirred at the same temperature for 2 min and at 0 °C for 20 min. Additional 1,6-diiodohexane (33 mg, 0.097 mmol) was added and the reaction mixture was stirred at RT for 5 min. The reaction mixture was monitored by LCMS. After detection of product, the reaction was quenched with water (5 mL). The solid product obtained was filtered, dissolved in 20% MeOH/DCM solution (20 mL) and concentrated under reduced pressure to get 100 mg crude product, which was purified by reverse phase HPLC to get pure tert-butyl N-(8-amino-3,7-dimethyl-10-phenyl-phenazin-10-iium-2-yl)-N-[6-[(8-amino-3,7-dimethyl-10-phenyl-phenazin-10-iium-2-yl)-tert-butoxycarbonyl-amino]hexyl]carbamate dichloride (6 mg.)

Step-3: Synthesis of 7,7’-(hexane-1,6-diylbis(azanediyl))bis(3-amino-2,8-dimethyl-5-phenyl phenazin-5-iium) chloride.

[1200] 7,7’-(2,2,15,15-Tetramethyl-4,13-dioxo-3,14-dioxa-5,12-dioxa-5,12-dialy)bis(3-amino-2,8-dimethyl-5-phenylphenazin-5-iium) chloride (5 mg, 0.13 mmol) was dissolved in DCM (1 mL). Trifluoroacetic acid (1 mL) was added and the reaction was stirred at RT for 2h. The desired product was detected by LCMS and NMR. The reaction mixture was concentrated under vacuum to obtain the desired product, which was triturated with diethyl ether and pentane. 1HNMR (CD$_3$OD): δ (ppm): 7.90-7.70 (m, 10H), 7.55-7.50 (m, 4H), 6.05 (s, 2H), 5.73 (s, 2H), 3.05 (m, 4H), 2.4 (s, 6H), 2.35 (s, 6H), 1.55-1.42 (m, 6H), 1.22-1.15 (m, 6H). LCMS: 740(M+) and 370 (half fragment).
EXAMPLE 7. Synthesis of Compounds 2 and 3.

[1201] This example provides a synthesis route for compounds 2 and 3. Appropriate starting materials can be obtained using the methods as presented in Example 2.

Compound 3: \( Y = \text{Cl} \)

Compound 2: \( Y = \text{H} \)
EXAMPLE 8. Synthesis of Compound 4

Synthesis of 7,7’-(octane-1,8-diylbis(azanediyl))bis(3-amino-2,8-dimethyl-5-phenylphenazin-5-ium) chloride

To a stirred solution of Safranin-0 (1.05 g, 3.0 mmol) in 15 mL of N,N-dimethylacetamide was added potassium carbonate (0.55 g, 4.0 mmol) and stirred at RT for 15 min. 1,8-Dibromooctane (272 mg, 1.0 mmol) was then added dropwise into the reaction mixture followed by the addition of potassium iodide (332 mg, 2.0 mmol). The reaction mixture was then stirred at 60 °C for 24h under nitrogen. The reaction mixture was then allowed to cool to RT, 20 mL water was added and the crude reaction mixture was lyophilized. The mixture was then purified by column chromatography (silica gel, 100-200 mesh, 0-10% MeOH in DCM). The product obtained by column chromatography was re-purified by HPLC to afford the desired product as a brown solid. 1H NMR (DMSO-d6): δ (ppm): 7.90-7.75 (m, 12H), 7.65-7.55 (m, 7H), 6.0 (s, 2H), 5.55 (s, 2H), 2.98 (m, 4H), 2.30 (s, 12 H), 1.35 (m, 4H), 1.05 (bs, 8H). 1H NMR (CD3OD) δ (ppm): 7.90-7.70 (m, 10H), 7.55-7.50 (m, 4H), 6.05 (s, 2H), 5.73 (s, 2H), 3.05 (m, 4H), 2.4 (s, 6H), 2.35 (s, 6H), 1.55-1.42 (m, 6H), 1.22-1.15 (m, 6H). LCMS: 740 (M+) and 370 (half fragment).
EXAMPLE 9. Synthesis of Compound 6

Synthesis of 3-amino-7-[(6-[(3,5-bis({6-[(7-amino-2,8-dimethyl-5-phenyl-5,10-phenazin-5-ylium-3-yl)amino]hexyl}carbamoyl)phenyl]form amido)hexyl)amino]-2,8-dimethyl-5-phenyl-5X^10-phenazin-5-ylium
Step-1: Synthesis of 2-(6-iodohexyl)isoindoline-1,3-dione

[1203] To a suspension of potassium phthalamide (700 mg, 3.7 mmol) in DMF (30 mL) was added 1,6-diiodohexane (3.83 g, 11.33 mmol) and the reaction mass was heated atw 80 °C for 1 h. (The reaction mass became clear on heating). The reaction mixture was cooled to RT, diluted with diethyl ether (100 mL) and water (100 mL), the organic layers were separated, and the aqueous layer was again extracted with diethyl ether (2x100 mL). The combined organic layer was washed with water (200 mL) and saturated brine solution (200 mL) The organic layer was dried over anhydrous sodium sulfate and concentrated under reduced pressure to obtain the product, which was purified by column chromatography (silica gel: 100-200 mesh; Eluent: 10 % ethyl acetate in hexane) to obtain pure product as white solid (2.1 g).

Step-2: Synthesis of tert-butyl N-[8-(tert-butoxycarbonylamino)-3,7-dimethyl-10-phenylphenazin-10-ium-2-yl]-N-[6-(1,3-dioxoisindolin-2-yl)hexyl]carbamate

[1204] To a solution of 3,7-bis(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium (500 mg, 0.90 mmol) in DMF (5 mL) was added cesium carbonate (1.48 g, 4.54 mmol) and the mixture stirred at RT for 10 min. 2-(6-Iodohexyl)isoindoline-1,3-dione (422 mg, 1.18 mmol) was added and the reaction mass was stirred at RT overnight. The reaction was monitored by LCMS and TLC. The reaction mass was diluted with EtOAc (25 mL) and water (25 mL), and the layers were separated. The aqueous layer was again extracted with EtOAc (2x25 mL). The combined organic layer was washed with water (2x100 mL), and saturated brine solution (200 mL), then dried over anhydrous sodium sulfate and concentrated under reduced pressure to obtain the product. This was purified by column chromatography by using neutral alumina and an eluent system of 0 to 2% Methanol in DCM to obtain pure product (200 mg.)

Step-3: Synthesis of tert-butyl N-(6-aminohexyl)-N-[8-(tert-butoxycarbonylamino)-3,7-dimethyl-10-phenylphenazin-10-ium-2-yl]carbamate

[1205] To a solution of 3-(tert-butoxycarbonyl(6-(1,3-dioxoisindolin-2-yl)hexyl)amino)-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium (800 mg, 1.04 mmol) in ethanol (40 mL) was added hydrazine hydrate monohydrate (1.072 mg, 20.8 mmol) and the reaction mixture was heated to reflux for 90 min. The reaction was monitored by TLC and LCMS. The solvent was evaporated under reduced pressure to dryness. The residue was dissolved in diethyl ether (150 mL) and filtered, the filtrate was concentrated under reduced pressure to obtain the crude product which was purified by column chromatography using neutral alumina (Eluent System:0 to 3% MeOH in DCM) to obtain pure product (410 mg).

[1206] To a solution of 3-((6-aminohexyl)(tert-butoxycarbonylamino)-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium (243 mg, 0.395 mmol) in DMF (3 mL) was added DIPEA (233 mg, 1.80 mmol) and stirred at RT for 10 min. Benzene-1,3,5-tricarbonyl trichloride (30 mg, 0.113 mmol) was added and the reaction was stirred at RT overnight. The reaction was monitored by TLC and LCMS. The reaction mass was diluted with EtOAc (30 mL) and water (30 mL), and the organic layer was separated. The aqueous layer was again extracted with EtOAc (2x30 mL), the combined organic layer was washed with water (100 mL) and saturated brine solution (100 mL). The organic layer was dried over anhydrous sodium sulfate and concentrated under reduced pressure to obtain the product which was purified by column chromatography using neutral alumina (Eluent: 0.2-1% MeOH in DCM) to obtain pure product (65 mg.)


[1207] To a solution of the diboc protected trimer (65 mg, 0.0325 mmol) in DCM (5 mL) was added trifluoroacetic acid (01 mL) and the reaction mixture was stirred at RT overnight. The reaction mixture was monitored by LCMS. The reaction mass was concentrated under reduced pressure to dryness and purified by reverse phase HPLC to obtain the product to obtain the product as the acetate counter anion. The product was dissolved in ethanol-HCl (20 mL) and concentrated to dryness (3 times), and the solid obtained was washed with water (20 mL) to remove inorganic impurities. The solid obtained was lyophilized to get the product (6.6 mg) which was confirmed by LCMS and NMR.

**EXAMPLE 10. Synthesis of Compounds 18 and 19**

Synthesis of 3-amino-7-\{[(2-[(7-amino-2,8-dimethyl-5-phenyl-5X^5,10-phenazin-5-ylium-3-yl]amino)methyl]phenyl)methyl]amino]-2,8-dimethyl-5-phenyl-5X^5,10-phenazin-5-ylium and 3-amino-7-\{[(2-[(7-amino-2,8-dimethyl-5-phenyl-5X^5,10-phenazin-5-ylium-3-yl]amino)methyl]phenyl)methyl]amino]-2,6-dimethyl-5-phenyl-5X^5,10-phenazin-5-ylium
Step 1: Synthesis of 7,7’-(1,2-phenylenebis(methylene))bis(tert-butoxycarbonylazanediyl)bis(3-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium) chloride & 7-(tert-butoxycarbonyl(2-((tert-butoxycarbonyl(7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium)-3-yl)amino)methyl)benzyl)amino)-3-(tert-butoxycarbonylamino)-2,6-dimethyl-5-phenylphenazin-5-ium chloride.

To a stirred solution of 3,7-bis(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride & 3,7-bis(tert-butoxycarbonylamino)-2,6-dimethyl-5-phenylphenazin-5-ium chloride (500 mg, 0.90 mmol) in 5 mL of DMF was added cesium carbonate.
carbonate (880 mg, 2.70 mmol) and the mixture stirred at RT for 15 min. The reaction mixture was then cooled to 0°C and o-xylene dibromide (132 mg, 0.50 mmol, diluted with 1 ml of DMF) was added dropwise. The reaction mixture was stirred at RT for 12 h. The reaction was monitored by TLC and LCMS. After completion of reaction, mixture was diluted with ice-cold water and filtered. The solid residue obtained was dissolved in diethyl ether (50 mL) and washed with brine solution (3x20 mL). The organic layer was dried over anhydrous sodium sulfate, and concentrated under reduced pressure to afford crude product which was then purified by column chromatography (neutral alumina, eluent 0-20% EtOAc in hexane) to afford the desired product as a dark brown solid (250 mg).

Step-2: Synthesis of 7,7’-(1,2-phenylenebis(methylene))bis(azanediyl)bis(3-amino-2,8-dimethyl-5-phenylphenazin-5-iium) chloride & 3-amino-7-(2-((7-amino-2,8-dimethyl-5-phenylphenazin-5-iium-3-ylamino)methyl)benzylamino)-2,6-dimethyl-5-phenylphenazin-5-iium chloride:

[1209] To a stirred solution of 7,7’-(1,2-phenylenebis(methylene))bis(tert-butoxycarbonylazanediyl)bis(3-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-iium) chloride (250 mg, 0.27 mmol) in 5 mL of DCM was added TFA (1 mL) at 0°C dropwise and the mixture stirred at RT for 12 h. The reaction was monitored by TLC and LCMS. After completion of reaction, the solvent was removed under reduced pressure to dryness and the residue purified by reverse phase HPLC to afford two peaks of the same mass. Both peaks were then treated separately with methanolic HC1 and dried, then washed with water and dried again to afford desired product. (Compound 18): 8mg. (Compound 19): 8mg. 1H NMR Compound 18: (DMSO-d6): δ (ppm): 8.15 (t, 2H), 7.90 (d, 4H), 7.85-7.75 (m, 6H), 7.6 (m, 3H), 7.40 (d, 4H), 7.05 (m, 2H), 6.65 (m, 2H), 5.95 (s, 2H), 5.45 (s, 2H), 4.10 (m, 4H), 2.40 (s, 6H), 2.30 (s, 6 H). LCMS: 732 (M+), 366(M/2). Compound 19: (DMSO-d6): δ (ppm): 8.15 (bs, IH), 7.95 (s, IH), 7.90-7.75 (m, 5H), 7.74-7.60 (m, 7H), 7.42 (d, 2H), 7.20-7.10 (m, 2H), 7.05 (t, IH), 6.65 (d, IH), 6.10 (s, IH), 5.95 (s, IH), 5.62 (s, IH), 4.58 (m, 2H), 4.40 (m, 2H), 2.40 (s, 3H), 2.30 (s, 6 H), 1.48 (s, 3H). LCMS: 732 (M+), 366(M/2).

EXAMPLE 11. Synthesis of Compound 20

Synthesis of 5-{[6-((4-((6-[(7-amino-5-chloranuide-2,8-dimethyl-5-phenyl-5X 6,10-phenazin-5-ylium-3-yl)amino]hexyl)carbamoyl)phenyl)phenyl)formamido)hexyl]amino}-2,8-dimethyl-5-phenyl-5X 6,10-phenazin-5-ylium-5-c)chloranuide
Step-1: Synthesis of bis(2,5-dioxopyrrolidin-l-yl) biphenyl-4,4'-dicarboxylate

To a stirred solution of biphenyl-4,4'-dicarboxylic acid (500 mg, 2.06 mmol) in 10 mL of DMF was added N-hydroxysuccinimide (594 mg, 5.16 mmol) and dicyclohexylcarbodiimide (1.06 g, 5.16 mmol) at 0°C and the mixture stirred at RT overnight. The reaction mixture was filtered and the filtered cake was washed with EtOAc. The washings and filtrate were combined, washed with brine solution (3x20 mL), dried over anhydrous sodium sulfate and concentrated under reduced pressure to afford a crude product that was dissolved in DCM and again filtered. The DCM layer was concentrated under reduced pressure to afford desired product (600 mg).

Step-2: Synthesis of tert-butyl N-[8-(tert-butoxycarbonylamino)-3,7-dimethyl-10-phenylphenazin-10-ium-2-yl]-N-[6-[[4-[[6-[tert-butoxycarbonyl]-8-(tert-butoxycarbonylamino)-3,7-

[1211] Bis(2,5-dioxopyrrolidin-1-yl)biphenyl-4,4'-dicarboxylate (20 mg, 0.045 mmol) and 3-((6-aminohexyl)(tert-butoxycarbonyl)amino)-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride (65.5 mg, 0.100 mmol) were dissolved in 2 mL of DMF and triethylamine (14 mg) was added. The reaction mixture was stirred at RT for 16 h. After completion of reaction, the mixture was diluted with ice-cold water and extracted with EtOAc. The organic layer was washed with brine solution (4x10 mL), dried over anhydrous sodium sulfate and concentrated under reduced pressure to afford the crude product, which was purified by column chromatography (neutral alumina) to afford the desired product (70 mg).


[1212] The product from Step-2 (70 mg) was dissolved in 2 mL of DCM and TFA (0.5 mL) was added at 0°C dropwise and stirred at RT for 12 h. The reaction was monitored by TLC and LCMS. After completion of reaction, solvent was removed under reduced pressure to dryness to obtained crude product which was purified by reverse phase HPLC. The product obtained after purification was then treated with Methanolic HCl and dried and then washed with water and freeze dried to afford the desired product (6 mg). \(^1\)H NMR (DMSO-d6): 8 (ppm): 8.56 (t, 2H), 7.97-7.95 (d, 4H), 7.90-7.75 (m, 12H), 7.70-7.65 (m, 2H), 7.62 (d, 4H), 7.60-7.45 (m, 3H), 6.02 (s, 2H), 5.58 (s, 2H), 3.25 (m, 4H), 2.98 (m, 4H), 2.35 (s, 6H), 2.33 (s, 6H), 1.50-1.42 (m, 4H), 1.40-1.30 (m, 4H), 1.20-1.05 (m, 8H).
EXAMPLE 12. Synthesis of Compound 21

Synthesis of (3-amino-7-{10-[(7-amino-5-chloranuide-2,8-dimethyl-5-phenyl-5\(\lambda^6\),10-phenazin-5-ylum-3-yl)]carbamoyl}decanamido}-2,8-dimethyl-5-phenyl-5\(\lambda^6\),10-phenazin-5-ylum-5-e)chloranuide

**Step-1:** Synthesis of bis(2,5-dioxopyrrolidin-1-yl) undecanedioate

[1213] To a stirred solution of undecanedioic acid (500 mg, 2.31 mmol) in 10 mL of anhydrous THF was added N-hydroxysuccinimide (585 mg, 5.09 mmol) and dicyclohexylcarbodiimide (1.08 g, 5.09 mmol) at 0°C and then allowed to stir at RT for 16 h. The reaction mixture was filtered and the filtrate was concentrated under reduced pressure. The product obtained was washed with diethyl ether and dried to afford the desired product (725 mg).

**Step-2:** Synthesis of (3-amino-7-{10-[(7-amino-5-chloranuide-2,8-dimethyl-5-phenyl-5\(\lambda^6\),10-phenazin-5-ylum-3-yl)]carbamoyl}decanamido}-2,8-dimethyl-5-phenyl-5\(\lambda^6\),10-phenazin-5-ylum-5-e)chloranuide

[1214] To a stirred solution of Safranin-O (350 mg, 1.0 mmol) in 10 mL of DMF was added sodium hydride (60 mg, 1.5 mmol) at 0°C and stirred for 10 min, bis(2,5-dioxopyrrolidin-1-yl) undecanedioate (205 mg, 0.5 mmol) was added and allowed to stir at RT for 16 h. After completion of reaction, the mixture was diluted with ice-cold water and filtered. The product obtained was dried and purified by reverse phase HPLC. The purified product was treated with Methanolic HCl (5 times), dried and washed with water and freeze dried to afford the desired product (5 mg). H NMR (CD\(_3\)OD): \(\delta\) (ppm): 8.56 (s, 1H), 8.18 (s, 2H), 7.97-7.95 (m, 3H), 7.90-7.80 (m, 6H), 7.60-7.50 (m, 4H), 6.18 (s, 2H), 2.55 (s, 6H), 2.45-2.40 (m, 10H), 1.65-1.58 (m, 4H), 1.35-1.25 (m, 10H).
EXAMPLE 13. Synthesis of Compounds 22 and 23

Step-1: Synthesis of 7,7'-(2,2,18,18-tetramethyl-4,16-dioxo-3,17-dioxa-5,15-diazanonadecane-5,15-diyl)bis(3-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium) chloride and 7-(tert-butoxycarbonyl(9-(tert-butoxycarbonyl(7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium-3-yl)amino)nonyl)amino)-3-(tert-butoxycarbonylamino)-2,6-dimethyl-1,5-phenylphenazin-5-ium chloride:

To a stirred solution of mixture of 3,7-bis(tert-butoxycarbonylamo)-2,8-dimethyl-5-phenylphenazin-5-ium chloride and 3,7-bis(tert-butoxycarbonylamo)-2,6-dimethyl-5-phenylphenazin-5-ium chloride (500 mg, 0.909 mmol) in 10 mL of DMF was added cesium carbonate (738 mg, 2.27 mmol) and stirred at RT for 15 min. The reaction mixture was cooled to 0°C and 1,9-dibromononane (156 mg, 0.545 mmol, diluted with 1 mL of DMF) was added dropwise. The reaction mixture was stirred at RT for 12 h. The reaction was monitored by TLC and LCMS. After completion of reaction, the mixture was diluted with ice-cold water and filtered. The solid residue obtained after filtration was dissolved in diethyl ether (200 mL) and washed with brine solution (3x50 mL). The ether layer was dried over anhydrous sodium sulfate, concentrated under reduced pressure to afford the crude product which was purified by column chromatography (neutral alumina, eluent 0-20% EtOAc in hexane) to afford the desired product (mixture of 2 products of same mass) as a dark brown solid (400 mg).

Step-2: Synthesis of 7,7'-(nonane-1,9-diylbis(azanediyi))bis(3-amino-2,8-dimethyl-5-phenylphenazin-5-ium) chloride and 3-amino-7-(9-(7-amino-2,8-dimethyl-5-phenylphenazin-5-ium-3-ylamino)nonylamino)-2,6-dimethyl-5-phenylphenazin-5-ium chloride:
To a stirred solution of mixture of 7,7"-(2,2,18,18-tetramethyl-4,16-dioxo-3,17-dioxaoxanoneadecane-5,15-diyl)bis(3-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-iium) chloride and 7-(tert-butoxycarbonyl(9-(tert-butoxycarbonyl(7-(tert-butoxycarbonyl amino)-2,8-dimethyl-5-phenylphenazin-5-iium-3-yl)amino)nonyl)amino)-3-(tert-butoxy carbonylamino)-2,6-dimethyl-5-phenylphenazin-5-iium chloride (400 mg, 0.32 mmol) in 5 mL of DCM was added TFA (2 mL) at 0°C dropwise and stirred at RT for 12 hrs. The reaction was monitored by TLC and LCMS. After completion of reaction, solvent was removed under reduced pressure to dryness to obtained crude product which was purified by reverse phase HPLC to afford two peaks of same mass. Both peaks were then treated separately with Methanolic HCl and dried, then washed with water and dried again to afford the desired products. Compound 22: 35 mg. Compound 23: 5 mg. 1H NMR Compound 22: (DMSO-d6): δ (ppm): 7.90-7.78 (m, 10H), 7.75-7.70 (m, 3H), 7.65-7.55 (m, 7H), 6.02 (s, 2H), 5.58 (s, 2H), 2.98 (m, 4H), 2.35 (s, 6H), 2.33 (s, 6H), 1.40-1.30 (m, 4H), 1.20-1.03 (m, 10H). Compound 23: (DMSO-d6): δ (ppm): 7.95 (d, 1H), 7.90-7.60 (m, 13H), 7.60-7.38 (m, 3H), 6.15 (s, 1H), 6.0 (s, 1H), 5.54 (s, 1H), 3.42 (m, 2H), 2.98 (m, 2H), 2.30 (m, 9 H), 1.60 (m, 2H), 1.40 (s, 3H), 1.38-1.20 (m, 8H), 1.18-1.02 (m, 4H).

EXAMPLE 14. Synthesis of Compound 24

Step-1: Synthesis of 2-(6-iodohexyl)isoindoline-1,3-dione

To a suspension of potassium 1,3-dioxoisindolin-2-ide (5 g, 27 mmol) in DMF (250 mL) was added 1,6-diiodohexane (22.83 g, 67.5 mmol) dropwise and heated at 85 °C for 2 h. The reaction mixture was monitored with LCMS. The reaction mixture was diluted with cold water and extracted with diethyl ether (2x300 mL), and the combined organic layer was washed with water (3x250 mL) and brine (250 mL). The organic layer dried over sodium sulfate and concentrated under reduced pressure to obtain a crude product which was purified by column chromatography with 10% EtOAc in hexane as eluent to afford 8.5 g of 2-(6-iodohexyl)isoindoline-1,3-dione.

Step-2: Synthesis of 3-(tert-butoxycarbonyl(6-(1,3-dioxoisindolin-2-yl)hexyl)amino)-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride

To a solution of 3,7-bis(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride (6 g, 10.90 mmol) in DMF (80 mL) at RT was added cesium carbonate (8.85 g, 27.25 mmol) portion-wise and stirred for 15 min. Then, 2-(6-iodohexyl)isoindoline-1,3-dione (5.06 g, 14.18 mmol) was dissolved in DMF (40 mL) and added dropwise at 0 °C. The reaction mixture was stirred at RT for 16 h. The reaction mixture was monitored by LCMS and diluted with cold water and extracted with EtOAc (2x200 mL). The combined organic layer washed with brine (4x100 mL), dried over sodium sulfate, and concentrated under reduced pressure. The crude product was purified by column chromatography (Neutral alumina eluent 40% EtOAc in
hexane to afford 6.5 g of 3-(tert-butoxycarbonyl(6-(1,3-dioxoisindolin-2-yl)hexyl)amino)-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride.

Step-3: Synthesis of 3-((6-aminohexyl)(tert-butoxycarbonyl)amino)-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride

[1219] To a solution of 3-(tert-butoxycarbonyl(6-(1,3-dioxoisindolin-2-yl)hexyl)amino)-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride (4 g, 5.12 mmol) in ethanol (250 mL) was added hydrazine hydrate (5.36 g, 107.38 mmol) and heated to reflux at 85 °C for 1 h. The reaction mixture was monitored by LCMS and then the reaction mixture was concentrated and the residue dissolved in diethyl ether and filtered. The filtrate was concentrated under reduced pressure and then the crude product was purified by column chromatography (Neutral alumina eluent 4 % MeOH in DCM) to afford 1.2 g of 3-((6-aminohexyl)(tert-butoxycarbonyl)amino)-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride.

Step-4: Synthesis of 3-[(tert-butoxycarbonyl)(6-{[3,5,7-tris({6-[((7-amino-2,8-dimethyl-5-phenyl-5X5-phenazin-5-yl)amino]hexyl}carbamoyl)adamantan-1-yl]formamido}hexyl)amino]-7-[(tert-butoxycarbonyl)amino]-2,8-dimethyl-5-phenyl-5X5-phenazin-5-yl tetrachloride

[1220] To a solution of adamantane-1,3,5,7-tetracarboxylic acid (30 mg, 0.0961 mmol) in DMF (6 mL) were added EDC.HCl (137 mg, 0.721 mmol) and HOBt (97 mg, 0.721 mmol) and the mixture stirred at RT for 15 min. Then 3-((6-aminohexyl)(tert-butoxycarbonyl)amino)-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride (280 mg, 0.432 mmol) and DIPEA (0.23 mL, 1.345 mmol) were added portion-wise and the mixture stirred at RT for 16 h. The reaction mixture was monitored by LCMS and diluted with water. The precipitate was filtered and washed with water. The residue was dissolved in DCM (75 mL), dried over sodium sulfate and concentrated under reduced pressure to obtain the crude product, which was purified by column chromatography (Neutral alumina eluent 5 % MeOH in DCM) to afford 120 mg of BOC protected tetramer of adamantane.

Step-5: Synthesis of 2-{3-amino-2,8-dimethyl-7-[(6-[[3,5,7-tris({6-[7-amino-2,8-dimethyl-5-phenyl-5X5-phenazin-5-yl]amino]hexyl}carbamoyl)adamantan-1-yl]formamido}hexyl)amino]-5X5-phenazin-5-yl}benzen-1-ide trichloride hydrochloride
[1221] To the BOC protected tetramer of adamantine from Step-4 (120 mg, 0.046 mmol) in DCM (4 mL) at 0°C was added TFA (0.1 mL) dropwise and the mixture stirred at RT for 16 h. The reaction mixture was monitored by LCMS and solvent was removed and the crude product was purified by HPLC. The product was treated with Methanolic HCl (4x20 mL) and concentrated each time, then triturated with water (5 mL), filtered, and washed with water (20 mL). The residue was dried under lyophilization to afford 25 mg of desired product. 1H NMR (DMSO): δ (ppm): 7.60-7.90 (m, 44 H), 6.02 (s, 4 H), 5.45 (s, 1 H), 2.90-3.0 (m, 16 H), 2.30 (s, 12H), 2.25 (s, 12H), 1.76 (s, 12H), 1.30-1.36 (m, 16H), 1.05-1.10 (m, 16H).

LCMS: 1897.10, M/4=474.6, M/3=632.6, M/2=948.5.

EXAMPLE 15. Synthesis of Compound 25

Synthesis of {3-amino-2,8-dimethyl-5-phenyl-7-[3-[[3,5,7-tris({3-[(7-amino-5-chloranuide-2,8-dimethyl-5-phenyl-5X₁₀-phenazin-5-ylium-3-yl)amino]propyl}carbamoyl)adamantan-1-yl]formamido]propyl]amino]-5X₁₀-phenazin-5-ylium-5-e}chloranuide
Step-1: Synthesis of 2-(3-iodopropyl) isoindoline-1,3-dione

[1222] To a suspension of potassium 1,3-dioxoisindolin-2-ide (3 g, 16.2 mmol) in DMF (150 mL) was added 1,3-diiodopropane (4.2 mL, 36.4 mmol) dropwise and heated at 85°C for 2 h. The reaction mixture was monitored by LCMS. The reaction mixture was diluted with cold water and extracted with diethyl ether (2x250 mL). The combined organic layer was washed with water (3x200 mL) and brine (250 mL). The organic layer was dried over sodium sulfate and concentrated under reduced pressure. The crude product was purified by chromatography with 10% EtOAc in hexane as eluent to afford 3 g of 2-(3-iodopropyl) isoindoline-1,3-dione.
Step-2: Synthesis of 3-(tert-butoxycarbonyl(3-(1,3-dioxoisoindolin-2-yl)propyl)amino)-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride

[1223] To a solution of 3, 7-bis(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride (4 g, 7.272 mmol) in DMF (50 mL) at RT was added cesium carbonate (5.9 g, 18.1 mmol) portion-wise and stirred for 15 min. 2-(3-Iodopropyl)isoindoline-1,3-dione (2.97 g, 9.45 mol) was dissolved in DMF (10 mL) and added dropwise at 0°C. The reaction mixture was stirred at RT for 16 h. The reaction mixture was monitored by LCMS and then diluted with cold water. The precipitate was filtered and washed with water. The precipitate was dissolved in DCM (150 mL) and dried over sodium sulfate, and concentrated under reduced pressure to give a crude product that was purified by column chromatography (neutral alumina: eluent 2 % MeOH in DCM) to afford 3 g of 3-(tert-butoxycarbonyl(3-(1,3-dioxoisoindolin-2-yl)propyl)amino)-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride.

Step-3: Synthesis of 3-((3-aminopropyl)(tert-butoxycarbonylamino)-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride

[1224] To a solution of 3-(tert-butoxycarbonyl(3-(1,3-dioxoisoindolin-2-yl)propyl)amino)-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride (3 g, 4.06 mmol) in ethanol (200 mL) was added hydrazine hydrate (3.9 mL, 81.3 mmol) and heated to reflux at 85°C for 1 h. The reaction mixture was monitored by LCMS, and then the reaction mixture was concentrated and the residue dissolved in diethyl ether and filtered. The filtrate was concentrated under reduced pressure and the crude product was purified by column chromatography (neutral alumina eluent 4 % MeOH in DCM) to afford 1 g of 3-((3-aminopropyl)(tert-butoxycarbonylamino)-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride.

Step-4: Synthesis of BOC protected tetramer of adamantane

[1225] To a solution of adamantane 1,3,5,7-tetraacarboxylic acid (30 mg, 0.0961 mmol) in DMF (6 mL) were added EDC.HCL (137 mg, 0721 mmol) and HOBT (97 mg, 0.721 mmol) and the mixture stirred at RT for 15 min. Then 3-((3-aminopropyl)(tert-butoxycarbonylamino)-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride (263 mg, 0.432 mole) was added portion-wise and the mixture stirred at RT for 16 h. The reaction mixture was monitored by LCMS, and then diluted with water. The precipitate was filtered and washed with water. The residue was dissolved in DCM (75 mL), dried over sodium sulfate and concentrated.
under reduced pressure. The crude product was purified by column chromatography (Neutral alumina eluent 3% MeOH in DCM) to afford 125 mg of BOC protected tetramer of adamantane.

Step-5: Synthesis of \{3-amino-2,8-dimethyl-5-phenyl-7-\-[3,5,7-tris(\[7-amino-5-chloranuide-2,8-dimethyl-5-phenyl-5X\]^6,10-phenazin-5-ylium-3-yl)amino]propyl\}carbamoyl adamantan-1-yl\[formamido\]propyl\]amino\]-5X\]^6,10-phenazin-5-ylium-5-e\}chloranuide

[1226] To the BOC protected tetramer of adamantane from Step-4 (125 mg, 0.046 mmol) in DCM (4 mL) at 0°C was added TFA (0.5 mL) dropwise and the mixture allowed to stir at RT for 16 h. The reaction mixture was monitored by LCMS and solvent was concentrated to obtain a crude product that was purified by reverse phase HPLC to obtain desired product. This product was treated with methanolic HCl (4x20 mL), concentrated each time, then triturated with water (5 mL), filtered and washed with water (20 mL). The residue was dried by lyophilization to afford 25 mg of \{3-amino-2,8-dimethyl-5-phenyl-7-\-[3,5,7-tris(\[7-amino-5-chloranuide-2,8-dimethyl-5-phenyl-5X\]^6,10-phenazin-5-ylium-3-yl)amino]propyl\}carbamoyl adamantan-1-yl\[formamido\]propyl\]amino\]-5X\]^6,10-phenazin-5-ylium-5-e\}chloranuide. \H NMR (DMSO): δ (ppm): 7.60-7.90 (m, 44H), 6.0 (s, 4H), 5.45 (s, 4H), 2.90-3.0 (m, 16H), 2.30 (s, 12H), 2.25 (s, 12H), 1.76 (s, 12H), 1.65-1.75 (m, 8H). LCMS: 1728.9, M/4=432.8, M/3=576.5, M/2=864.3.

EXAMPLE 16. Synthesis of Compound 26

Synthesis of \(3\)-amino-7-\{[6-\-[\(7\)-amino-5-chloranuide-2,8-dimethyl-5-phenyl-5X\]^6,10-phenazin-5-ylium-3-yl\]amino\]hexyl\]carbamoyl\]pyridin-2-yl\]pyridin-3-yl\]formamido\]hexyl\]amino\]-2,8-dimethyl-5-phenyl-5X\]^6,10-phenazin-5-ylium-5-e\}chloranuide

To a suspension of 2,2'-bipyridine-5,5'-dicarboxylic acid (50 mg, 0.204 mmol) in DMF (5 mL) were added EDC.HCl (155 mg, 0.816 mmol) and HOBt (109 mg, 0.816 mmol) and the mixture stirred at RT for 20 min. Then 3-((6-aminohexyl)(tert-butoxycarbonylamino)-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-i um chloride (293 mg, 0.450 mmol) and DIPEA (0.35 mL, 2.04 mmol) were added portion-wise and the mixture stirred at RT for 12 h. The reaction mixture was monitored by LCMS, and then diluted with water, extracted with EtOAc (2x25 mL). The combined organic layer was washed with brine (4x25 mL), dried over sodium sulfate, and concentrated under reduced pressure. The crude product was purified by column chromatography (neutral alumina eluent 5% MeOH in DCM) to afford 125 mg of BOC protected dimer.


To the BOC protected dimer from Step-1 (90 mg, 0.0596 mmol) in DCM (5 mL) at 0°C was added TFA (0.4 mL) dropwise and the mixture stirred at RT for 12 h. The reaction mixture was monitored by LCMS. The solvent was evaporated and the crude product purified by HPLC.
to obtain the desired product, which was treated with methanolic HCl (4x15 mL), concentrated each time, then triturated with water (5 mL), filtered and washed with water (20 mL). The residue was dried by lyophilization to afford 15 mg of title compound. \( ^1H \) NMR (DMSO): \( \delta \) (ppm): 9.10 (s, 2H), 8.83 (t, 2 H), 8.43 (d, 2 H), 8.38 (d, 2H), 7.90-7.75 (m, 10 H) 7.62-7.72 (m, 2 H), 7.60 (d, 4 H), 7.60-7.50 (m, 2 H), 6.0 (s, 2H), 5.50 (s, 2H), 3.26 (m, 4H), 2.99 (m, 4H), 2.35 (s, 6H), 2.33 (s, 6H), 1.50-1.42 (m, 4H), 1.40-1.30 (m, 4H), 1.20-1.05 (m, 8H). LCMS: 1036.56, M/3=346.3, M/2=518.9.

**EXAMPLE 17. Synthesis of Compound 27**

Synthesis of \{3-amino-7-[(6\{\{6-[(7-amino-5-chloranuide-2,8-dimethyl-5-phenyl-5X \(^6\),10-phenazin-5-ylium-3-yl)amino]hexyl]carbamoyl)adamantan-1-yl]formamido}hexyl]amino\-2,8-dimethyl-5-phenyl-5X \(^6\),10-phenazin-5-ylium-5-e\}chloranuide

[1229] To a solution of 1,3-adamantanedicarboxylic acid (40 mg, 0.178 mmol) in DMF (65 mL) were added EDC.HCl (119 mg, 0.623 mmol) and HOBt (84 mg, 0.623 mmol) and the mixture stirred at RT for 15 min. Then 3-((6-aminohexyl)(tert-butoxycarbonyl)amino)-7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride (255 mg, 0.392 mmol) and DIPEA (0.22 mL, 1.335 mmol) were added portion-wise and the mixture stirred at RT for 16 h. The reaction mixture was monitored by LCMS and diluted with water and extracted with EtOAc (2x25 mL). The combined organic layer was washed with water (2x20 mL) and brine, dried over sodium sulfate, and concentrated under reduced pressure to obtain the crude product, which was purified by column chromatography (Neutral alumina eluent 4% MeOH in DCM) to afford 150 mg of tert-butyl N-[8-(tert-butoxycarbonylamino)-3,7-dimethyl-10-phenyl-phenazin-10-ium-2-yl]-N-[6-[[3-[6-[tert-butoxycarbonyl- [8-(tert-butoxycarbonylamino)-3,7-dimethyl-10-phenyl-phenazin-10-ium-2-yl]amino]hexyl carbamoyl] adamantane-1-carbonyl]amino]hexyl] carbamate dichloride.
Step-2: Synthesis of N\textsubscript{1},N\textsubscript{3}-bis\{6-[(8-amino-3,7-dimethyl-10-phenylphenazin-10-ium-2-yl)amino]hexyl\}adamantane-1,3-dicarboxamide dichloride

To the compound from Step-1 (150 mg, 0.100 mmol) in DCM (3 mL) at 0°C was added TFA (0.3 mL) dropwise and the mixture stirred at RT for 16 h. The reaction mixture was monitored by LCMS, then the solvent was concentrated and the crude product was purified by HPLC to obtain pure product. This was treated with methanolic HCl (4x15 mL), concentrated each time, then triturated with water (5 mL), filtered, and washed with water (10 mL). The residue was vacuum dried under lyophilization to afford 20 mg of N\textsubscript{1}, N\textsubscript{3}-bis\{6-[(8-amino-3,7-dimethyl-10-phenylphenazin-10-ium-2-yl)amino]hexyl\}adamantane-1,3-dicarboxamide dichloride.

\textbf{H NMR (DMSO):} \(\delta\) (ppm): 7.80-7.90 (m, 10 H), 7.60 (d, 6H), 7.50-7.60 (m, 2H), 7.40-7.45 (m, 2H), 6.02 (s, 2H), 5.50 (s, 2H), 2.98-3.04 (m, 8H), 2.30 (s, 6H), 2.28 (s, 6H), 2.04 (m, 2H), 1.8 (m, 2H), 1.70-1.75 (m, 8H), 1.55-1.60 (m, 2H), 1.25-1.40 (m, 10H), 1.05 (m, 6H).

LCMS: 1016.6 (M), 508.6 (M/2).
EXAMPLE 18. Synthesis of Compounds 28 and 29

Synthesis of 7,7'-(dodecane-1,12-diylbis(azanediyl))bis(3-amino-2,8-dimethyl-5-phenylphenazin-5-ium) chloride and 3-amino-7-(12-(7-amino-2,8-dimethyl-5-phenylphenazin-5-ium-3-ylamino)dodecylamino)-2,6-dimethyl-5-phenylphenazin-5-ium chloride.
Step-1: Synthesis of 7,7"-(2,2,21,21-tetramethyl-4,19-dioxo-3,20-dioxa-5,18-diazadocosane-5,18-diyl)bis(3-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium) chloride and 7-(tert-butoxycarbonyl(12-(tert-butoxycarbonyl(7-(tert-butoxycarbonylamin o)-2,8-dimethyl-5-phenylphenazin-5-ium-3-yl)amino)dodecyl)amino)-3-(tert-butoxycarbonylamin o)-2,6-dimethyl-5-phenylphenazin-5-ium chloride

[1231] To a stirred solution of a mixture of 3,7-bis(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride and 3,7-bis(tert-butoxycarbonylamino)-2,6-dimethyl-5-phenylphenazin-5-ium chloride (1.0 g, 1.81 mmol) in 15 mL of DMF was added cesium carbonate (1.48 g, 4.54 mmol) and the mixture stirred at RT for 15 min. The reaction mixture was then cooled to 0°C and to it was added 1,12-dibromododecane (328 mg, 0.99 mmol, diluted with 1 mL of DMF) dropwise. The reaction mixture was then stirred at RT for 12 h. The reaction was monitored by TLC and LCMS. After completion of reaction, the mixture was diluted with ice-cold water and filtered. The solid residue obtained after filtration was dissolved in diethyl ether (200 mL) and washed with brine solution (3x50 mL). The ether layer was then dried over anhydrous sodium sulfate, and concentrated under reduced pressure to afford a crude product which was purified by column chromatography (neutral alumina, eluent 0-20% EtOAc in hexane) to afford the desired product (mixture of 2 products of same mass) as a dark brown solid (500 mg).

Step-2: Synthesis of 7,7"-(dodecane-1,12-diyl)bis(azanediyl))bis(3-amino-2,8-dimethyl-5-phenylphenazin-5-ium) chloride and 3-amino-7-(12-(7-amino-2,8-dimethyl-5-phenylphenazin-5-ium-3-ylamino)dodecylamino)-2,6-dimethyl-5-phenylphenazin-5-ium chloride:

[1232] To a stirred solution of mixture of 7,7"-(2,2,21,21-tetramethyl-4,19-dioxo-3,20-dioxa-5,18-diazadocosane-5,18-diyl)bis(3-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium) chloride and 7-(tert-butoxycarbonyl(12-(tert-butoxycarbonyl(7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium-3-yl)amino)dodecylamino)-3-(tert-butoxycarbonylamino)-2,6-dimethyl-5-phenylphenazin-5-ium chloride (500 mg, 0.39 mmol) in 5 mL of DCM was added TFA (2 mL) at 0°C dropwise and stirred at RT for 12 h. The reaction was monitored by TLC and LCMS. After completion of reaction, the solvent was removed under reduced pressure to dryness to obtain a crude product which was purified by HPLC to afford two peaks of the same mass. Both peaks were then treated separately with Methanolic HCl and dried and then washed with water, and dried again to afford the desired products (Compound 28: 35 mg and Compound 29: 55 mg). Compound 28: H NMR (DMSO-d6): δ (ppm): 7.90-7.78 (m, 10H), 7.75-7.70 (m, 3H), 7.65-7.55 (m, 7H), 6.02 (s, 2H), 5.58(s, 2H), 2.98 (m, 4H), 2.35 (s, 6
Compound 29: H NMR (DMSO-d6): δ (ppm): 7.95 (d, 1H), 7.90-7.60 (m, 15H), 7.60-7.38 (m, 3H), 6.15 (s, 1H), 6.0 (s, 1H), 5.54 (s, 1H), 3.42 (m, 2H), 2.98 (m, 2H), 2.30 (m, 9H), 1.60 (m, 2H), 1.40 (s, 3H), 1.38-1.20 (m, 14H), 1.18-1.02 (m, 4H).

EXAMPLE 19. Synthesis of Compounds 4 and 31

Synthesis of 7,7’-(octane-1,8-diylbis(azanediyl))bis(3-amino-2,8-dimethyl-5-phenylphenazin-5-ium) chloride & 3-amino-7-(8-(7-amino-2,8-dimethyl-5-phenylphenazin-5-ium-3-ylamino) octylamino)-2,6-dimethyl-5-phenylphenazin-5-ium chloride
Step-1: Synthesis of 3,7-bis(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride and 3,7-bis(tert-butoxycarbonylamino)-2,6-dimethyl-5-phenylphenazin-5-ium chloride.

[1233] To a stirred solution of Safranin-0 (10.0 g, 28.57 mmol) in 100 mL of DMF was added sodium hydride (3.42 g, 85.71 mmol) portion-wise at 0°C. After addition, the reaction mixture was stirred at RT for 15 min. Boc anhydride (12.45 g, 57.14 mmol, diluted with 15 mL of DMF) was added dropwise into the reaction mixture and stirred at RT for 2h. The reaction was monitored by TLC and LCMS. After completion of reaction, the mixture was quenched using MeOH (30 mL), and concentrated under reduced pressure to obtain the crude product which was purified by column chromatography (neutral alumina, eluent 25% DCM in hexane to 100% DCM) to afford the desired products (a mixture of two products of the same mass) as a dark brown solid (5.0 g).

Step-2: Synthesis of 7,7''-(2,2,17,17-tetramethyl-4,15-dioxo-3,16-dioxo-5,14-diazaoctadecane-5,14-diyl)bis(3-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium) chloride and 7-(tert-butoxycarbonyl(8-(tert-butoxycarbonyl(7-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium-3-yl)amino)octyl)amino)-3-(tert-butoxycarbonylamino)-2,6-dimethyl-5-phenylphenazin-5-ium chloride.

[1234] To a stirred solution of a mixture of 3,7-bis(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-ium chloride and 3,7-bis(tert-butoxycarbonylamino)-2,6-dimethyl-5-phenylphenazin-5-ium chloride (5.0 g, 9.07 mmol) in 60 mL of DMF was added cesium carbonate (8.87 g, 27.22 mmol) and stirred at RT for 15 min. The reaction mixture was cooled to 0°C and to it was added 1,8-diiodooctane (2.05 g, 5.62 mmol, diluted with 5 mL of DMF) dropwise. The reaction mixture was stirred at RT for 12 h. The reaction was monitored by TLC.
and LCMS. After completion of reaction, the mixture was diluted with ice-cold water and filtered. The solid residue was dissolved in diethyl ether (250 mL) and washed with brine solution (3×50 mL). The ether layer was dried over anhydrous sodium sulfate, and concentrated under reduced pressure to afford the crude product which was purified by column chromatography (neutral alumina, eluent 0-40% EtOAc in hexane) to afford the desired product (mixture of 2 products of same mass) as a dark brown solid (3 g).

Step-3: Synthesis of 7,7''-(octane-1,8-diylbis(azanediyl))bis(3-amino-2,8-dimethyl-5-phenylphenazin-5-iium) chloride and 3-amino-7-(8-(7-amino-2,8-dimethyl-5-phenylphenazin-5-iium-3-ylamino)octylamino)-2,6-dimethyl-5-phenylphenazin-5-iium chloride.

[1235] To a stirred solution of a mixture of 7,7''-(2,2,17,17-tetramethyl-4,15-dioxo-3,16-dioxa-5,14-diazaoctadecane-5,14-diyl)bis(3-(tert-butoxycarbonylamino)-2,8-dimethyl-5-phenylphenazin-5-iium) chloride and 7-(tert-butoxycarbonyl(7-(tert-butoxycarbonyl(8-(7-amino-2,8-dimethyl-5-phenylphenazin-5-iium-3-ylamino)octylamino)-3-((tert-butoxy carbonylamino)-2,6-dimethyl-5-phenylphenazin-5-iium chloride (2.5 g, 2.06 mmol) in 25 mL of DCM was added TFA (10 mL) at 0°C dropwise and the mixture stirred at RT for 12 h. The reaction was monitored by TLC and LCMS. After completion of reaction, the solvent was removed under reduced pressure to dryness to obtain a crude product (2 g mixture of two compounds). 400 mg of crude product was purified by reverse phase HPLC to afford two peaks of the same mass. Both peaks were then treated separately with methanolic HCl and dried, and then washed with water and dried again to afford both regioisomeric products.

**EXAMPLE PI. Synthesis of Compounds 2, 3, 5, and 7-17**

[1236] Compounds 2, 3, 5 and 7-17 can be synthesized using the conditions provided in the Examples presented above using appropriate starting materials.

**EXAMPLE BI. Targeting of Raji Cells and Rabbit MSCs to Various Organs**

[1237] The femur, cecum, heart, kidney, liver, trachea, lungs, pancreas, spleen, and a portion of the small intestine were extracted from 3 month old C57B1/6 mice and washed 3 times with PBS in 50 ml conical tubes.

[1238] Non-adherent Raji cells (107) were incubated in 500 µl of 10 µM calcein AM (Invitrogen, Cat N° C3100MP) in PBS for 30 min on a shaker at RT. The cells were washed by adding 500 µl PBS, centrifuging at 500g for 4 min, removing supernatant, and resuspending the cells in 500 µl PBS. The cells were then incubated in 500 µl 10 µM Compound 20 in PBS or in
PBS alone (control) for 30 min on a shaker at RT. The cells were washed by adding 500 µl PBS, centrifuging at 500g for 4 min, removing supernatant, and resuspending cells in 1 mL PBS. The cells were then counted, and 0.5 x 10^6 cells were added over each organ in 1 mL of PBS in a p48 well plate, and incubated for 30 min at RT. The organs were then gently washed in 1 mL of PBS in a new p48 well.

[1239] Rabbit mesenchymal stem cells (rbMSCs) were treated as described above, except that washing was for 2 min instead of 4 min.

[1240] Adherence of the Raji cells or MSCs to the organs was evaluated by detecting the fluorescence of calcein dye using a ChemiDoc MP Imaging System (470/530 filter) and ImageLab software and compared to the PBS control. The results are shown in FIG. 1 (Raji cells) and FIG. 2 (rbMSCs).

**EXAMPLE B2. Targeting of Raji Cells to Meniscus Explants**

[1241] Whole menisci were extracted from 4-6 month old NZW rabbits and washed 3 times with PBS in 50 ml conical tubes. The menisci were incubated with 100 µM of biotin-conjugated compound 4 or biotin-conjugated compound 20 in a final volume of 1 mL in PBS or 1 mL PBS alone for 30 min at RT in a 48 well plate, then washed twice in new p48 wells with 1 mL PBS.

[1242] The menisci were incubated with 1 µg/ml of streptavidin-FITC (SA-FITC) (Thermo 21224) in a final volume of 1 mL in PBS for 30 min at RT in the dark, then washed twice in a new p48 well plate with 1 mL PBS. Staining of the menisci was evaluated by measuring fluorescence in FITC channel (470/530 filter) using ChemiDoc MP Imaging System and ImageLab software.

[1243] Non-adherent Raji cells (10^7) were incubated with compound 4 or compound 20 as described above in Example B1. Cells were counted, and 0.5 x 10^6 cells were placed over the meniscus explants in 1 mL of PBS in a 48 well plate and incubated for 30 min at RT. The explants were gently washed in 1 mL of PBS in a new p48 well plate.

[1244] Cell adherence to the meniscus explants was evaluated by measuring fluorescence of calcein dye using a ChemiDoc MP Imaging System (470/530 FITC filter) and ImageLab software.
The results are shown in FIG. 3A and FIG. 3B. These results demonstrate that compounds 4 and 20 promote adherence of Raji cells to meniscus explants. Compound 6873 is a reference compound.

EXAMPLE B3. Persistance of Compound 4 in the Knee After Intra-Articular Injection

Six- to eight-week old Sprague Dawley rats were anesthetized with 3% sevofluorane, and both right and left knees were shaved and washed. 250 µl of a solution of 10 mg/ml Compound 4 in PEG400 (Spectrum POI 10) was injected intra-articularly through the patellar ligament on the right knees. 250 µl of vehicle (PEG400) was injected intra-articularly into left knees as a control.

Rats were euthanized at 1h, 4h, 8h and 24h post-injection, and femoral condyles were extracted for macroscopic and fluorescence evaluation using a Gel Logic Pro6000 Imaging System (530/600 filter) and Carestream software.

The results are shown in FIG. 4. These results demonstrate that compound 4 is present in the knee 24 hr after intra-articular injection.

EXAMPLE B4. Staining of Small Intestine After Oral Administration of Compound 20

Six- to eight-week old C57BL/6 mice were anesthetized with 3% sevofluorane. A solution of 10 mg/ml Compound 4 or 10 mg/ml Safranin-0 (Sigma S8884) in 20% cyclodextrin was administered by oral gavage at a dose of 100 mg/kg. A solution of 20% cyclodextrin was administered by oral gavage as a control.

After 24h, mice were euthanized and a portion of small intestine and Peyer's patches were extracted, washed in PBS and fluorescence was measured using a Gel Logic Pro6000 Imaging System (530/600 filter) and Carestream software.

The results are shown in FIG. 5A and FIG. 5B. These results demonstrate that Compound 4 stains the small intestine but not Peyer's patches after oral administration.

EXAMPLE B5. Organ Staining Following Oral Administration of Compound 4

Six- to eight-week old Sprague Dawley rats were anesthetized with 3% sevofluorane. A solution of 10 mg/ml Compound 4 or 10 mg/ml Safranin-0 (Sigma S8884) in 20% cyclodextrin
(Sigma C4805) was administered by oral gavage at a dose of 100 mg/kg. A solution of 20% cyclodextrin was administered by oral gavage as a control.

[1253] After 24h, rats were euthanized and different organs were extracted and washed in PBS. Fluorescence was measured using a Gel Logic Pro6000 Imaging System (530/600 filter) and Carestream software to determine the localization of Compound 4 or safranin-O. The results are shown in FIG. 6 and FIG. 7.

EXAMPLE B6. Organ Staining Following Intravenous Administration of Compound 4

[1254] Six- to eight-week old Sprague Dawley rats were anesthetized with 3% sevofluorane. A solution of 100 mg/ml Compound 4 in 100% DMSO was administered intravenously at a dose of 100 mg/Kg. A solution of 100% DMSO was administered IV as a control.

[1255] After 2h, rats were euthanized and different organs were extracted and washed in PBS. Fluorescence was measured using a Gel Logic Pro6000 Imaging System (530/600 filter) and Carestream software to determine where Compound 4 was localized. The results are shown in FIG. 8 and FIG. 9.
1. A method of repairing an injured target tissue selected from the group consisting of pancreas, kidney, intestine, heart, thymus, liver, brain, bladder, and blood, comprising depositing in the injured target tissue a (i) a cationic dye multimer comprising a first cationic dye moiety, a second cationic dye moiety, and a first linker connecting the first and second cationic dye moieties; or (ii) a cationic dye comprising a linker.

2. The method of claim 1, wherein the cationic dye multimer further comprises a second linker and a third cationic dye moiety.

3. The method of claim 2, wherein the cationic dye multimer further comprises a third linker and a fourth cationic dye moiety.

4. The method of claim 1, wherein the first and second cationic dye moieties are different cationic dye moieties.

5. The method of claim 1, wherein the first and second cationic dye moieties are the same cationic dye moiety.

6. The method of any of claims 1-5, wherein each cationic dye moiety is independently selected from the group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange, acriflavine, and methylene blue.

7. The method of any of claims 1-6, wherein at least one cationic dye moiety is safranin-O and the pendant phenyl ring of the safranin-0 optionally is substituted with 1-3 substituents independently selected from —NH₂, —NHR, —NR₂, —OH, —O’, —NHCOCH₃, —NHCOR, —OCH₃, —OR, —C₂H₅, —R, —C₆H₅, —NO₂, —NR₃⁺, halo, trihalide, —CN, -SO₂H, -COOH, —COOR, —CHO, and —COR, wherein R is C₁-C₆ linear or branched alkyl.

8. The method of claim 1, wherein the first cationic dye moiety is azure A and the second cationic dye multimer is safranin-O.
The method of any of claims 1-8, comprising a linker selected from the group consisting of:

(a) \[ \begin{array}{c} \text{H} \\
\text{N} \\
\text{N} \\
\text{H} \\
\end{array} \] \[ \begin{array}{c} \text{H} \\
\text{N} \\
\text{N} \\
\text{H} \\
\end{array} \]

, in which \( n \) is 1-6, \( \eta i \) is 1-4, and each * is an attachment site for a cationic dye moiety;

(a.1) \[ \begin{array}{c} \text{H} \\
\text{N} \\
\text{N} \\
\text{H} \\
\end{array} \] \[ \begin{array}{c} \text{H} \\
\text{N} \\
\text{N} \\
\text{H} \\
\end{array} \]

, in which \( n \) is 1-6, \( \eta i \) is 1-4, and * is an attachment site for a cationic dye moiety;

(a.2) \[ \begin{array}{c} \text{N} \\
\text{N} \\
\text{N} \\
\text{N} \\
\end{array} \] \[ \begin{array}{c} \text{N} \\
\text{N} \\
\text{N} \\
\text{N} \\
\end{array} \]

, in which \( n \) is 1-6, \( \eta i \) is 1-4, and each * is an attachment site for a cationic dye moiety;

(b) \[ \begin{array}{c} \text{N} \\
\text{N} \\
\text{N} \\
\text{N} \\
\end{array} \] \[ \begin{array}{c} \text{N} \\
\text{N} \\
\text{N} \\
\text{N} \\
\end{array} \]

, in which \( n \) is 0-6, \( \eta i \) is 1-4, and each * is an attachment site for a cationic dye moiety;

(b.1) \[ \begin{array}{c} \text{R}_a \text{R}_b \\
\text{R}_a \text{R}_b \\
\text{R}_a \text{R}_b \\
\text{R}_a \text{R}_b \\
\end{array} \] \[ \begin{array}{c} \text{R}_a \text{R}_b \\
\text{R}_a \text{R}_b \\
\text{R}_a \text{R}_b \\
\text{R}_a \text{R}_b \\
\end{array} \]

, in which \( n \) is 0-6, \( \eta i \) is 1-4, and each * is an attachment site for a cationic dye moiety;

(c) \[ \begin{array}{c} \text{R}_a \text{R}_b \\
\text{R}_a \text{R}_b \\
\text{R}_a \text{R}_b \\
\text{R}_a \text{R}_b \\
\end{array} \] \[ \begin{array}{c} \text{R}_a \text{R}_b \\
\text{R}_a \text{R}_b \\
\text{R}_a \text{R}_b \\
\text{R}_a \text{R}_b \\
\end{array} \]

, in which \( n \) is 0-6; \( n i \) is 1-4; for each independent instance of \( R_a \) and \( R_b \), (1) \( R_a \) and \( R_b \) independently are H or CH₃, or (2) \( R_a \) and \( R_b \) are \[ \begin{array}{c} \text{V} \\
\text{a} \\
\text{r} \\
\text{a} \\
\end{array} \] \[ \begin{array}{c} \text{V} \\
\text{a} \\
\text{r} \\
\text{a} \\
\end{array} \]

, in which \( \eta i \) is 1-4; for each independent instance of \( R_a \) and \( R_b \), (1) \( R_a \) and \( R_b \) independently are H or CH₃, or (2) \( R_a \) and \( R_b \) are \[ \begin{array}{c} \text{Y} \\
\text{a} \\
\text{r} \\
\text{a} \\
\end{array} \] \[ \begin{array}{c} \text{Y} \\
\text{a} \\
\text{r} \\
\text{a} \\
\end{array} \]
or \( \text{R}_a \text{R}_b \) are \( \text{R}_a \text{R}_b \); and * is an attachment site for a cationic dye moiety;

(c.2) in which \( n \) is 0-6; \( n_i \) is 1-4; for each independent instance of \( \text{R}_a \) and \( \text{R}_b \), (1) \( \text{R}_a \) and \( \text{R}_b \) independently are H or CH\(_3\) or (2) \( \text{R}_a \) and \( \text{R}_b \) are \( \text{R}_a \text{R}_b \); or (3) two of \( \text{R}_a \text{R}_b \) are \( \text{R}_a \text{R}_b \); and * is an attachment site for a cationic dye moiety;

(d) where \( k \) is 2-10; for each independent instance of \( \text{R}_a \) and \( \text{R}_b \), \( \text{R}_a \) and \( \text{R}_b \) (1) independently are H or CH\(_3\), or (2) \( \text{R}_a \) and \( \text{R}_b \) are \( \text{R}_a \text{R}_b \) or \( \text{R}_a \text{R}_b \), or (3) two of \( \text{R}_a \text{R}_b \) are \( \text{R}_a \text{R}_b \); and each * is an attachment site for a cationic dye moiety;

(e) in which \( n \) is 0-6, \( n_i \) is 1-4, and each * is an attachment site for a cationic dye moiety;

\[
\begin{array}{c}
\text{N} \\
\text{O} \\
\text{N} \\
\end{array}
\]
\( n \), in which \( n \) is 0-6, \( n_i \) is 1-4, and each * is an attachment site for a cationic dye moiety;

(f) in which \( n_i \) is 0-5, \( \text{H}_2 \) is 1-5 and each * is an attachment site for a cationic dye moiety;

(f.1) in which \( n_i \) is 0-5, \( \text{H}_2 \) is 1-5 and * is an attachment site for a cationic dye moiety;
In which $r^{ii}$ is 0-5, $n_2$ is 1-5 and * is an attachment site for a cationic dye moiety;

In which $n_i$ is 0-5, $n_2$ is 1-5 and each * is an attachment site for a cationic dye moiety;

In which $n_1$ is 0-5, $n_2$ is 1-5 and * is an attachment site for a cationic dye moiety;

In which $n_i$ is 0-5, $n_2$ is 1-5 and each * is an attachment site for a cationic dye moiety;

In which $n_i$ is 0-5, $n_2$ is 1-5, and each * is an attachment site for a cationic dye moiety;
(h.1), in which \( n_1 \) is 0-5, \( n_2 \) is 1-5, and * is an attachment site for a cationic dye moiety;

(h.2), in which \( n_1 \) is 0-5, \( n_2 \) is 1-5, and * is an attachment site for a cationic dye moiety;

(i), in which \( n_1 \) and \( n_2 \) independently are 1-5 and each * is an attachment site for a cationic dye moiety;

(i.1), in which \( n_1 \) and \( n_2 \) independently are 1-5 and * is an attachment site for a cationic dye moiety;

(i.2), in which \( n_1 \) and \( n_2 \) independently are 1-5 and * is an attachment site for a cationic dye moiety;
, in which \( n_2 \) is 1-5 and each * is an attachment site for a cationic dye moiety;

, in which \( n_2 \) is 1-5 and * is an attachment site for a cationic dye moiety;

, in which \( n_2 \) is 1-5 and * is an attachment site for a cationic dye moiety;

, in which \( l_1 \) and \( l_2 \) independently are 1-4, \( n \) is 1-4; **ring**

A is aryl, heteroaryl, cycloalkyl, or heterocyclyl, optionally substituted with halo or C1-C6 linear or branched alkyl; for each independent instance of \( R_{a_1} \) and \( R_{b_1} \), \( R_{a_1} \) and \( R_{b_1} \) (1) independently are H or CH₃, or (2) \( R_{a_1} \) and \( R_{b_1} \) independently are \( ^\prime_{3} \) or \( ^\prime_{4} \), or (3) two of \( CR_{a_1}R_{b_1} \) are \( ^\prime_{2} \leq ^\prime_{3} \); for each independent instance of \( R_{a_2} \) and \( R_{b_2} \), \( R_{a_2} \) and \( R_{b_2} \) (1) independently are
H or CH₃, or (2) Rₐ₁ and Rₜ₂ independent are \( \text{O} \), or (3) two of CRₐ₂Rₜ₂ are \( \text{O} \); and each * is an attachment site for a cationic dye moiety;

(l)

\[ R_{c1} R_{d1} \]
\[ R_{a1} R_{b1} \]
\[ R_{a1} R_{b1} \]
\[ R_{a2} R_{b2} \]

\[ R_{c1} R_{d1} \]
\[ R_{a1} R_{b1} \]
\[ R_{a2} R_{b2} \]

\[ R_{c1} R_{d1} \]
\[ R_{a1} R_{b1} \]
\[ R_{a2} R_{b2} \]

(l.1)

, in which \( I₁, I₂, n, o₁, \) and \( o₂ \) independently are 1-4; ring A is aryl, heteroaryl, cycloalkyl, or heterocyclyl, optionally substituted with halo or C1-C6 linear or branched alkyl; for each independent instance of \( R_{a1} \) and \( R_{b1} \), \( R_{a2} \) and \( R_{b2} \) independently are H or CH₃, or (2) \( R_{a1} \) and \( R_{b1} \) independently are \( \text{O} \), or (3) two of CRₐ₁Rₜ₁ are \( \text{O} \); for each independent instance of \( R_{a2} \) and \( R_{b2} \), \( R_{a2} \) and \( R_{b2} \) independently are \( \text{O} \), or (3) two of CRₐ₂Rₜ₂ are \( \text{O} \); for each independent instance of \( R_{c1} \) and \( R_{d1} \), \( R_{c2} \) and \( R_{d2} \) (1) independently are H or CH₃, or (2) \( R_{c1} \) and \( R_{d1} \) independently are \( \text{O} \), or (3) two of CR₂Rd₂ are \( \text{O} \); and each * is an attachment site for a cationic dye moiety;

(l.1)

\[ R_{c1} R_{d1} \]
\[ R_{a1} R_{b1} \]
\[ R_{a2} R_{b2} \]

\[ R_{c1} R_{d1} \]
\[ R_{a1} R_{b1} \]
\[ R_{a2} R_{b2} \]

\[ R_{c1} R_{d1} \]
\[ R_{a1} R_{b1} \]
\[ R_{a2} R_{b2} \]

(l.1)

, in which \( I₁, I₂, n, o₁, \) and \( o₂ \) independently are 1-4; ring A is aryl, heteroaryl, cycloalkyl, or heterocyclyl, optionally
substituted with halo or C1-C6 linear or branched alkyl; for each independent
instance of R ai and Rbi, R ai and Rbi (1) independently are H or CH 3 , or (2)
Rai and Rbi independently are ' ¾

or ' ¾

, or (3) two of CR aiRbi are

, for each independent instance of R a and R , R a and R
independently are H or CH 3 , or (2) R a and R

(1)

independently are ' ¾

or

O

, or (3) two of CR a R b are

'

; for each independent instance of

R i and R i , R i and R i (1) independently are H or CH 3 , or (2) R i and R i

V7
independently are ' ¾

0

or ' ¾

or (3) two of CR iRdi are

·

; for

each independent instance of R and R d , R and R d (1) independently are

H or CH 3 , or (2) R

and R d independently are ' ¾

or ' ¾

, or (3) two of

; and * is an attachment site for a cationic dye moiety;

CR R d are

2

, in which

n , oi, and 0 2 independently

are 1-4; ring A is aryl, heteroaryl, cycloalkyl, or heterocyclyl, optionally

substituted with halo or C1-C6 linear or branched alkyl; for each independent
instance of R ai and Rbi, R ai and Rbi (1) independently are H or CH 3 , or (2)
R ai and Rbi independently are ' ¾

or ' ¾

, or (3) two of CR aiRbi are

, for each independent instance of R a and R , R a and R
independently are H or CH 3 , or (2) R a and R

(1)

independently are ' ¾

or

O

'¾

, or (3) two of CR a R b are

; for each independent instance of

R i and Rdi, R i and Rdi (1) independently are H or CH 3 , or (2) R i and Rdi

V7
independently are ' ¾

0

or ' ¾

or (3) two of CR iRdi are

·

; for


each independent instance of $R_{c2}$ and $R_{d2}$. $R_{c2}$ and $R_{d2}$ independently are $H$ or $\text{CH}_3$, or
(2) $R_{c2}$ and $R_{d2}$ independently are $\text{CR}_{c2}\text{R}_{d2}$ are $\text{O}$; and * is an attachment site for a cationic dye moiety;

![Diagram](m)

, in which $n$ is 0-6, $n\text{i}$ is 1-4, and each * is an attachment site for a cationic dye moiety;

![Diagram](m.1)

, in which $n$ is 0-6, $n\text{i}$ is 1-4, and * is an attachment site for a cationic dye moiety;

![Diagram](n)

, in which $n\text{2}$ is 1-5 and each * is an attachment site for a cationic dye moiety;

![Diagram](n.1)

, in which $n\text{2}$ is 1-5 and * is an attachment site for a cationic dye moiety;
, in which $n_2$ is 1-5 and * is an attachment site for a cationic dye moiety;

, in which in which $n_1$ is 0-5, $\frac{3}{4}$ is 1-5, $n_3$ is 0-5, and * is an attachment site for a cationic dye moiety;

, in which in which $n_4$ is 0-5, $n_2$ is 1-5, and * is an attachment site for a cationic dye moiety;
10. The method of claim 1, wherein the cationic dye multimer has a formula selected from the group consisting of:

**Formula (1):**

\[
\begin{align*}
D_1 & \quad \left[ & \begin{array}{c}
\text{H} \\
\text{N} \\
\text{N}
\end{array} & \text{N} & \text{N} \\
\text{H} & \text{N} & \text{O}
\end{array} \right] & \quad \text{n}_2
\end{align*}
\]

\[D_2\]

, wherein each of \(D_1\) and \(D_2\) is a cationic dye moiety, \(n\) is 1-6, and \(\pi_1\) is 1-4; and

**Formula (2):**

\[
\begin{align*}
D_1 & \quad \left[ & \begin{array}{c}
\text{H} \\
\text{N} \\
\text{N}
\end{array} & \text{N} & \text{N} \\
\text{H} & \text{N} & \text{O}
\end{array} \right] & \quad \text{n}_2
\end{align*}
\]

\[D_2\]

, wherein each of \(D_1\) and \(D_2\) is a cationic dye moiety, \(n\) is 0-6, and \(\pi_1\) is 1-4; and

**Formula (3):**

\[
\begin{align*}
D_1 & \quad \left[ & \begin{array}{c}
\text{R}_a & \text{R}_b \\
\text{N} & \text{N}
\end{array} & \text{N} & \text{N} \\
\text{H} & \text{N} & \text{O}
\end{array} \right] & \quad \text{n}_2
\end{align*}
\]

\[D_2\]

, wherein each of \(D_1\) and \(D_2\) is a cationic dye moiety; \(n\) is 0-6, and \(\pi_1\) is 1-4; and, for each independent...
instance of $R_a$ and $R_b$, (1) $R_a$ and $R_b$ independently are H or CH$_3$, or (2) $R_a$ and $R_b$ are

$$D1$$

or

$$D2$$

or

(3) two of $CR_aR_b$ are

$\text{H}_3C$

or

$\text{H}_2N$

or

$\text{NH}$

$\text{N}$

$\text{C}$

$\text{R}_1$

$\text{R}_2$

$\text{R}_3$

$\text{R}_4$

$\text{R}_5$

$\text{R}_6$

or

(3) two of $CR_aR_b$ are

$\text{H}_3C$

or

$\text{H}_2N$

or

$\text{NH}$

$\text{N}$

$\text{C}$

$\text{R}_1$

$\text{R}_2$

$\text{R}_3$

$\text{R}_4$

$\text{R}_5$

$\text{R}_6$

$R_i$, $R_2$, $R_3$, $R_4$, $R_5$, and $R_6$ independently are absent or independently are selected from $-\text{NH}_2$, $-\text{NHR}$, $-\text{NR}_2$, $-\text{OH}$, $-\text{O}^\cdot$, $-\text{NHOCH}_3$, $-\text{NHCOR}$, $-\text{OCH}_3$, $-\text{OR}$, $-\text{C}_2\text{H}_5$, $-\text{R}$, $-\text{C}_6\text{H}_5$, $-\text{N0}_2$, $-\text{NR}_3^+$, halo, trihalide, $-\text{CN}$, $-\text{S0}_3\text{H}$, $-\text{COOH}$, $-\text{COOR}$, $-\text{CHO}$, and $-\text{COR}$, wherein $R$ is C1-C6 linear or branched alkyl;
formula (5):

\[
D_1 \quad \begin{array}{c}
\text{D1} \\
\text{D2}
\end{array} \quad n
\]

wherein each of \(D_1\) and \(D_2\) is a cationic dye moiety, \(n\) is 0-6, and \(n_1\) is 1-4;

formula (6):

\[
D_1 \quad \begin{array}{c}
\text{D1} \\
\text{D2}
\end{array} \quad n_2
\]

formula (7):

\[
D_1 \quad \begin{array}{c}
\text{D1} \\
\text{D2}
\end{array} \quad n_2
\]

formula (8):

\[
D_1 \quad \begin{array}{c}
\text{D1} \\
\text{D2}
\end{array} \quad n_2
\]

a cationic dye moiety, \(n_1\) is 0-5, and \(n_2\) is 1-5;
formula (9): (9) , wherein each of D1 and D2 is a cationic dye moiety and \( n_1 \) and \( n_2 \) independently are 1-5;

formula (10): (10) , wherein each of D1 and D2 is a cationic dye moiety and \( n \) is 1-6;

formula (10a):

wherein \( n \) is 1-6; \( R_1, R_2, R_3, R_4, R_5, \) and \( R_6 \) independently are absent or independently are selected from \(-\text{NH}_2, -\text{NHR}, -\text{NR}_2, -\text{OH}, -\text{O}^-, -\text{NHCOCH}_3, -\text{NHCOR}, -\text{OCH}_3, -\text{OR}, -\text{C}_2\text{H}_5, -\text{R}, -\text{C}_6\text{H}_5, -\text{NO}_2, -\text{NR}_3^+, \) halo, trihalide, \(-\text{CN}, -\text{SO}_3\text{H}, -\text{COOH}, -\text{COOR}, -\text{CHO}, \) and \(-\text{COR}, \) wherein \( R \) is C1-C6 linear or branched alkyl;
formula (11):  

\[(11)\]

wherein each of \(D_1\) and \(D_2\) is a cationic dye moiety; \(I_1\) and \(I_2\) independently are 1-4; \(n\) is 1-4; ring \(A\) is aryl, heteroaryl, cycloalkyl, or heterocyclyl, optionally substituted with halo or Cl-C6 linear or branched alkyl; for each independent instance of \(R_{a1}\) and \(R_{b1}\), \(R_{a1}\) and \(R_{b1}\) (1) independently are H or CH₃, or (2) \(R_{a1}\) and \(R_{b1}\) are \(\triangle\) or \(\triangle\), or (3) two of \(CR_{a1}R_{b1}\) are \(\triangle\) or \(\triangle\); and, for each independent instance of \(R_{a2}\) and \(R_{b2}\), \(R_{a2}\) and \(R_{b2}\) (1) independently are H or CH₃, or (2) \(R_{a2}\) and \(R_{b2}\) are \(\triangle\) or \(\triangle\), or (3) two of \(CR_{a2}R_{b2}\) are \(\triangle\) or \(\triangle\).

formula (11a):  

\[(11a)\]

wherein \(I_1\) and \(I_2\) independently are 1-4; \(n\) is 1-4; ring \(A\) is aryl, heteroaryl, cycloalkyl, or heterocyclyl, optionally substituted with halo or Cl-C6 linear or branched alkyl; for each independent instance of \(R_{a1}\) and \(R_{b1}\), \(R_{a1}\) and \(R_{b1}\) (1) independently are H or CH₃, or (2) \(R_{a1}\) and \(R_{b1}\) are \(\triangle\) or \(\triangle\), or (3) two of \(CR_{a1}R_{b1}\) are \(\triangle\) or \(\triangle\); for each independent instance of \(R_{a2}\) and \(R_{b2}\), \(R_{a2}\) and \(R_{b2}\) (1) independently are H or CH₃, or (2) \(R_{a2}\) and \(R_{b2}\) are \(\triangle\) or \(\triangle\).
(3) two of CR_{a2}R_{b2} are independently are absent or independently are selected from —NH_2, —NHR, 
—NR_2, —OH, —O^-, —NHCOCH_3, —NHCOR, —OCH_3, —OR, —C_2H_5, 
—R, —C_6H_5, —N_0, —NR_3^+, halo, trihalide, —CN, —SO_3H, —COOH, 
—COOR, —CHO, and —COR, wherein R is C1-C6 linear or branched alkyl;

![Chemical Structure](image)

formula (12): 

wherein each of D1 and D2 is a cationic dye moiety; I_1, I_2, n, o_1, and o_2 independently are 1-4; ring A is aryl, heteroaryl, cycloalkyl, or heterocyclyl, optionally substituted with halo or C1-C6 linear or branched alkyl; for each independent instance of R_{ai} and R_{bi}, R_{ai} and R_{bi} (1) independently are H or CH_3, or (2) 

R_{ai} and R_{bi} are... or...; for each independent instance of R_{a2} and R_{b2}, R_{a2} and R_{b2} (1) independently are H or CH_3, or (2) R_{a2} and R_{b2} are... or...; for each independent instance of R_{ai} and R_{di}, R_{ai} and R_{di} (1) independently are H or CH_3, or (2) R_{ai} and R_{di} independently are... or...; for each independent instance of R_{ci} and R_{di}, R_{ci} and R_{di} (1) independently are H or CH_3, or (2) R_{ci} and R_{di} independently are... or...; for each independent instance of R_{c2} and R_{d2}, R_{c2} and R_{d2} (1) independently are H or CH_3, or (2) R_{c2} and R_{d2} independently are... or...; for each independent instance of
formula (12a):

\[
(12a)
\]

wherein \( I_1, I_2, n, o, \) and \( \theta_2 \) independently are 1-4; ring A is aryl, heteroaryl, cycloalkyl, or heterocyclic; for each independent instance of \( R_{a1} \) and \( R_{b1} \), \( R_{a1} \) and \( R_{b1} \) (1) independently are H or \( \text{CH}_3 \), or (2) \( R_{a1} \) and \( R_{b1} \) are \( \frac{1}{2} \) or \( \frac{3}{2} \), or (3) \( \text{lorso} \) of \( CR_{a1}R_{b1} \); for each independent instance of \( R_{b2} \) and \( R_{b2} \), \( R_{a2} \) and \( R_{a2} \) (1) independently are H or \( \text{CH}_3 \), or (2) \( R_{a2} \) and \( R_{b2} \) are \( \frac{1}{2} \) or \( \frac{3}{2} \), or (3) \( \text{lorso} \) of \( CR_{a2}R_{b2} \); for each independent instance of \( R_{c1} \) and \( R_{d1} \), \( R_{c1} \) and \( R_{d1} \) (1) independently are H or \( \text{CH}_3 \), or (2) \( R_{c1} \) and \( R_{d1} \) independently are \( \frac{1}{2} \) or \( \frac{3}{2} \), or (3) two of \( CR_{c1}R_{d1} \) are \( \frac{1}{2} \) or \( \frac{3}{2} \); for each independent instance of \( R_{c2} \) and \( R_{d2} \), \( R_{c2} \) and \( R_{d2} \) (1) independently are H or \( \text{CH}_3 \), or (2) \( R_{c2} \) and \( R_{d2} \) independently are \( \frac{1}{2} \) or \( \frac{3}{2} \), or (3) two of \( CR_{c2}R_{d2} \) are \( \frac{1}{2} \) or \( \frac{3}{2} \); \( R_1, R_2, R_3, R_4, R_5, \) and \( R_6 \) independently are absent or independently are selected from —NH\(_2\), —NR\(_2\), —OH, —O\(^-\), —NHCOCH\(_3\), —NHCOR, —OCH\(_3\), —OR, —C\(_2\)H\(_5\), —R, —C\(_6\)H\(_5\), —N\(_2\)O\(_2\), —NR\(_3\), halo, trihalide, —CN, —S\(_0\)\(_2\)H, —COOH, —COOR, —CHO, and —COR, wherein R is C\(_1\)-C\(_6\) linear or branched alkyl;
Each of D1 and D2 is a cationic dye moiety; I1, I2, n, independently are 1-4; 01, and 02 independently are 1-8; ring A is aryl, heteroaryl, cycloalkyl, or heterocyclyl; for each independent instance of R ai and R bi, R ai and R bi (1) independently are H or CH3, or (2) R ai and R bi are \( \text{O} \) or \( \text{O} \), or (3) two of CR ai R bi are \( \text{O} \) or \( \text{O} \); for each independent instance of R ci and R di, R ci and R di (1) independently are H or CH3, or (2) R ci and R di are \( \text{O} \) or \( \text{O} \), or (3) two of CR ci R di are \( \text{O} \) or \( \text{O} \); for each independent instance of R c2 and R d2, R c2 and R d2 (1) independently are H or CH3, or (2) R c2 and R d2 are \( \text{O} \) or \( \text{O} \), or (3) two of CR c2 R d2 are \( \text{O} \) or \( \text{O} \);
in which each of $D_1$, $D_2$, and $D_3$ is a cationic dye moiety, $n$ is 0-6, $i$ is 1-4, $n_b$ is 0-6, and $n_j$ is 0-6;

wherein each of $D_1$, $D_2$, and $D_3$ is a cationic dye moiety, $n$ and $nb$ independently are 0-6, and $ni$ and $n_j$ independently are 1-4;

wherein each of $D_1$, $D_2$, and $D_3$ is a cationic dye moiety; $k_i$ is 2-10; $\frac{3}{4}$ is 2-10; for each independent instance of $R_{ai}$ and $R_{bi}$, $R_{ai}$ and $R_{bi}$ (1) independently are H or $\text{CH}_3$, or (2) $R_{ai}$ and $R_{bi}$ are $\text{O}$ or $\text{H}_2\text{O}$, or (3) two of $\text{CR}_{ai}R_{bi}$ are $\text{H}$; and, for each independent instance of $R_{a2}$ and $R_{b2}$, $R_{a2}$ and $R_{b2}$ (1) independently are H or $\text{CH}_3$, or (2) $R_{a2}$ and $R_{b2}$ are $\text{O}$ or $\text{H}_2\text{O}$, or (3) two of $\text{CR}_{a2}R_{b2}$ are $\text{H}$.
independently are H or CH₃, or (2) Rₐ and Rₐ are \( \text{or} \) or \( \text{or} \), or (3) two of CRₐᵢRᵢᵢ are \( \text{or} \) or \( \text{or} \). and, for each independent instance of Rₐ₂ and Rₐ₂,

Rₐ₂ and Rₐ₂ (1) independently are H or CH₃, or (2) Rₐ₂ and Rₐ₂ are \( \text{or} \) or \( \text{or} \) or (3) two of CRₐ₂Rᵢ₂ are \( \text{or} \);

formula (18):

\[
\text{wherein each of D₁, D₂, and D₃ is a cationic dye moiety, } n \text{ and } n₂ \text{ independently are 0-6, and } n₁ \text{ and } n₂ \text{ independently are 1-4;}
\]

formula (19):

\[
\text{wherein each of D₁, D₂, and D₃ is a cationic dye moiety, } n₁ \text{ and } n₂ \text{ independently are 0-5, and } n₂ \text{ and } n₂ \text{ independently are 1-5;}
\]

formula (20):

\[
\text{wherein each of D₁ and D₂ is a cationic dye moiety, } n₁ \text{ and } n₂ \text{ independently are 0-5 and } \frac{1}{4} \text{ and } n₁ \frac{3}{4} \text{ independently are 1-5;}
\]
formula (21):  
\[ (21) \]

wherein each of \( D_1, D_2, \) and \( D_3 \) is a cationic dye moiety, \( n_1 \) and \( n_2 \) independently are 0-5 and \( n_2 \) and \( n_2' \) independently are 1-5;

formula (22):  
\[ (22) \]

wherein each of \( D_1, D_2, \) and \( D_3 \) is a cationic dye moiety, \( n_1, n_2, n_3, \) and \( n_2' \) independently are 1-5;

formula (23):  
\[ (23) \]

wherein each of \( D_1, D_2, \) and \( D_3 \) is a cationic dye moiety and \( n \) and \( n_2' \) independently are 1-6;
formula (24):  

\[ (24) \text{, wherein } m \text{ is } 2; \text{ each of } D_1, \text{ a first } D_2, \text{ and a second } D_2 \text{ is a cationic dye moiety; } I_1 \text{ and } I_2 \text{ independently are } 1-4; \text{ ring } A \text{ is aryl, heteroaryl, cycloalkyl, or heterocyclyl, optionally substituted with halo or C1-C6 linear or branched alkyl; for each independent instance of } R_{a1} \text{ and } R_{i1}, R_{a2} \text{ and } R_{i2} \text{ (1) independently are } H \text{ or } \text{CH}_3, \text{ or (2) } R_{a1} \text{ and } R_{i1} \text{ are or , or (3) two of CR}_{a1}R_{i1} \text{ are and, for each independent instance of } R_{a2} \text{ and } R_{i2}, R_{a2} \text{ and } R_{i2} \text{ (1) independently are } H \text{ or } \text{CH}_3, \text{ or (2) } R_{a2} \text{ and } R_{i2} \text{ are or , or (3) two of CR}_{a2}R_{i2} \text{ are .} \]

formula (24a):  

\[ (24a), \text{ wherein } m \text{ is } 2; \text{ each of } I_1 \text{ and } I_2 \text{ independently are } 1-4; \text{ ring } A \text{ is aryl, heteroaryl, cycloalkyl, or heterocyclyl, optionally substituted with halo or C1-C6 linear or branched alkyl; for each independent instance of } R_{a1} \text{ and } R_{i1}, R_{a2} \text{ and } R_{i2} \text{ (1) independently are } H \text{ or } \text{CH}_3, \text{ or (2) } R_{a2} \text{ and } R_{i2} \text{ are or , or (3) two of CR}_{a2}R_{i2} \text{ are .} \]
of \( \text{CR}_a R_b \) are \( \alpha \); for each independent instance of \( R_{a2} \) and \( R_{b2} \), \( R_a \) and \( R_{b2} \) (1) independently are \( H \) or \( \text{CH}_3 \), or (2) \( R_{a2} \) and \( R_{b2} \) are \( \gamma \) or \( \delta \), or (3) two of \( \text{CR}_{a2} R_{b2} \) are \( \gamma \); for each independent instance of \( R_{a2} \) and \( R_{b2} \) independently are absent or independently are selected from \( -\text{NH}_2, -\text{NHR}, -\text{NR}_2, -\text{OH}, -\text{O}, -\text{NHCOCH}_3, -\text{NHCOR}, -\text{OCH}_3, -\text{OR}, -\text{C}_2\text{H}_5, -\text{R}, -\text{C}_6\text{H}_5, -\text{N0}_2, -\text{NR}_3^+, \) halo, trihalide, \( -\text{CN}, -\text{SO}_3\text{H}, -\text{COOH, -COOR, -CHO, and -COR;} \) and \( R \) is \( \text{C}1-\text{C}6 \) linear or branched alkyl;

formula (25): \( (25) \),

wherein \( m \) is 2; each of \( \text{D}1 \), a first \( \text{D}2 \), and a second \( \text{D}2 \) is a cationic dye moiety; \( l_f, l_2, n, o_i, \) and \( o_2 \) independently are 1-4; ring \( A \) is aryl, heteroaryl, cycloalkyl, or heterocyclyl, optionally substituted with halo or \( \text{C}1-\text{C}6 \) linear or branched alkyl; for each independent instance of \( R_{a1} i \) and \( R_{b1} i \), \( R_{a1} i \) and \( R_{b1} i \) (1) independently are \( H \) or \( \text{CH}_3 \), or (2) \( R_{a1} i \) and \( R_{b1} i \) are \( \alpha \) or \( \delta \), or (3) two of \( \text{CR}_{a1} R_{b1} i \) are \( \beta \); for each independent instance of \( R_{a2} i \) and \( R_{b2} \), \( R_{a1} i \) and \( R_{b2} \) (1) independently are \( H \) or \( \text{CH}_3 \), or (2) \( R_{a2} i \) and \( R_{b2} \) are \( \alpha \) or \( \delta \), or (3) two of \( \text{CR}_{a2} R_{b2} \) are \( \beta \); for each independent instance of \( R_{c1} i \) and \( R_{di} i \), \( R_{c1} i \) and \( R_{di} i \) (1) independently are \( H \) or \( \text{CH}_3 \), or (2) \( R_{c1} i \) and \( R_{di} i \) are \( \alpha \) or \( \delta \), or (3) two of \( \text{CR}_{c1} R_{di} i \) are \( \beta \); for each independent instance of \( R_{c2} i \) and \( R_{di} i \), \( R_{c2} i \) and \( R_{di} i \) (1) independently are \( H \) or \( \text{CH}_3 \), or (2) \( R_{c2} i \) and \( R_{di} i \) are \( \alpha \) or \( \delta \), or (3) two of \( \text{CR}_{c2} R_{di} i \) are \( \beta \); for each independent instance of \( R_{c3} i \) and \( R_{di} i \), \( R_{c3} i \) and \( R_{di} i \) (1) independently are \( H \) or \( \text{CH}_3 \), or (2) \( R_{c3} i \) and \( R_{di} i \) are \( \alpha \) or \( \delta \), or (3) two of \( \text{CR}_{c3} R_{di} i \) are \( \beta \); for each independent instance of \( R_{c4} i \) and \( R_{di} i \), \( R_{c4} i \) and \( R_{di} i \) (1) independently are \( H \) or \( \text{CH}_3 \), or (2) \( R_{c4} i \) and \( R_{di} i \) are \( \alpha \) or \( \delta \), or (3) two of \( \text{CR}_{c4} R_{di} i \) are \( \beta \); for each independent instance of \( R_{c5} i \) and \( R_{di} i \), \( R_{c5} i \) and \( R_{di} i \) (1) independently are \( H \) or \( \text{CH}_3 \), or (2) \( R_{c5} i \) and \( R_{di} i \) are \( \alpha \) or \( \delta \), or (3) two of \( \text{CR}_{c5} R_{di} i \) are \( \beta \); for each independent instance of \( R_{c6} i \) and \( R_{di} i \), \( R_{c6} i \) and \( R_{di} i \) (1) independently are \( H \) or \( \text{CH}_3 \), or (2) \( R_{c6} i \) and \( R_{di} i \) are \( \alpha \) or \( \delta \), or (3) two of \( \text{CR}_{c6} R_{di} i \) are \( \beta \); for each independent instance of \( R_{c7} i \) and \( R_{di} i \), \( R_{c7} i \) and \( R_{di} i \) (1) independently are \( H \) or \( \text{CH}_3 \), or (2) \( R_{c7} i \) and \( R_{di} i \) are \( \alpha \) or \( \delta \), or (3) two of \( \text{CR}_{c7} R_{di} i \) are \( \beta \); for each independent instance of \( R_{c8} i \) and \( R_{di} i \), \( R_{c8} i \) and \( R_{di} i \) (1) independently are \( H \) or \( \text{CH}_3 \), or (2) \( R_{c8} i \) and \( R_{di} i \) are \( \alpha \) or \( \delta \), or (3) two of \( \text{CR}_{c8} R_{di} i \) are \( \beta \); for each independent instance of \( R_{c9} i \) and \( R_{di} i \), \( R_{c9} i \) and \( R_{di} i \) (1) independently are \( H \) or \( \text{CH}_3 \), or (2) \( R_{c9} i \) and \( R_{di} i \) are \( \alpha \) or \( \delta \), or (3) two of \( \text{CR}_{c9} R_{di} i \) are \( \beta \); for each independent instance of \( R_{c10} i \) and \( R_{di} i \), \( R_{c10} i \) and \( R_{di} i \) (1) independently are \( H \) or \( \text{CH}_3 \), or (2) \( R_{c10} i \) and \( R_{di} i \) are \( \alpha \) or \( \delta \), or (3) two of \( \text{CR}_{c10} R_{di} i \) are \( \beta \); for each independent instance of \( R_{c11} i \) and \( R_{di} i \), \( R_{c11} i \) and \( R_{di} i \) (1) independently are \( H \) or \( \text{CH}_3 \), or (2) \( R_{c11} i \) and \( R_{di} i \) are \( \alpha \) or \( \delta \), or (3) two of \( \text{CR}_{c11} R_{di} i \) are \( \beta \); for each independent instance of \( R_{c12} i \) and \( R_{di} i \), \( R_{c12} i \) and \( R_{di} i \) (1) independently are \( H \) or \( \text{CH}_3 \), or (2) \( R_{c12} i \) and \( R_{di} i \) are \( \alpha \) or \( \delta \), or (3) two of \( \text{CR}_{c12} R_{di} i \) are \( \beta \); for each independent instance of \( R_{c13} i \) and \( R_{di} i \),
independently are \( \frac{1}{3} \) or \( \frac{2}{3} \), or (3) two of \( CR_{ci}R_{di} \) are \( \frac{1}{2} \) or \( \frac{3}{2} \); for each independent instance of \( R_{e2} \) and \( R_{d2} \), \( R_{e2} \) and \( R_{d2} \) (1) independently are H or \( CH_3 \), or (2) \( R_{e2} \) and \( R_{d2} \) independently are \( \frac{1}{3} \) or \( \frac{2}{3} \), or (3) two of \( CR_{e2}R_{d2} \) are \( \frac{1}{2} \).

formula (25a):

\[
\text{(25a)}
\]

wherein \( m \) is 2; \( I_1, I_2, n, 0_1, \) and \( 0_2 \) independently are 1-4; ring \( A \) is aryl, heteroaryl, cycloalkyl, or heterocyclyl, optionally substituted with halo or Cl- C6 linear or branched alkyl; for each independent instance of \( R_{a1} \) and \( R_{b1}, R_{a1} \) and \( R_{b1} \) (1) independently are H or \( CH_3 \), or (2) \( R_{a1} \) and \( R_{b1} \) are \( \frac{1}{3} \) or \( \frac{2}{3} \), or (3) two of \( CR_{a1}R_{b1} \) are \( \frac{1}{2} \) or \( \frac{3}{2} \); for each independent instance of \( R_{a2} \) and \( R_{b2}, R_{a2} \) and \( R_{b2} \) (1) independently are H or \( CH_3 \), or (2) \( R_{a2} \) and \( R_{b2} \) are \( \frac{1}{3} \) or \( \frac{2}{3} \); for each independent instance of \( R_{c1} \) and \( R_{d1}, R_{c1} \) and \( R_{d1} \) (1) independently are H or \( CH_3 \), or (2) \( R_{c1} \) and \( R_{d1} \) independently are \( \frac{1}{3} \) or \( \frac{2}{3} \), or (3) two of \( CR_{c1}R_{d1} \) are \( \frac{1}{2} \) or \( \frac{3}{2} \); for each independent instance of \( R_{e2} \) and \( R_{d2}, R_{e2} \) and \( R_{d2} \) (1) independently are H or \( CH_3 \), or (2) \( R_{e2} \) and \( R_{d2} \) independently are \( \frac{1}{3} \) or \( \frac{2}{3} \).
or (3) two of \( CR_2R_3 \) are independently are absent or independently are selected from \( \text{—NH}_2, \text{—NHR,} \)
\( \text{—NR}_2, \text{—OH,} \text{—O',} \text{—NHCOCH}_3, \text{—NHCOR,} \text{—OCH}_3, \text{—OR,} \text{—C}_2\text{H}_5, \)
\( \text{—R,} \text{—C}_6\text{H}_5, \text{—NO}_2, \text{—NR}_3^+, \text{halo, trihalide,} \text{—CN,} \text{—S}_0^3\text{H,} \text{—COOH,} \)
\( \text{—COOR,} \text{—CHO, and} \text{—COR; and} \text{R} \text{is C1-C6 linear or branched alkyl;} \)

\[
\text{O} \\
\text{or (3) two of CR}_2\text{R}_3 \text{are} \]

\[
\text{R, R}_2, \text{R}_3, \text{R}_4, \text{R}_5, \text{and R}_6 \text{independently are absent or independently are selected from} \]

\[
\text{—NH}_2, \text{—NHR,} \\
\text{—NR}_2, \text{—OH,} \text{—O’,} \text{—NHCOCH}_3, \text{—NHCOR,} \text{—OCH}_3, \text{—OR,} \text{—C}_2\text{H}_5, \\
\text{—R,} \text{—C}_6\text{H}_5, \text{—NO}_2, \text{—NR}_3^+, \text{halo, trihalide,} \text{—CN,} \text{—S}_0^3\text{H,} \text{—COOH,} \\
\text{—COOR,} \text{—CHO, and} \text{—COR; and} \text{R} \text{is C1-C6 linear or branched alkyl;} \]

\[
\text{formula (26), (27), (28), (29), (30), (31), or (32):} \\
\]

\[
\text{(26)} \\
\text{(27)} \\
\text{(28)} \\
\text{(29)} \]
wherein $D_i$ is a cationic dye moiety, $n_x$ is 0-5, $n_y$ is 1-5, and $L_i$ is absent or $L_i$ is a linker selected from linker (a.1), linker (a.2), linker (b.1), linker (c.1), linker (c.2), linker (d), linker (e.1), linker (f.1), linker (f.2), linker (g.1), linker (g.2), linker (h.1), linker (h.2), linker (i.1), linker (i.2), linker (j.1), linker (j.2), linker (k), linker (1.1), linker (1.2), is linker (m.1), linker (n.1), linker (n.2), linker (o), linker (p), linker (q), linker (r), and linker (s);

and $D_4$ is a cationic dye moiety and $L$ is absent or $L$ is a linker selected from linker (a.1), linker (a.2), linker (b.1), linker (c.1), linker (c.2), linker (d), linker (e.1), linker (f.1), linker (f.2), linker (g.1), linker (g.2), linker (h.1), linker (h.2), linker (i.1), linker (i.2), linker (j.1), linker (j.2), linker (k), linker (1.1),
linker (1.2), is linker (m.l), linker (n.l), linker (n.2), linker (o), linker (p),
linker (q), linker (r), and linker (s); and

\[
\text{formula (34):} \quad \text{wherein each of}
\]

\(D_1, \ D_2, \ \text{and} \ D_3\) is a cationic dye moiety and \(L\) is absent or \(L\) is a linker

selected from linker (a.l), linker (a.2), linker (b.l), linker (c.l), linker (c.2),
linker (d), linker (e.l), linker (f.l), linker (f.2), linker (g.l), linker (g.2), linker
(h.l), linker (h.2), linker (i.l), linker (i.2), linker (j.l), linker (j.2), linker (k),
linker (1.1), linker (1.2), is linker (m.l), linker (n.l), linker (n.2), linker (o),
linker (p), linker (q), linker (r), and linker (s); or

wherein the cationic dye multimer is

11. The method of any of claims 1-10, wherein the cationic dye is selected from the
group consisting of safranin-O, toluidine blue, azure A, azure B, azure C, acridine orange,
acriflavine, and methylene blue.
FIG. 1

0 is basal adherence seen with cells alone.
FIG. 6B

Vehicle

Spleen

Small intestine

Compound 4

Sahranin O
FIG. 7A

- Brain
  - Upper view
  - Lower view

- Kidney
  - Open kidney

- Heart
  - Open heart

- Spleen
  - Open spleen
A. CLASSIFICATION OF SUBJECT MATTER

INV. A61K47/55  C12N5/00  A61K47/69  A61P19/02

ADD.

According to International Patent Classification (IPC) and both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61K  C12N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, BIOSIS, EMBASE, CHEM ABS Data, DISSERTATION ABS, PASCAL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tbody>
<tr>
<td>Y</td>
<td>Wo 01/58495 A2 (GEN HOSPITAL CORP [US]; KÖCHEVAR I RENÉE [US]; REDMOND ROBERT W [US]; AZ) 16 August 2001 (2001-08-16) example 5</td>
<td>1-11</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:
  
  "A" document defining the general state of the art which is not considered to be of particular relevance
  
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  "O" document referring to an oral disclosure, use, exhibition or other means
  
  "P" document published prior to the international filing date but later than the priority date claimed
  
  
  "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  
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  "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  
  "Z" document member of the same patent family

Date of the actual completion of the international search: 2 November 2016

Date of mailing of the international search report: 09/11/2016

Name and mailing address of the ISA:
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Authorized officer:
Dul I aart, Anwyn

Form PCT/ISA210 (second sheet) (April 2005)
<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tr>
<td>Y</td>
<td><strong>US 6 684 886 BI (ALLEYNE NEVILLE [US])</strong>&lt;br&gt;3 February 2004 (2004-02-03)&lt;br&gt;column 3, line 45 - column 4, line 11 claims</td>
<td>1-11</td>
</tr>
<tr>
<td>Y</td>
<td><strong>WO 03/080138 A1 (SULZER ORTHOPEDICS LTD [CH]; BITTMANN PEDRO [CH]; NADLER DANIEL [CH])</strong>&lt;br&gt;2 October 2003 (2003-10-02)&lt;br&gt;page 5 - page 6&lt;br&gt;page 7, line 23 - page 8, line 2 claims</td>
<td>1-11</td>
</tr>
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