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(71) Applicant *(for all designated States except US)*: **CYALUME TECHNOLOGIES, INC.** [US/US]; 96 Windsor Street, West Springfield, MA 01089 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **CRANOR, Earl** [US/US]; 24 Lincoln Park, Longmeadow, MA 01106 (US). **JACOB, Linda** [US/US]; 98 Maple Vale Drive, Woodbridge, CT 06525 (US).

(74) Agents: **LANDER, Ferris, H.** et al.; MCHALE & SLAVIN, P.A., 2588 Pga Boulevard, Palm Beach Gardens, FL 33410 (US).

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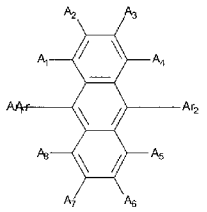
(54) Title: BLUE/VIOLET DIPHENYLANTHRACENE CHEMILUMINESCENT FLUORESCERS



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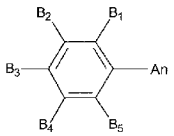

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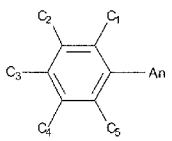


(3)

(57) Abstract: Compounds are disclosed for the production of chemiluminescent light, particularly for the production of blue/violet light within the range of about 390nm to less than 438 nm, and most particularly to the use of compounds composed of symmetrically and asymmetrically substituted anthracenes which are effective for increasing the production of such blue/violet light when used as fluorescers in conjunction with chemiluminescent systems. These systems utilize derivatives of 9,10-diphenylanthracene containing one or more fluorines As shown in General Formulae (1-3). The variables shown in Formulae (1-3) are defined in the specification.

BLUE/VIOLET DIPHENYLANTHRACENE CHEMILUMINESCENT FLUORESCERS

FIELD OF THE INVENTION

This invention relates to the production of chemiluminescent light, particularly to the production of blue/violet light within the range of about 390nm to less than438 nm, and most particularly to the use of compounds composed of symmetrically and asymmetrically substituted anthracenes which are effective for increasing the production of such blue/violet light when used as fluorescers in conjunction with chemiluminescent systems.

BACKGROUND OF THE INVENTION

The principle techniques for the production of chemiluminescent light comprising the reaction of an oxalate solution including a dye with a solution of hydrogen peroxide containing a suitable catalyst have been well described in the following U.S. Pat. Nos. 6,740,263; 5,232,635; 4,717,511; 4,678,608; 3,888,786; 3,775,336; 3,749,679; 3,597,362; 3,557,233; 3,391,068; 3,391,069, which are incorporated herein by reference.

Chemiluminescence is produced by a reaction, in the liquid phase, of an activator such as hydrogen peroxide with a fluorescent agent and an oxalate. Optionally, other secondary compounds can be present such as catalysts, dyes etc. The production of chemiluminescent light by the reaction of a catalyzed hydrogen peroxide solution with a fluorescer solution is well known in the art. Blue, green and yellow chemiluminescent light has been produced depending upon the particular fluorescer employed in the fluorescer solution. Examples of these prior art chemiluminescent light-systems can be found in one or more of the following U.S. Pat. Nos. 3,749,679; 3,391,068; 3,974,368; 3,557,233; 3,597,362; 3,775,336; 3,888,786.

Historically, the light output of blue chemiluminescent devices has been based upon 9,10-diphenylanthracene (DPHA) and 2-chloro-9,10-bis(4-methoxyphenyl)anthracene (BPEN). However, although the light output is measured from 400-500 nm, most of the substituted 9,10-diphenylanthracene derivatives have chemiluminescent emission maxima greater than 445 nm. The most common blue used in chemiluminescent devices is BPEN with an emission maximum of 451 nm. None of the

reported non-polymeric substituted diphenylanthracene dyes used for chemiluminescence has a listed emission maximum below DPHA (438 nm). This invention teaches the development of dyes suitable for oxalate/peroxide chemiluminescent systems with a spectrum having an emission maximum at a wavelength below the one observed for DPHA, but at wavelengths greater than the ultra-violet region. This would enable the production of a chemiluminescent system with greater output in the violet region of the visible spectrum, particularly, a chemiluminescent system which produces light having an emission maximum from about 390nm to less than 438 nm without the need for filters to protect the observer from ultraviolet radiation.

DESCRIPTION OF THE PRIOR ART

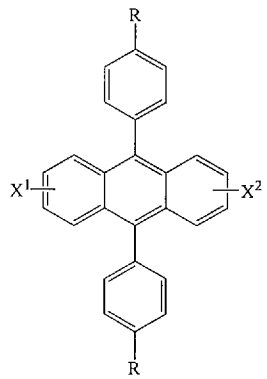
United States Patent 3,888,786 to Maulding relates to a chemiluminescent system to obtain chemiluminescent light by reacting an oxalic-type compound of the group consisting of an oxalic-type ester with a hydroperoxide compound in the presence of a solvent and chloro, fluoro, or lower alkyl bis(phenylethynyl)-substituted aromatic compound as a fluorescer. Similarly, U.S. Patents 3,729,426, 3,948,797, 4,017,415 and 5,122,306 teach the use of substitutued anthracene derivatives such as 9,10-bis(phenylethynyl)anthracene, 9,10-bis(4-methoxyphenyl)-2-chloroanthracene, monochloro-substituted 9,10-bis(phenylethynyl)anthracenes such as 1-chloro-9,10-bis(phenylethynyl)anthracene, dichloro-substituted 9,10-bis(phenylethynyl)anthracenes such as 1,8-dichloro-9,10-bis(phenylethynyl)anthracene, 1,5-dichloro-9,10-bis(phenylethynyl)anthracene, 2,3-dichloro-9,10-bis(phenylethynyl)anthracene, 9,10-diphenylanthracene and the like, as suitable fluorescers for chemiluminescent systems. United States Patent 3,970,660 to Bollyky is directed toward a chemiluminescent system comprising (1) derivatives of a polycarbonyl compound substituted with at least one nitrogen-containing hetero group and which may have an alkanol or amine substituent, (2) a hydroperoxide compound, (3) a diluent, and (4) a fluorescer, inclusive of halogen substituted anthracenes, said ingredients in combination producing visible chemiluminescent light and a process of producing such light. United States Patent 4,076,645 to Vega teaches compositions and methods for producing chemiluminescence by the reaction of bis(6-carbopentoxy-2,4,5-trichlorophenyl)oxalate with a peroxide in presence of 9,10-bis(phenylethynyl)anthracene the initial luminosity on mixing these

reaction components in a suitable diluent is increased by using the specific concentration of bis-oxalate ester component in the range from 0.05 to 0.09 mole per liter in the reaction mixture.

United States Patent 4,859,369 to Baretz et al, teaches aqueous chemiluminescent systems, inclusive of halogen substituted anthracene fluorescers including those emitting in the blue region of the spectrum chemiluminescent systems, which have been found to exhibit improved chemiluminescence due to the presence of minor amounts of a water-soluble polymer.

United States Patent 5,232,635 to Van Moer et al is directed toward new derivatives of anthracene for the emission of a blue chemiluminescent light. The derivatives are of 9,10-bisphenylanthracene substituted at the 2 position of the anthracene ring and on the phenyl groups including 9,10-bis(4-fluorophenyl)-2-fluoroanthracene. The production of turquoise chemiluminescent light is also disclosed by mixing said derivatives with a green 9,10-bis(phenylethynyl) anthracene.

United States Patent 6,740,263 to Park et al describes an anthracene and chemiluminescent compositions as shown below. Wherein, R is an alkyl group having 1-8 carbon atoms, and X^1 and X^2 are independently hydrogen or a halogen.



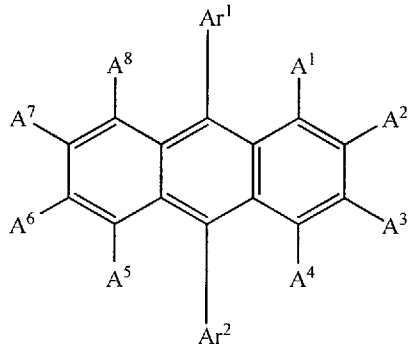
The disclosure of Park et al relates to an anthracene compound and a chemiluminescent composition comprising the compound, and more particularly to a novel anthracene compound, which is capable of emitting a blue light of a high intensity for a prolonged period of time compared with conventional anthracene compounds used as luminescent dyes in chemiluminescent compositions emitting blue light, and a chemiluminescent composition comprising the anthracene compound.

The above referenced prior art disclosures fail to teach or suggest the novel compounds as instantly disclosed, nor do they teach a chemiluminescent system which produces light having an emission maximum from about 390nm to less than 438 nm.

SUMMARY OF THE INVENTION

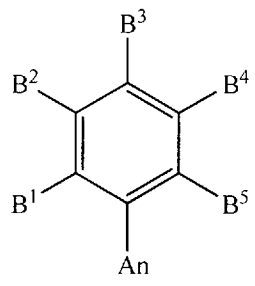
It is a primary objective of the instant invention to teach new species of fluoro-substituted 9,10-diphenylanthracenes including symmetrically and/or asymmetrically substituted constituents.

It is a further objective of the instant invention to provide fluorescer compounds based upon symmetrical and asymmetrical 9,10-diphenylanthracene derivatives of Formula (1), where the substituents on the anthracene labeled A^1, A^2, A^3, A^4, A^5, A^6, A^7, and A^8 are either fluorine or hydrogen.



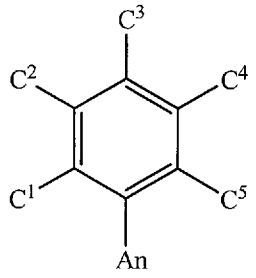
(1)

Furthermore, if Ar^1 and Ar^2 are the same, at least two of the substituents, B^1, B^2, B^3, B^4, and B^5, as shown in Figure (2), are not hydrogen, wherein B^1, B^2, B^4, and B^5 are either hydrogen or fluorine and B^3 is either hydrogen, fluorine, trifluoromethyl, or an alkoxy group with 1-10 carbons.

$Ar^1 =$ 

(2)

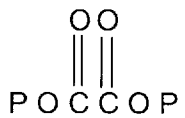
Additionally, if Ar^1 and Ar^2 are not the same, Ar^1 will meet the conditions described above and the second ring, as shown in Figure 3, may be completely substituted with hydrogen or wherein at least one of the substituents, C^1, C^2, C^3, C^4, and C^5 which are not hydrogen, wherein C^1, C^2, C^4, and C^5 are either hydrogen or fluorine and C^3 is either hydrogen, fluorine, trifluoromethyl, or an alkoxy group with 1-10 carbons.

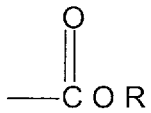
$Ar^2 =$ 

(3)

It is a further objective of the instant invention to provide a chemiluminescent composition comprised of a solution of the fluorescer and oxalate, , which when mixed with a solution of hydrogen peroxide in an appropriate solvent provides a chemiluminescent system exhibiting improved light output in the spectral region of about 390 nm to less than 438 nm particularly, a chemiluminescent system which produces light having an emission maximum from about 390nm to less than 438 nm, and more specifically a chemiluminescent system which produces light having an emission maximum in the region from about 400nm to about 420 nm.

In accordance with the present invention, the oxalate compound is a bis(phenyl) oxalate ester having the formula:



in which the phenyl groups(P) are substituted by at least one carbalkoxy group of the formula 

in which R is (a) an alkyl group (1-18 carbons, straight chain, branched chain, cyclic) or (b) a substituted alkyl group, where said substituents are selected from

the group consisting of fluoro, chloro, trifluoromethyl, alkoxy, cyano, carbalkoxy, and phenyl; and in which (2) the phenyl groups P, are substituted by at least two additional substituents selected from the group consisting of fluoro, chloro, bromo, cyano, trifluoromethyl, carbalkoxy, nitro, alkoxy, alkoxy methyl, methyl, and higher alkyl, said additional substituents being selected so that the sum of their Hammett sigma constants for phenols lies between 1.0 and 2.

In a preferred embodiment the oxalate is bis(2,4,5-trichloro-6-carbopentoxyphenyl)oxalate.

Other objects and advantages of this invention will become apparent from the following description taken in conjunction with any accompanying drawings wherein are set forth, by way of illustration and example, certain embodiments of this invention. Any drawings contained herein constitute a part of this specification and include exemplary embodiments of the present invention and illustrate various objects and features thereof.

BRIEF DESCRIPTION OF THE FIGURES

As follows, Figures 1-88 illustrate anthracene derivatives with the same or symmetrically substituted aryl rings in the 9 and 10 positions, and Figures 89 - 660 illustrate anthracene derivatives with different or asymmetric aryl rings in the 9 and 10 positions.

Figure 1 illustrates a 9,10-bis(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 2 illustrates a 9,10-bis[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 3 illustrates a 9,10-bis(3,4,5-trifluorophenyl)anthracene

Figure 4 illustrates a 9,10-bis(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 5 illustrates a 9,10-bis(2,3,5,6-tetrafluoro-4-methoxypheny)anthracene;

Figure 6 illustrates a 9,10-bis(2,6-difluoro-4-methoxyphenyl)anthracene;

Figure 7 illustrates a 9,10-bis(2,4-difluorophenyl)anthracene

Figure 8 illustrates a 9,10-bis(3,4-difluorophenyl)anthracene;

Figure 9 illustrates a 2-fluoro-9,10-bis(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 10 illustrates a 2-fluoro-9,10-bis[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 11 illustrates a 2-fluoro-9,10-bis(3,4,5-trifluorophenyl)anthracene

Figure 12 illustrates a 2-fluoro-9,10-bis(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 13 illustrates a 2-fluoro-9,10-bis(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 14 illustrates a 9,10-bis(2,6-difluoro-4-methoxyphenyl)-2-fluoroanthracene;

Figure 15 illustrates a 9,10-bis(2,4-difluorophenyl)-2-fluoroanthracene;

Figure 16 illustrates a 9,10-bis(3,4-difluorophenyl)-2-fluoroanthracene anthracene;

Figure 17 illustrates a 1-fluoro-9,10-bis(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 18 illustrates a 1-fluoro-9,10-bis[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 19 illustrates a 1-fluoro-9,10-bis(3,4,5-trifluorophenyl)anthracene

Figure 20 illustrates a 1-fluoro-9,10-bis(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 21 illustrates a 1-fluoro-9,10-bis(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 22 illustrates a 9,10-bis(2,6-difluoro-4-methoxyphenyl)-1-fluoroanthracene;

Figure 23 illustrates a 9,10-bis(2,4-difluorophenyl)1-fluoroanthracene;

Figure 24 illustrates a 9,10-bis(3,4-difluorophenyl)1-fluoroanthracene;

Figure 25 illustrates a 1,4-difluoro-9,10-bis(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 26 illustrates a 1,4-difluoro-9,10-bis[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 27 illustrates a 1,4-difluoro-9,10-bis(3,4,5-trifluorophenyl)anthracene;

Figure 28 illustrates a 1,4-difluoro-9,10-bis(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 29 illustrates a 1,4-difluoro-9,10-bis(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 30 illustrates a 9,10-bis(2,6-difluoro-4-methoxyphenyl)-1,4-difluoroanthracene;

Figure 31 illustrates a 9,10-bis(2,4-difluorophenyl)-1,4-difluoroanthracene;

Figure 32 illustrates a 9,10-bis(3,4-difluorophenyl)-1,4-difluoroanthracene;

Figure 33 illustrates a 2,3-difluoro-9,10-bis(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 34 illustrates a 2,3-difluoro-9,10-bis[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 35 illustrates a 2,3-difluoro-9,10-bis(3,4,5-trifluorophenyl)anthracene;

Figure 36 illustrates a 2,3-difluoro-9,10-bis(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 37 illustrates a 2,3-difluoro9,10-bis(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 38 illustrates a 9,10-bis(2,6-difluoro-4-methoxyphenyl)-2,3-difluoroanthracene;

Figure 39 illustrates a 9,10-bis(2,4-difluorophenyl)-2,3-difluoroanthracene;

Figure 40 illustrates a 9,10-bis(3,4-difluorophenyl)-2,3-difluoroanthracene;

Figure 41 illustrates a 1,4,5-trifluoro-9,10-bis(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 42 illustrates a 1,4,5-trifluoro-9,10-bis[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 43 illustrates a 1,4,5-trifluoro-9,10-bis(3,4,5-trifluorophenyl)anthracene;

Figure 44 illustrates a 1,4,5-trifluoro-9,10-bis(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 45 illustrates a 1,4,5-trifluoro-9,10-bis(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 46 illustrates a 9,10-bis(2,6-difluoro-4-methoxyphenyl)-1,4,5-trifluoroanthracene;

Figure 47 illustrates a 9,10-bis(2,4-difluorophenyl)-1,4,5trifluoroanthracene;

Figure 48 illustrates a 9,10-bis(3,4-difluorophenyl)-1,4,5-trifluoroanthracene;

Figure 49 illustrates a 1,4,6-trifluoro-9,10-bis(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 50 illustrates a 1,4,6-trifluoro-9,10-bis[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 51 illustrates a 1,4,6-trifluoro-9,10-bis(3,4,5-trifluorophenyl)anthracene;

Figure 52 illustrates a 1,4,6-trifluoro-9,10-bis(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 53 illustrates a 1,4,6-trifluoro-9,10-bis(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 54 illustrates a 9,10-bis(2,6-difluoro-4-methoxyphenyl)-1,4,6-trifluoroanthracene;

Figure 55 illustrates a 9,10-bis(2,4-difluorophenyl)-1,4,6-trifluoroanthracene;

Figure 56 illustrates a 9,10-bis(3,4-difluorophenyl)-1,4,6-trifluoroanthracene;

Figure 57 illustrates a 1,2,3,4-tetrafluoro-9,10-bis(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 58 illustrates a 1,2,3,4-tetrafluoro-9,10-bis[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 59 illustrates a 1,2,3,4-tetrafluoro-9,10-bis(3,4,5-trifluorophenyl)anthracene

Figure 60 illustrates a 1,2,3,4-tetrafluoro-9,10-bis(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 61 illustrates a 1,2,3,4-tetrafluoro-9,10-bis(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 62 illustrates a 9,10-bis(2,6-difluoro-4-methoxyphenyl)-1,2,3,4-tetrafluoroanthracene;

Figure 63 illustrates a 9,10-bis(2,4-difluorophenyl)-1,2,3,4-tetrafluoroanthracene;

Figure 64 illustrates a 9,10-bis(3,4-difluorophenyl)-1,2,3,4-tetrafluoroanthracene;

Figure 65 illustrates a 1,2,3,4,5-pentafluoro-9,10-bis(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 66 illustrates a 1,2,3,4,5-pentafluoro-9,10-bis[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 67 illustrates a 1,2,3,4,5-pentafluoro-9,10-bis(3,4,5-trifluorophenyl)anthracene

Figure 68 illustrates a 1,2,3,4,5-pentafluoro-9,10-bis(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 69 illustrates a 1,2,3,4,5-pentafluoro-9,10-bis(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 70 illustrates a 9,10-bis(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5-pentafluoroanthracene;

Figure 71 illustrates a 9,10-bis(2,4-difluorophenyl)-1,2,3,4,5-pentafluoroanthracene;

Figure 72 illustrates a 9,10-bis(3,4-difluorophenyl)-1,2,3,4,5-pentafluoroanthracene;

Figure 73 illustrates a 1,2,3,4,6-pentafluoro-9,10-bis(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 74 illustrates a 1,2,3,4,6-pentafluoro-9,10-bis[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 75 illustrates a 1,2,3,4,6-pentafluoro-9,10-bis(3,4,5-trifluorophenyl)anthracene:

Figure 76 illustrates a 1,2,3,4,6-pentafluoro-9,10-bis(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 77 illustrates a 1,2,3,4,6-pentafluoro-9,10-bis(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 78 illustrates a 9,10-bis(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,6-pentafluoroanthracene;

Figure 79 illustrates a 9,10-bis(2,4-difluorophenyl)-1,2,3,4,6-pentafluoroanthracene;

Figure 80 illustrates a 9,10-bis(3,4-difluorophenyl)-1,2,3,4,6-pentafluoroanthracene;

Figure 81 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9,10-bis(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 82 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9,10-bis[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 83 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9,10-bis(3,4,5-trifluorophenyl)anthracene

Figure 84 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9,10-bis(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 85 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9,10-bis(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 86 illustrates a 9,10-bis(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5,6,7,8-octafluoroanthracene;

Figure 87 illustrates a 9,10-bis(2,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoroanthracene;

Figure 88 illustrates a 9,10-bis(3,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoroanthracene;

Figure 89 illustrates a 9-(2,3,4,5,6-pentafluorophenyl)-10-phenylanthracene;

Figure 90 illustrates a 9-(4-methoxyphenyl)-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 91 illustrates a 9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoropheny)lanthracene;

Figure 92 illustrates a 9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 93 illustrates a 9-(2,3,4,5,6-pentafluorophenyl)-10-(3,4,5-trifluoro)anthracene;

Figure 94 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(2,3,4,5,6-pentafluorophenyl)anthracene

Figure 95 illustrates a 9-(3,4-difluorophenyl)-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 96 illustrates a 9-(2,3,4,5,6-pentafluorophenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 97 illustrates a 9-(2,4-difluorophenyl)-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 98 illustrates a 9-phenyl-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 99 illustrates a 9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 100 illustrates a 9-(2,3,5,6-tetrafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 101 illustrates a 9-(2,3,5,6-tetrafluorophenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 102 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 103 illustrates a 9-(3,4-difluorophenyl)-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 104 illustrates a 9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,,5,6-tetrafluorophenyl)anthracene;

Figure 105 illustrates a 9-(3,4-difluorophenyl)-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 106 illustrates a 9-phenyl-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 107 illustrates a 9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 108 illustrates a 9-(2,3,5,6-tetrafluoro-4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 109 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 110 illustrates a 9-(3,4-difluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 111 illustrates a 9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 112 illustrates a 9-(2,4-difluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 113 illustrates a 9-phenyl-10-(3,4,5-trifluorophenyl)anthracene;

Figure 114 illustrates a 9-(4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 115 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 116 illustrates a 9-(3,4-difluorophenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 117 illustrates a 9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(3,4,5-trifluorophenyl)anthracene;

Figure 118 illustrates a 9-(2,4-difluorophenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 119 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-phenylanthracene:

Figure 120 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(4-methoxyphenyl)anthracene:

Figure 121 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(3,4-difluorophenyl)anthracene;

Figure 122 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 123 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(2,4-difluorophenyl)anthracene;

Figure 124 illustrates a 9-(3,4-difluorophenyl)-10-phenylanthracene;

Figure 125 illustrates a 9-(3,4-difluorophenyl)-10-(4-methoxyphenyl)anthracene;

Figure 126 illustrates a 9-(3,4-difluorophenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 127 illustrates a 9-(2,4-difluorophenyl)-10-(3,4-difluorophenyl)anthracene;

Figure 128 illustrates a 9-phenyl-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 129 illustrates a 9-(4-methoxyphenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 130 illustrates a 9-(2,4-difluorophenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 131 illustrates a 9-(2,4-difluorophenyl)-10-phenylanthracene;

Figure 132 illustrates a 9-(2,4-difluorophenyl)-10-(4-methoxyphenyl)anthracene;

Figure 133 illustrates a 1-fluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-phenylanthracene;

Figure 134 illustrates a 1-fluoro-9-(4-methoxyphenyl)-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 135 illustrates a 1-fluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoropheny)lanthracene;

Figure 136 illustrates a 1-fluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 137 illustrates a 1-fluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(3,4,5-trifluoro)anthracene;

Figure 138 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1-fluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene

Figure 139 illustrates a 9-(3,4-difluorophenyl)-1-fluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 140 illustrates a 1-fluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 141 illustrates a 9-(2,4-difluorophenyl)-1-fluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 142 illustrates a 1-fluoro-9-phenyl-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 143 illustrates a 1-fluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 144 illustrates a 1-fluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 145 illustrates a 1-fluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 146 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1-fluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 147 illustrates a 9-(3,4-difluorophenyl)-1-fluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 148 illustrates a 1-fluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,,5,6-tetrafluorophenyl)anthracene;

Figure 149 illustrates a 9-(3,4-difluorophenyl)-1-fluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 150 illustrates a 1-fluoro-9-phenyl-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 151 illustrates a 1-fluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 152 illustrates a 1-fluoro-9-(2,3,5,6-tetrafluoro-4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 153 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1-fluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 154 illustrates a 9-(3,4-difluorophenyl)-1-fluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 155 illustrates a 1-fluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 156 illustrates a 9-(2,4-difluorophenyl)-1-fluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 157 illustrates a 1-fluoro-9-phenyl-10-(3,4,5-trifluorophenyl)anthracene;

Figure 158 illustrates a 1-fluoro-9-(4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 159 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1-fluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 160 illustrates a 9-(3,4-difluorophenyl)-1-fluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 161 illustrates a 1-fluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(3,4,5-trifluorophenyl)anthracene;

Figure 162 illustrates a 9-(2,4-difluorophenyl)-1-fluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 163 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1-fluoro-10-phenylanthracene:

Figure 164 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1-fluoro-10-(4-methoxyphenyl)anthracene:

Figure 165 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(3,4-difluorophenyl)-1-fluoroanthracene;

Figure 166 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1-fluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 167 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1-fluoro-10-(2,4-difluorophenyl)anthracene;

Figure 168 illustrates a 9-(3,4-difluorophenyl)-1-fluoro-10-phenylanthracene;

Figure 169 illustrates a 9-(3,4-difluorophenyl)-1-fluoro-10-(4-methoxyphenyl)anthracene;

Figure 170 illustrates a 9-(3,4-difluorophenyl)-1-fluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 171 illustrates a 9-(2,4-difluorophenyl)-1-fluoro-10-(3,4-difluorophenyl)anthracene;

Figure 172 illustrates a 1-fluoro-9-phenyl-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 173 illustrates a 1-fluoro-9-(4-methoxyphenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 174 illustrates a 9-(2,4-difluorophenyl)-1-fluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 175 illustrates a 9-(2,4-difluorophenyl)-1-fluoro-10-phenylanthracene;

Figure 176 illustrates a 9-(2,4-difluorophenyl)-1-fluoro-10-(4-methoxyphenyl)anthracene;

Figure 177 illustrates a 2-fluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-phenylanthracene;

Figure 178 illustrates a 2-fluoro-9-(4-methoxyphenyl)-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 179 illustrates a 2-fluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoropheny)lanthracene;

Figure 180 illustrates a 2-fluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 181 illustrates a 2-fluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(3,4,5-trifluoro)anthracene;

Figure 182 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2-fluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene

Figure 183 illustrates a 9-(3,4-difluorophenyl)-2-fluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 184 illustrates a 2-fluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 185 illustrates a 9-(2,4-difluorophenyl)-2-fluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 186 illustrates a 2-fluoro-9-phenyl-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 187 illustrates a 2-fluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 188 illustrates a 2-fluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 189 illustrates a 2-fluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 190 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2-fluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 191 illustrates a 9-(3,4-difluorophenyl)-2-fluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 192 illustrates a 2-fluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,,5,6-tetrafluorophenyl)anthracene;

Figure 193 illustrates a 9-(3,4-difluorophenyl)-2-fluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 194 illustrates a 2-fluoro-9-phenyl-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 195 illustrates a 2-fluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 196 illustrates a 2-fluoro-9-(2,3,5,6-tetrafluoro-4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 197 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2-fluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 198 illustrates a 9-(3,4-difluorophenyl)-2-fluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 199 illustrates a 2-fluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 200 illustrates a 9-(2,4-difluorophenyl)-2-fluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 201 illustrates a 2-fluoro-9-phenyl-10-(3,4,5-trifluorophenyl)anthracene;

Figure 202 illustrates a 2-fluoro-9-(4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 203 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2-fluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 204 illustrates a 9-(3,4-difluorophenyl)-2-fluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 205 illustrates a 2-fluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(3,4,5-trifluorophenyl)anthracene;

Figure 206 illustrates a 9-(2,4-difluorophenyl)-2-fluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 207 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2-fluoro-10-phenylanthracene:

Figure 208 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2-fluoro-10-(4-methoxyphenyl)anthracene:

Figure 209 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(3,4-difluorophenyl)-2-fluoroanthracene;

Figure 210 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2-fluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 211 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2-fluoro-10-(2,4-difluorophenyl)anthracene;

Figure 212 illustrates a 9-(3,4-difluorophenyl)-2-fluoro-10-phenylanthracene;

Figure 213 illustrates a 9-(3,4-difluorophenyl)-2-fluoro-10-(4-methoxyphenyl)anthracene;

Figure 214 illustrates a 9-(3,4-difluorophenyl)-2-fluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 215 illustrates a 9-(2,4-difluorophenyl)-2-fluoro-10-(3,4-difluorophenyl)anthracene;

Figure 216 illustrates a 2-fluoro-9-phenyl-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 217 illustrates a 2-fluoro-9-(4-methoxyphenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 218 illustrates a 9-(2,4-difluorophenyl)-2-fluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 219 illustrates a 9-(2,4-difluorophenyl)-2-fluoro-10-phenylanthracene;

Figure 220 illustrates a 9-(2,4-difluorophenyl)-2-fluoro-10-(4-methoxyphenyl)anthracene;

Figure 221 illustrates a 1,4-difluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-phenylanthracene;

Figure 222 illustrates a 1,4-difluoro-9-(4-methoxyphenyl)-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 223 illustrates a 1,4-difluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoropheny)lanthracene;

Figure 224 illustrates a 1,4-difluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 225 illustrates a 1,4-difluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(3,4,5-trifluoro)anthracene;

Figure 226 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4-difluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene

Figure 227 illustrates a 9-(3,4-difluorophenyl)-1,4-difluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 228 illustrates a 1,4-difluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 229 illustrates a 9-(2,4-difluorophenyl)-1,4-difluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 230 illustrates a 1,4-difluoro-9-phenyl-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 231 illustrates a 1,4-difluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 232 illustrates a 1,4-difluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 233 illustrates a 1,4-difluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 234 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4-difluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 235 illustrates a 9-(3,4-difluorophenyl)-1,4-difluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 236 illustrates a 1,4-difluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,,5,6-tetrafluorophenyl)anthracene;

Figure 237 illustrates a 9-(3,4-difluorophenyl)-1,4-difluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 238 illustrates a 1,4-difluoro-9-phenyl-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 239 illustrates a 1,4-difluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 240 illustrates a 1,4-difluoro-9-(2,3,5,6-tetrafluoro-4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 241 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4-difluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 242 illustrates a 9-(3,4-difluorophenyl)-1,4-difluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 243 illustrates a 1,4-difluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 244 illustrates a 9-(2,4-difluorophenyl)-1,4-difluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 245 illustrates a 1,4-difluoro-9-phenyl-10-(3,4,5-trifluorophenyl)anthracene;

Figure 246 illustrates a 1,4-difluoro-9-(4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 247 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4-difluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 248 illustrates a 9-(3,4-difluorophenyl)-1,4-difluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 249 illustrates a 1,4-difluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(3,4,5-trifluorophenyl)anthracene;

Figure 250 illustrates a 9-(2,4-difluorophenyl)-1,4-difluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 251 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4-difluoro-10-phenylanthracene:

Figure 252 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4-difluoro-10-(4-methoxyphenyl)anthracene:

Figure 253 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(3,4-difluorophenyl)-1,4-difluoroanthracene;

Figure 254 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4-difluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 255 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4-difluoro-10-(2,4-difluorophenyl)anthracene;

Figure 256 illustrates a 9-(3,4-difluorophenyl)-1,4-difluoro-10-phenylanthracene;

Figure 257 illustrates a 9-(3,4-difluorophenyl)-1,4-difluoro-10-(4-methoxyphenyl)anthracene;

Figure 258 illustrates a 9-(3,4-difluorophenyl)-1,4-difluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 259 illustrates a 9-(2,4-difluorophenyl)-1,4-difluoro-10-(3,4-difluorophenyl)anthracene;

Figure 260 illustrates a 1,4-difluoro-9-phenyl-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 261 illustrates a 1,4-difluoro-9-(4-methoxyphenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 262 illustrates a 9-(2,4-difluorophenyl)-1,4-difluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 263 illustrates a 9-(2,4-difluorophenyl)-1,4-difluoro-10-phenylanthracene;

Figure 264 illustrates a 9-(2,4-difluorophenyl)-1,4-difluoro-10-(4-methoxyphenyl)anthracene;

Figure 265 illustrates a 2,3-difluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-phenylanthracene;

Figure 266 illustrates a 2,3-difluoro-9-(4-methoxyphenyl)-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 267 illustrates a 2,3-difluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoropheny)lanthracene;

Figure 268 illustrates a 2,3-difluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 269 illustrates a 2,3-difluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(3,4,5-trifluoro)anthracene;

Figure 270 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3-difluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene

Figure 271 illustrates a 9-(3,4-difluorophenyl)-2,3-difluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 272 illustrates a 2,3-difluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 273 illustrates a 9-(2,4-difluorophenyl)-2,3-difluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 274 illustrates a 2,3-difluoro-9-phenyl-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 275 illustrates a 2,3-difluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 276 illustrates a 2,3-difluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 277 illustrates a 2,3-difluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 278 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3-difluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 279 illustrates a 9-(3,4-difluorophenyl)-2,3-difluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 280 illustrates a 2,3-difluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,,5,6-tetrafluorophenyl)anthracene;

Figure 281 illustrates a 9-(3,4-difluorophenyl)-2,3-difluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 282 illustrates a 2,3-difluoro-9-phenyl-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 283 illustrates a 2,3-difluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 284 illustrates a 2,3-difluoro-9-(2,3,5,6-tetrafluoro-4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 285 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3-difluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 286 illustrates a 9-(3,4-difluorophenyl)-2,3-difluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 287 illustrates a 2,3-difluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 288 illustrates a 9-(2,4-difluorophenyl)-2,3-difluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 289 illustrates a 2,3-difluoro-9-phenyl-10-(3,4,5-trifluorophenyl)anthracene;

Figure 290 illustrates a 2,3-difluoro-9-(4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 291 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3-difluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 292 illustrates a 9-(3,4-difluorophenyl)-2,3-difluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 293 illustrates a 2,3-difluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(3,4,5-trifluorophenyl)anthracene;

Figure 294 illustrates a 9-(2,4-difluorophenyl)-2,3-difluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 295 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3-difluoro-10-phenylanthracene:

Figure 296 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3-difluoro-10-(4-methoxyphenyl)anthracene:

Figure 297 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(3,4-difluorophenyl)-2,3-difluoroanthracene;

Figure 298 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3-difluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 299 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3-difluoro-10-(2,4-difluorophenyl)anthracene;

Figure 300 illustrates a 9-(3,4-difluorophenyl)-2,3-difluoro-10-phenylanthracene;

Figure 301 illustrates a 9-(3,4-difluorophenyl)-2,3-difluoro-10-(4-methoxyphenyl)anthracene;

Figure 302 illustrates a 9-(3,4-difluorophenyl)-2,3-difluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 303 illustrates a 9-(2,4-difluorophenyl)-2,3-difluoro-10-(3,4-difluorophenyl)anthracene;

Figure 304 illustrates a 2,3-difluoro-9-phenyl-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 305 illustrates a 2,3-difluoro-9-(4-methoxyphenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 306 illustrates a 9-(2,4-difluorophenyl)-2,3-difluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 307 illustrates a 9-(2,4-difluorophenyl)-2,3-difluoro-10-phenylanthracene;

Figure 308 illustrates a 9-(2,4-difluorophenyl)-2,3-difluoro-10-(4-methoxyphenyl)anthracene;

Figure 309 illustrates a 1,4,5-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-phenylanthracene;

Figure 310 illustrates a 1,4,5-trifluoro-9-(4-methoxyphenyl)-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 311 illustrates a 1,4,5-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoropheny)lanthracene;

Figure 312 illustrates a 1,4,5-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 313 illustrates a 1,4,5-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(3,4,5-trifluoro)anthracene;

Figure 314 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4,5-trifluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene

Figure 315 illustrates a 9-(3,4-difluorophenyl)-1,4,5-trifluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 316 illustrates a 1,4,5-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 317 illustrates a 9-(2,4-difluorophenyl)-1,4,5-trifluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 318 illustrates a 1,4,5-trifluoro-9-phenyl-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 319 illustrates a 1,4,5-trifluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 320 illustrates a 1,4,5-trifluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 321 illustrates a 1,4,5-trifluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 322 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4,5-trifluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 323 illustrates a 9-(3,4-difluorophenyl)-1,4,5-trifluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 324 illustrates a 1,4,5-trifluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,,5,6-tetrafluorophenyl)anthracene;

Figure 325 illustrates a 9-(3,4-difluorophenyl)-1,4,5-trifluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 326 illustrates a 1,4,5-trifluoro-9-phenyl-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 327 illustrates a 1,4,5-trifluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 328 illustrates a 1,4,5-trifluoro-9-(2,3,5,6-tetrafluoro-4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 329 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4,5-trifluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 330 illustrates a 9-(3,4-difluorophenyl)-1,4,5-trifluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 331 illustrates a 1,4,5-trifluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 332 illustrates a 9-(2,4-difluorophenyl)-1,4,5-trifluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 333 illustrates a 1,4,5-trifluoro-9-phenyl-10-(3,4,5-trifluorophenyl) anthracene;

Figure 334 illustrates a 1,4,5-trifluoro-9-(4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 335 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4,5-trifluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 336 illustrates a 9-(3,4-difluorophenyl)-1,4,5-trifluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 337 illustrates a 1,4,5-trifluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(3,4,5-trifluorophenyl)anthracene;

Figure 338 illustrates a 9-(2,4-difluorophenyl)-1,4,5-trifluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 339 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4,5-trifluoro-10-phenylanthracene:

Figure 340 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4,5-trifluoro-10-(4-methoxyphenyl)anthracene:

Figure 341 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(3,4-difluorophenyl)-1,4,5-trifluoroanthracene;

Figure 342 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4,5-trifluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 343 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4,5-trifluoro-10-(2,4-difluorophenyl)anthracene;

Figure 344 illustrates a 9-(3,4-difluorophenyl)-1,4,5-trifluoro-10-phenylanthracene;

Figure 345 illustrates a 9-(3,4-difluorophenyl)-1,4,5-trifluoro-10-(4-methoxyphenyl)anthracene;

Figure 346 illustrates a 9-(3,4-difluorophenyl)-1,4,5-trifluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 347 illustrates a 9-(2,4-difluorophenyl)-1,4,5-trifluoro-10-(3,4-difluorophenyl)anthracene;

Figure 348 illustrates a 1,4,5-trifluoro-9-phenyl-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 349 illustrates a 1,4,5-trifluoro-9-(4-methoxyphenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 350 illustrates a 9-(2,4-difluorophenyl)-1,4,5-trifluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 351 illustrates a 9-(2,4-difluorophenyl)-1,4,5-trifluoro-10-phenylanthracene;

Figure 352 illustrates a 9-(2,4-difluorophenyl)-1,4,5-trifluoro-10-(4-methoxyphenyl)anthracene;

Figure 353 illustrates a 2,3,5-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-phenylanthracene;

Figure 354 illustrates a 2,3,5-trifluoro-9-(4-methoxyphenyl)-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 355 illustrates a 2,3,5-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoropheny)lanthracene;

Figure 356 illustrates a 2,3,5-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 357 illustrates a 2,3,5-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(3,4,5-trifluoro)anthracene;

Figure 358 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3,5-trifluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene

Figure 359 illustrates a 9-(3,4-difluorophenyl)-2,3,5-trifluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 360 illustrates a 2,3,5-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 361 illustrates a 9-(2,4-difluorophenyl)-2,3,5-trifluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 362 illustrates a 2,3,5-trifluoro-9-phenyl-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 363 illustrates a 2,3,5-trifluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 364 illustrates a 2,3,5-trifluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 365 illustrates a 2,3,5-trifluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 366 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3,5-trifluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 367 illustrates a 9-(3,4-difluorophenyl)-2,3,5-trifluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 368 illustrates a 2,3,5-trifluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,,5,6-tetrafluorophenyl)anthracene;

Figure 369 illustrates a 9-(3,4-difluorophenyl)-2,3,5-trifluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 370 illustrates a 2,3,5-trifluoro-9-phenyl-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 371 illustrates a 2,3,5-trifluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 372 illustrates a 2,3,5-trifluoro-9-(2,3,5,6-tetrafluoro-4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 373 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3,5-trifluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 374 illustrates a 9-(3,4-difluorophenyl)-2,3,5-trifluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 375 illustrates a 2,3,5-trifluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 376 illustrates a 9-(2,4-difluorophenyl)-2,3,5-trifluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 377 illustrates a 2,3,5-trifluoro-9-phenyl-10-(3,4,5-trifluorophenyl)anthracene;

Figure 378 illustrates a 2,3,5-trifluoro-9-(4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 379 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3,5-trifluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 380 illustrates a 9-(3,4-difluorophenyl)-2,3,5-trifluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 381 illustrates a 2,3,5-trifluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(3,4,5-trifluorophenyl)anthracene;

Figure 382 illustrates a 9-(2,4-difluorophenyl)-2,3,5-trifluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 383 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3,5-trifluoro-10-phenylanthracene:

Figure 384 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3,5-trifluoro-10-(4-methoxyphenyl)anthracene:

Figure 385 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(3,4-difluorophenyl)-2,3,5-trifluoroanthracene;

Figure 386 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3,5-trifluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 387 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3,5-trifluoro-10-(2,4-difluorophenyl)anthracene;

Figure 388 illustrates a 9-(3,4-difluorophenyl)-2,3,5-trifluoro-10-phenylanthracene;

Figure 389 illustrates a 9-(3,4-difluorophenyl)-2,3,5-trifluoro-10-(4-methoxyphenyl)anthracene;

Figure 390 illustrates a 9-(3,4-difluorophenyl)-2,3,5-trifluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 391 illustrates a 9-(2,4-difluorophenyl)-2,3,5-trifluoro-10-(3,4-difluorophenyl)anthracene;

Figure 392 illustrates a 2,3,5-trifluoro-9-phenyl-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 393 illustrates a 2,3,5-trifluoro-9-(4-methoxyphenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 394 illustrates a 9-(2,4-difluorophenyl)-2,3,5-trifluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 395 illustrates a 9-(2,4-difluorophenyl)-2,3,5-trifluoro-10-phenylanthracene;

Figure 396 illustrates a 9-(2,4-difluorophenyl)-2,3,5-trifluoro-10-(4-methoxyphenyl)anthracene;

Figure 397 illustrates a 1,4,6-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-phenylanthracene;

Figure 398 illustrates a 1,4,6-trifluoro-9-(4-methoxyphenyl)-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 399 illustrates a 1,4,6-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoropheny)lanthracene;

Figure 400 illustrates a 1,4,6-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 401 illustrates a 1,4,6-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(3,4,5-trifluoro)anthracene;

Figure 402 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4,6-trifluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene

Figure 403 illustrates a 9-(3,4-difluorophenyl)-1,4,6-trifluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 404 illustrates a 1,4,6-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 405 illustrates a 9-(2,4-difluorophenyl)-1,4,6-trifluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 406 illustrates a 1,4,6-trifluoro-9-phenyl-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 407 illustrates a 1,4,6-trifluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 408 illustrates a 1,4,6-trifluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 409 illustrates a 1,4,6-trifluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 410 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4,6-trifluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 411 illustrates a 9-(3,4-difluorophenyl)-1,4,6-trifluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 412 illustrates a 1,4,6-trifluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,,5,6-tetrafluorophenyl)anthracene;

Figure 413 illustrates a 9-(3,4-difluorophenyl)-1,4,6-trifluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 414 illustrates a 1,4,6-trifluoro-9-phenyl-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 415 illustrates a 1,4,6-trifluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 416 illustrates a 1,4,6-trifluoro-9-(2,3,5,6-tetrafluoro-4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 417 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4,6-trifluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 418 illustrates a 9-(3,4-difluorophenyl)-1,4,6-trifluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 419 illustrates a 1,4,6-trifluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 420 illustrates a 9-(2,4-difluorophenyl)-1,4,6-trifluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 421 illustrates a 1,4,6-trifluoro-9-phenyl-10-(3,4,5-trifluorophenyl)anthracene;

Figure 422 illustrates a 1,4,6-trifluoro-9-(4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 423 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4,6-trifluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 424 illustrates a 9-(3,4-difluorophenyl)-1,4,6-trifluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 425 illustrates a 1,4,6-trifluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(3,4,5-trifluorophenyl)anthracene;

Figure 426 illustrates a 9-(2,4-difluorophenyl)-1,4,6-trifluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 427 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4,6-trifluoro-10-phenylanthracene:

Figure 428 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4,6-trifluoro-10-(4-methoxyphenyl)anthracene:

Figure 429 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(3,4-difluorophenyl)-1,4,6-trifluoroanthracene;

Figure 430 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4,6-trifluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 431 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,4,6-trifluoro-10-(2,4-difluorophenyl)anthracene;

Figure 432 illustrates a 9-(3,4-difluorophenyl)-1,4,6-trifluoro-10-phenylanthracene;

Figure 433 illustrates a 9-(3,4-difluorophenyl)-1,4,6-trifluoro-10-(4-methoxyphenyl)anthracene;

Figure 434 illustrates a 9-(3,4-difluorophenyl)-1,4,6-trifluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 435 illustrates a 9-(2,4-difluorophenyl)-1,4,6-trifluoro-10-(3,4-difluorophenyl)anthracene;

Figure 436 illustrates a 1,4,6-trifluoro-9-phenyl-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 437 illustrates a 1,4,6-trifluoro-9-(4-methoxyphenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 438 illustrates a 9-(2,4-difluorophenyl)-1,4,6-trifluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 439 illustrates a 9-(2,4-difluorophenyl)-1,4,6-trifluoro-10-phenylanthracene;

Figure 440 illustrates a 9-(2,4-difluorophenyl)-1,4,6-trifluoro-10-(4-methoxyphenyl)anthracene;

Figure 441 illustrates a 2,3,6-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-phenylanthracene;

Figure 442 illustrates a 2,3,6-trifluoro-9-(4-methoxyphenyl)-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 443 illustrates a 2,3,6-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoropheny)lanthracene;

Figure 444 illustrates a 2,3,6-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 445 illustrates a 2,3,6-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(3,4,5-trifluoro)anthracene;

Figure 446 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3,6-trifluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene

Figure 447 illustrates a 9-(3,4-difluorophenyl)-2,3,6-trifluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 448 illustrates a 2,3,6-trifluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 449 illustrates a 9-(2,4-difluorophenyl)-2,3,6-trifluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 450 illustrates a 2,3,6-trifluoro-9-phenyl-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 451 illustrates a 2,3,6-trifluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 452 illustrates a 2,3,6-trifluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 453 illustrates a 2,3,6-trifluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 454 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3,6-trifluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 455 illustrates a 9-(3,4-difluorophenyl)-2,3,6-trifluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 456 illustrates a 2,3,6-trifluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,,5,6-tetrafluorophenyl)anthracene;

Figure 457 illustrates a 9-(3,4-difluorophenyl)-2,3,6-trifluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 458 illustrates a 2,3,6-trifluoro-9-phenyl-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 459 illustrates a 2,3,6-trifluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 460 illustrates a 2,3,6-trifluoro-9-(2,3,5,6-tetrafluoro-4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 461 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3,6-trifluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 462 illustrates a 9-(3,4-difluorophenyl)-2,3,6-trifluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 463 illustrates a 2,3,6-trifluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 464 illustrates a 9-(2,4-difluorophenyl)-2,3,6-trifluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 465 illustrates a 2,3,6-trifluoro-9-phenyl-10-(3,4,5-trifluorophenyl)anthracene;

Figure 466 illustrates a 2,3,6-trifluoro-9-(4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 467 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3,6-trifluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 468 illustrates a 9-(3,4-difluorophenyl)-2,3,6-trifluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 469 illustrates a 2,3,6-trifluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(3,4,5-trifluorophenyl)anthracene;

Figure 470 illustrates a 9-(2,4-difluorophenyl)-2,3,6-trifluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 471 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3,6-trifluoro-10-phenylanthracene:

Figure 472 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3,6-trifluoro-10-(4-methoxyphenyl)anthracene:

Figure 473 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(3,4-difluorophenyl)-2,3,6-trifluoroanthracene;

Figure 474 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3,6-trifluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 475 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-2,3,6-trifluoro-10-(2,4-difluorophenyl)anthracene;

Figure 476 illustrates a 9-(3,4-difluorophenyl)-2,3,6-trifluoro-10-phenylanthracene;

Figure 477 illustrates a 9-(3,4-difluorophenyl)-2,3,6-trifluoro-10-(4-methoxyphenyl)anthracene;

Figure 478 illustrates a 9-(3,4-difluorophenyl)-2,3,6-trifluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 479 illustrates a 9-(2,4-difluorophenyl)-2,3,6-trifluoro-10-(3,4-difluorophenyl)anthracene;

Figure 480 illustrates a 2,3,6-trifluoro-9-phenyl-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 481 illustrates a 2,3,6-trifluoro-9-(4-methoxyphenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 482 illustrates a 9-(2,4-difluorophenyl)-2,3,6-trifluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 483 illustrates a 9-(2,4-difluorophenyl)-2,3,6-trifluoro-10-phenylanthracene;

Figure 484 illustrates a 9-(2,4-difluorophenyl)-2,3,6-trifluoro-10-(4-methoxyphenyl)anthracene;

Figure 485 illustrates a 1,2,3,4-tetrafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-phenylanthracene;

Figure 486 illustrates a 1,2,3,4-tetrafluoro-9-(4-methoxyphenyl)-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 487 illustrates a 1,2,3,4-tetrafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoropheny)lanthracene;

Figure 488 illustrates a 1,2,3,4-tetrafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 489 illustrates a 1,2,3,4-tetrafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(3,4,5-trifluoro)anthracene;

Figure 490 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4-tetrafluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene

Figure 491 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4-tetrafluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 492 illustrates a 1,2,3,4-tetrafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 493 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4-tetrafluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 494 illustrates a 1,2,3,4-tetrafluoro-9-phenyl-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 495 illustrates a 1,2,3,4-tetrafluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 496 illustrates a 1,2,3,4-tetrafluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 497 illustrates a 1,2,3,4-tetrafluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 498 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4-tetrafluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 499 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4-tetrafluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 500 illustrates a 1,2,3,4-tetrafluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,,5,6-tetrafluorophenyl)anthracene;

Figure 501 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4-tetrafluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 502 illustrates a 1,2,3,4-tetrafluoro-9-phenyl-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 503 illustrates a 1,2,3,4-tetrafluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 504 illustrates a 1,2,3,4-tetrafluoro-9-(2,3,5,6-tetrafluoro-4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 505 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4-tetrafluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 506 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4-tetrafluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 507 illustrates a 1,2,3,4-tetrafluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 508 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4-tetrafluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 509 illustrates a 1,2,3,4-tetrafluoro-9-phenyl-10-(3,4,5-trifluorophenyl)anthracene;

Figure 510 illustrates a 1,2,3,4-tetrafluoro-9-(4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 511 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4-tetrafluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 512 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4-tetrafluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 513 illustrates a 1,2,3,4-tetrafluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(3,4,5-trifluorophenyl)anthracene;

Figure 514 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4-tetrafluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 515 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4-tetrafluoro-10-phenylanthracene:

Figure 516 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4-tetrafluoro-10-(4-methoxyphenyl)anthracene:

Figure 517 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(3,4-difluorophenyl)-1,2,3,4-tetrafluoroanthracene;

Figure 518 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4-tetrafluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 519 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4-tetrafluoro-10-(2,4-difluorophenyl)anthracene;

Figure 520 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4-tetrafluoro-10-phenylanthracene;

Figure 521 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4-tetrafluoro-10-(4-methoxyphenyl)anthracene;

Figure 522 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4-tetrafluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 523 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4-tetrafluoro-10-(3,4-difluorophenyl)anthracene;

Figure 524 illustrates a 1,2,3,4-tetrafluoro-9-phenyl-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 525 illustrates a 1,2,3,4-tetrafluoro-9-(4-methoxyphenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 526 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4-tetrafluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 527 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4-tetrafluoro-10-phenylanthracene;

Figure 528 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4-tetrafluoro-10-(4-methoxyphenyl)anthracene;

Figure 529 illustrates a 1,2,3,4,5-pentafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-phenylanthracene;

Figure 530 illustrates a 1,2,3,4,5-pentafluoro-9-(4-methoxyphenyl)-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 531 illustrates a 1,2,3,4,5-pentafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoropheny)lanthracene;

Figure 532 illustrates a 1,2,3,4,5-pentafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 533 illustrates a 1,2,3,4,5-pentafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(3,4,5-trifluoro)anthracene;

Figure 534 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5-pentafluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene

Figure 535 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,5-pentafluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 536 illustrates a 1,2,3,4,5-pentafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 537 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,5-pentafluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 538 illustrates a 1,2,3,4,5-pentafluoro-9-phenyl-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 539 illustrates a 1,2,3,4,5-pentafluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 540 illustrates a 1,2,3,4,5-pentafluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 541 illustrates a 1,2,3,4,5-pentafluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 542 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5-pentafluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 543 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,5-pentafluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 544 illustrates a 1,2,3,4,5-pentafluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,,5,6-tetrafluorophenyl)anthracene;

Figure 545 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,5-pentafluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 546 illustrates a 1,2,3,4,5-pentafluoro-9-phenyl-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 547 illustrates a 1,2,3,4,5-pentafluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 548 illustrates a 1,2,3,4,5-pentafluoro-9-(2,3,5,6-tetrafluoro-4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 549 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5-pentafluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 550 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,5-pentafluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 551 illustrates a 1,2,3,4,5-pentafluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 552 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,5-pentafluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 553 illustrates a 1,2,3,4,5-pentafluoro-9-phenyl-10-(3,4,5-trifluorophenyl)anthracene;

Figure 554 illustrates a 1,2,3,4,5-pentafluoro-9-(4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 555 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5-pentafluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 556 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,5-pentafluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 557 illustrates a 1,2,3,4,5-pentafluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(3,4,5-trifluorophenyl)anthracene;

Figure 558 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,5-pentafluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 559 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5-pentafluoro-10-phenylanthracene:

Figure 560 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5-pentafluoro-10-(4-methoxyphenyl)anthracene:

Figure 561 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(3,4-difluorophenyl)-1,2,3,4,5-pentafluoroanthracene;

Figure 562 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5-pentafluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 563 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5-pentafluoro-10-(2,4-difluorophenyl)anthracene;

Figure 564 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,5-pentafluoro-10-phenylanthracene;

Figure 565 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,5-pentafluoro-10-(4-methoxyphenyl)anthracene;

Figure 566 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,5-pentafluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 567 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,5-pentafluoro-10-(3,4-difluorophenyl)anthracene;

Figure 568 illustrates a 1,2,3,4,5-pentafluoro-9-phenyl-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 569 illustrates a 1,2,3,4,5-pentafluoro-9-(4-methoxyphenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 570 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,5-pentafluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 571 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,5-pentafluoro-10-phenylanthracene;

Figure 572 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,5-pentafluoro-10-(4-methoxyphenyl)anthracene;

Figure 573 illustrates a 1,2,3,4,6-pentafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-phenylanthracene;

Figure 574 illustrates a 1,2,3,4,6-pentafluoro-9-(4-methoxyphenyl)-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 575 illustrates a 1,2,3,4,6-pentafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoropheny)lanthracene;

Figure 576 illustrates a 1,2,3,4,6-pentafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 577 illustrates a 1,2,3,4,6-pentafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(3,4,5-trifluoro)anthracene;

Figure 578 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,6-pentafluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene

Figure 579 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,6-pentafluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 580 illustrates a 1,2,3,4,6-pentafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 581 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,6-pentafluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 582 illustrates a 1,2,3,4,6-pentafluoro-9-phenyl-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 583 illustrates a 1,2,3,4,6-pentafluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 584 illustrates a 1,2,3,4,6-pentafluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 585 illustrates a 1,2,3,4,6-pentafluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 586 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,6-pentafluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 587 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,6-pentafluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 588 illustrates a 1,2,3,4,6-pentafluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,,5,6-tetrafluorophenyl)anthracene;

Figure 589 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,6-pentafluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 590 illustrates a 1,2,3,4,6-pentafluoro-9-phenyl-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 591 illustrates a 1,2,3,4,6-pentafluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 592 illustrates a 1,2,3,4,6-pentafluoro-9-(2,3,5,6-tetrafluoro-4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 593 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,6-pentafluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 594 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,6-pentafluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 595 illustrates a 1,2,3,4,6-pentafluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 596 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,6-pentafluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 597 illustrates a 1,2,3,4,6-pentafluoro-9-phenyl-10-(3,4,5-trifluorophenyl)anthracene;

Figure 598 illustrates a 1,2,3,4,6-pentafluoro-9-(4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 599 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,6-pentafluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 600 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,6-pentafluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 601 illustrates a 1,2,3,4,6-pentafluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(3,4,5-trifluorophenyl)anthracene;

Figure 602 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,6-pentafluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 603 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,6-pentafluoro-10-phenylanthracene:

Figure 604 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,6-pentafluoro-10-(4-methoxyphenyl)anthracene:

Figure 605 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(3,4-difluorophenyl)-1,2,3,4,6-pentafluoroanthracene;

Figure 606 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,6-pentafluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 607 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,6-pentafluoro-10-(2,4-difluorophenyl)anthracene;

Figure 608 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,6-pentafluoro-10-phenylanthracene;

Figure 609 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,6-pentafluoro-10-(4-methoxyphenyl)anthracene;

Figure 610 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,6-pentafluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 611 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,6-pentafluoro-10-(3,4-difluorophenyl)anthracene;

Figure 612 illustrates a 1,2,3,4,6-pentafluoro-9-phenyl-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 613 illustrates a 1,2,3,4,6-pentafluoro-9-(4-methoxyphenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 614 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,6-pentafluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 615 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,6-pentafluoro-10-phenylanthracene;

Figure 616 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,6-pentafluoro-10-(4-methoxyphenyl)anthracene;

Figure 617 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-phenylanthracene;

Figure 618 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-(4-methoxyphenyl)-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 619 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoropheny)lanthracene;

Figure 620 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 621 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-(3,4,5-trifluoro)anthracene;

Figure 622 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5,6,7,8-octafluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene

Figure 623 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 624 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-(2,3,4,5,6-pentafluorophenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 625 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoro-10-(2,3,4,5,6-pentafluorophenyl)anthracene;

Figure 626 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-phenyl-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 627 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 628 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 629 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-(2,3,5,6-tetrafluorophenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 630 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5,6,7,8-octafluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 631 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 632 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,,5,6-tetrafluorophenyl)anthracene;

Figure 633 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoro-10-(2,3,5,6-tetrafluorophenyl)anthracene;

Figure 634 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-phenyl-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 635 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-(4-methoxyphenyl)-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 636 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-(2,3,5,6-tetrafluoro-4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 637 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5,6,7,8-octafluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 638 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 639 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 640 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoro-10-(2,3,5,6-tetrafluoro-4-methoxyphenyl)anthracene;

Figure 641 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-phenyl-10-(3,4,5-trifluorophenyl)anthracene;

Figure 642 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-(4-methoxyphenyl)-10-(3,4,5-trifluorophenyl)anthracene;

Figure 643 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5,6,7,8-octafluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 644 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 645 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]-10-(3,4,5-trifluorophenyl)anthracene;

Figure 646 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoro-10-(3,4,5-trifluorophenyl)anthracene;

Figure 647 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5,6,7,8-octafluoro-10-phenylanthracene:

Figure 648 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5,6,7,8-octafluoro-10-(4-methoxyphenyl)anthracene:

Figure 649 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-10-(3,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoroanthracene;

Figure 650 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5,6,7,8-octafluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 651 illustrates a 9-(2,6-difluoro-4-methoxyphenyl)-1,2,3,4,5,6,7,8-octafluoro-10-(2,4-difluorophenyl)anthracene;

Figure 652 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoro-10-phenylanthracene;

Figure 653 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoro-10-(4-methoxyphenyl)anthracene;

Figure 654 illustrates a 9-(3,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 655 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoro-10-(3,4-difluorophenyl)anthracene;

Figure 656 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-phenyl-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 657 illustrates a 1,2,3,4,5,6,7,8-octafluoro-9-(4-methoxyphenyl)-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

Figure 658 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoro-10-[2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl]anthracene;

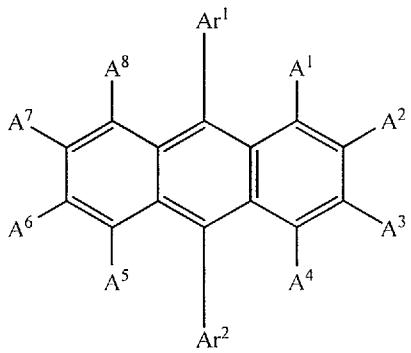
Figure 659 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoro-10-phenylanthracene;

Figure 660 illustrates a 9-(2,4-difluorophenyl)-1,2,3,4,5,6,7,8-octafluoro-10-(4-methoxyphenyl)anthracene;

Figure 661 is a graph which illustrates chemiluminescent systems containing several of the instantly disclosed anthracene fluorescers, which are shown to produce light having an emission maximum from about 390 nm to less than 438 nm.

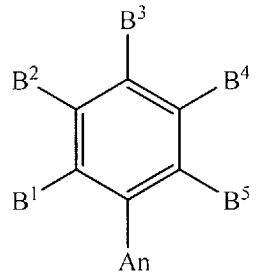
DETAILED DESCRIPTION OF THE INVENTION

The present invention can be achieved by providing a compound represented by Formula (1):



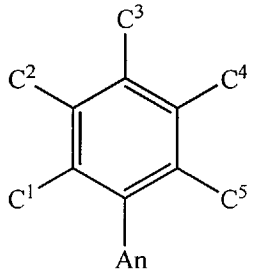
(1)

wherein Ar^1 has a structure represented by Formula (2), where An shows the attachment to the anthracene ring as described in Formula (1),

$Ar^1 =$ 

(2)

wherein Ar^2 has a structure represented by Formula (3), where An shows the attachment to the anthracene ring,

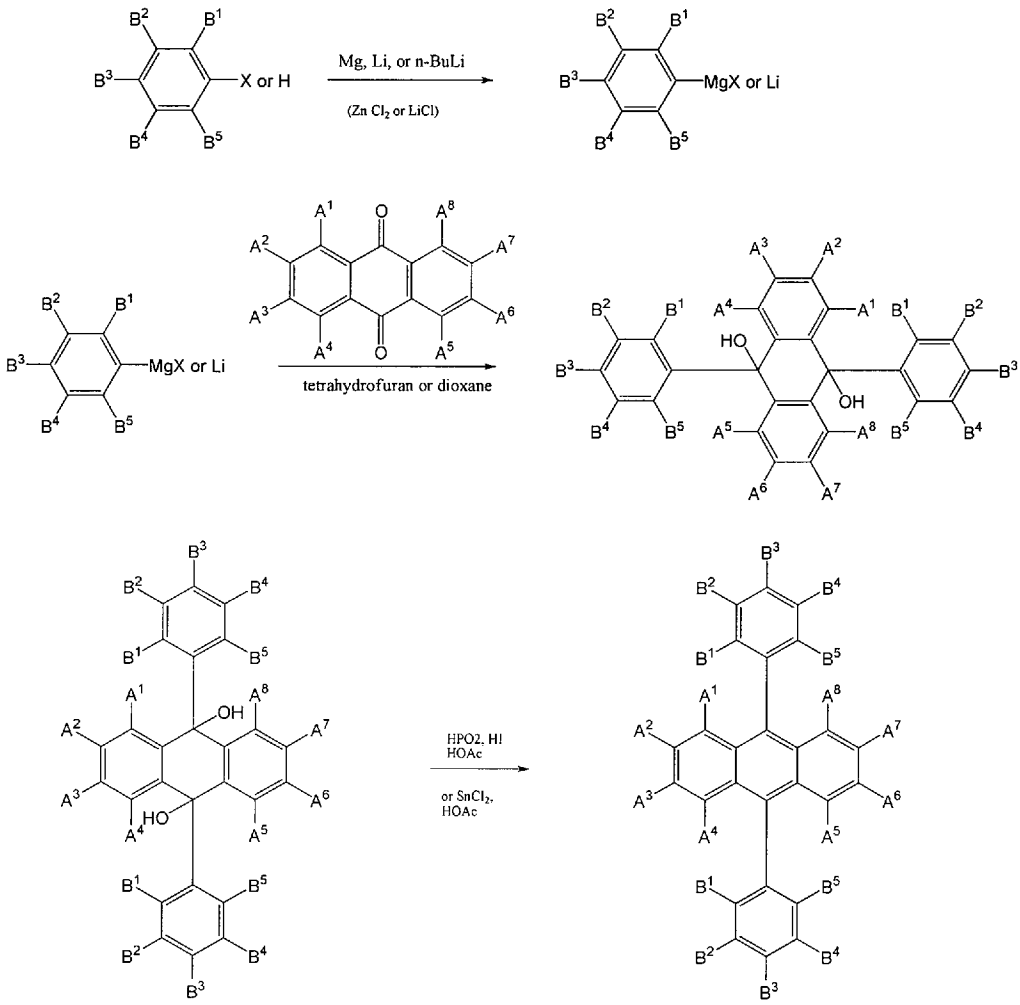
$Ar^2 =$ 

(3)

wherein Ar^1 and Ar^2 are the same or different from each other.

The new species of anthracenes according to the invention may be prepared by a method, according to one of the Reaction Schemes given below.

Reaction Scheme 1



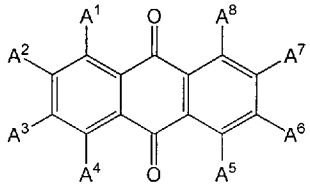
One process of the present invention, as shown in Reaction Scheme 1, to obtain derivatives in Formula (1) where Ar^1 and Ar^2 are the same may be described as a synthetic process comprising steps of:

a) generation of a fluorinated aryl organometallic metallic reagent by the reaction of an fluorinated aryl halide with magnesium or n-butyllithium or by the substitution of an aryl hydrogen using n-butyllithium;

b) reaction of the organometallic reagent [RMgX or RLi] with an anthraquinone derivative to form a diol, wherein R is represented by Formula 2 and X may be a halogen. It is further contemplated that this reaction may be carried out in the presence of lithium chloride or zinc chloride;

c) reduction of said diol to form a DPHA derivative using either a combination of sodium hypophosphite and potassium iodide in acetic acid (U.S. 5,232,635 to Van Moer et al) or a solution of stannous chloride in a solution of stannous chloride in glacial acetic acid (U.S.6,740,263 to Park et al).

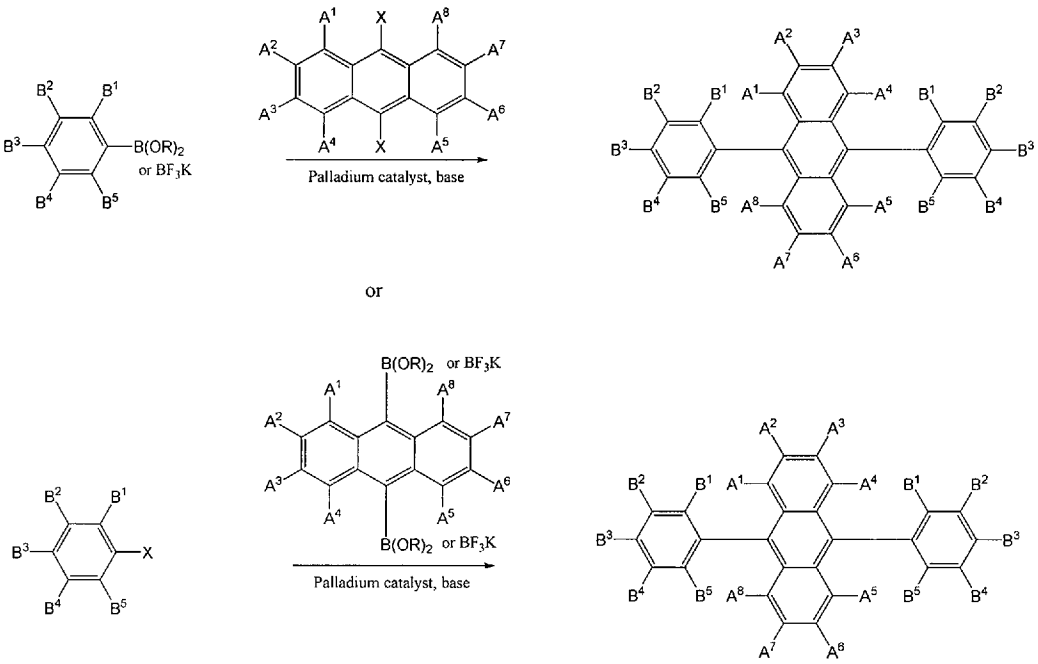
wherein, A^1, A^2, A^3, A^4, A^5, A^6, A^7, and A^8 represents one selected from the group consisting of hydrogen or fluorine, and B^1, B^2, B^4, and B^5 represents one selected from the group consisting of hydrogen and fluorine, where at least two of these are fluorine, and B^3 represents one selected from a group consisting of hydrogen, fluorine, trifluoromethyl, and an alkoxy group with 1-10 carbons.



(4)

Fluorinated anthraquinones represented by Formula (4) may be purchased from commercial sources or made as described by Tannaci et al. (*J. Org. Chem.* **2007**, *72*, 5567-5573), Mallory et al. (*J. Am. Chem. Soc.* **1990**, *112*, 2577-2581), and Moer et al. (U.S. Pat. No. 5,232,635).

Reaction Scheme 2

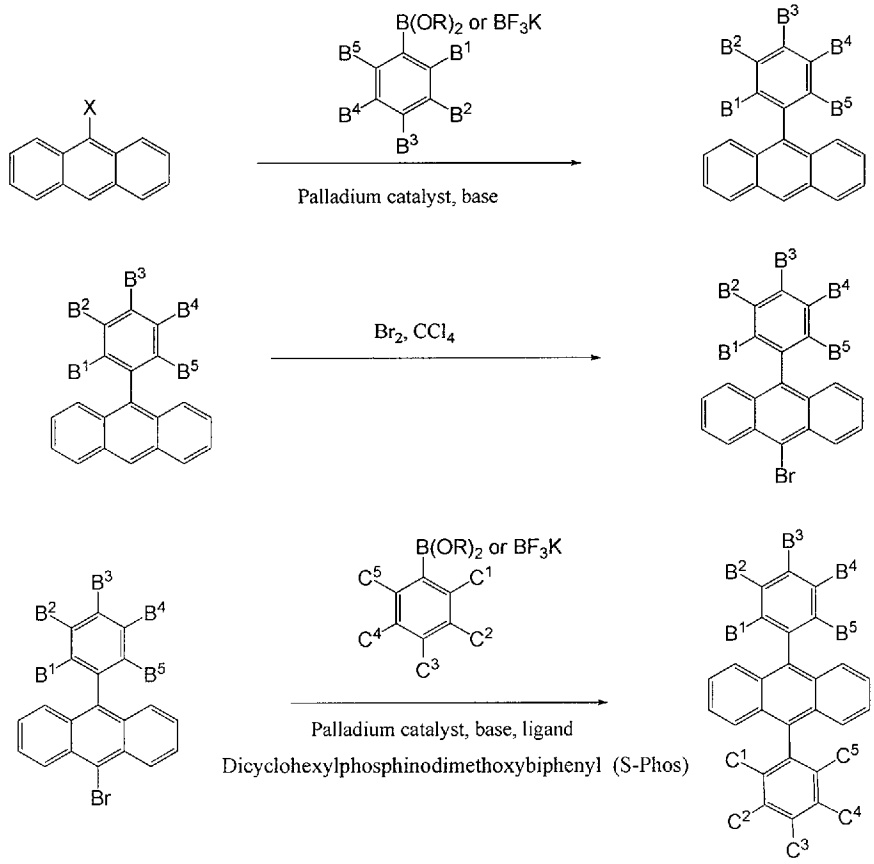


Alternatively, symmetrical derivatives may be made via the Suzuki-Miyaura reaction or variation thereof using either a 9,10-dichloroanthracene, 9,10-dibromoanthracene, or 9,10-diiodoanthracene derivative and an aryl boronic acid, boronic ester, or trifluoroborate. Additionally, a 9,10-anthracenediboronic acid, equivalent ester, or trifluoroborate can be reacted with an aryl halide or triflate. Both pathways are as shown in Reaction Scheme 2 comprising the reaction of:

a) a boronic acid, dialkylboronate ester, or trifluoroborate indicated by $B(OR)_2$, or BF_3K with the preferred examples being the boronic acid, the dimethyl ester of the boronic acid, or the picolinate ester of boronic acid, an aryl species, where X is either bromine, iodine, or a triflate, with the preferred example being bromine, a palladium catalyst from a large family of commercially available compounds, with the preferred examples being palladium(II) acetate, tetrakis(triphenylphosphine)palladium(0), and dichlorobis(chlorodi-*tert*-butylphosphine)palladium(II), a suitable base, with the preferred examples being potassium phosphate, sodium carbonate, potassium carbonate, and potassium

fluoride, a suitable solvent, with the preferred examples being toluene, tetrahydrofuran, isopropanol, and 1,2-dimethoxyethane.

Reaction Scheme 3



Another process of the invention, as shown is Reaction Scheme 3, to produce asymmetrical anthracene derivatives, where Ar^1 and Ar^2 are not the same, may be described as a synthetic process comprising steps of:

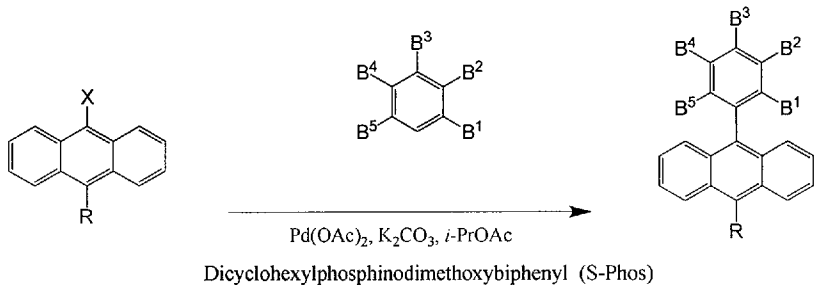
a) a coupling reaction between: i) a 9-substituted anthracene, where X is bromine, iodine, or triflate; ii) a fluorinated arylboronic acid, arylboronic ester, or aryltrifluoroborate, wherein the other substituents are as defined in Figure 2; iii) a palladium catalyst from a large family of commercially available compounds, with the preferred examples being palladium(II) acetate, tetrakis(triphenylphosphine)palladium(0), and dichlorobis(chlorodi-

tert-butylphosphine)palladium(II); iv) a suitable base, with the preferred examples being potassium phosphate, sodium carbonate, and potassium fluoride, and a suitable solvent, with the preferred examples being toluene, tetrahydrofuran, isopropanol, and 1,2-dimethoxyethane; v) optionally including a phosphorous ligand;

b) halogenation of the 10 position of the anthracene using, for example, bromine in tetrachloromethane as illustrated; and

c) a second coupling reaction similar to the one described in part a), wherein the other substituents are as defined in Figure 3 with the addition of a phosphorous ligand, with the preferred examples being 2-cyclohexylphosphino-2'6'-dimethoxy-1,1'-biphenyl (S-Phos) or tris(o-tolyl)phosphine.

Reaction Scheme 4



Alternatively, the asymmetric derivatives of the present invention can be made by via a synthetic coupling reaction as shown in Reaction Scheme 4 containing:

a) either a 9-haloanthracene or a 9-halo-10-arylanthracene, where the halogen is bromine or chlorine, with the preferred example being bromine and the aryl group R is described by Figure 3; b) an aryl ring with at least 3 to 4 fluorines, at least one hydrogen, where the remaining substituent can be hydrogen, fluorine, an alkoxy group, or a trifluoromethyl group; c) palladium acetate; d) 2-cyclohexylphosphino-2'6'-dimethoxy-1,1'-biphenyl (S-Phos); e) a suitable acetate solvent, with the preferred example being isopropyl acetate.

The production of a chemiluminescent system exhibiting a blue/violet emission spectrum with a maximum in the range of about 390 nm to less than-438 nm according to the present invention is accomplished by the combination of two solutions, A and B:

wherein solution A comprises:

an oxalate selected from a family of substituted carbalkoxyphenyloxalates at a concentration of 10 to 30 percent by weight, with the preferred example being bis(2,4,5-trichloro-6-carbopentoxyphenyl)oxalate at a concentration of 14 to 23; percent,

an anthracene of Formula 1 as described in this invention at a concentration of 0.025 to 0.5 percent by weight, with the preferred amount being 0.10 to 0.25 percent; and

a suitable solvent from a family of phthalates, benzoates, and citrates, with the preferred solvent being butyl benzoate;

wherein solution B comprises:

a solution of 70% aqueous hydrogen peroxide at a concentration of 2 to 6.5 percent of the total weight, with the preferred amount being 3 to 4 percent; and

a catalyst from a family of salicylates:

wherein said catalyst is at a concentration of 0.0015 to 0.05 percent by weight with the preferred amount being 0.005 to 0.010 percent; and

a solvent from a family of phthalates, benzoates, and citrates, with the preferred example being dimethyl phthalate, dibutyl phthalate, triethyl citrate, benzyl benzoate, butyl benzoate, propylene glycol dibenzoate, ethylhexyl diphenyl phosphate, ethylene glycol dibenzoate, and n-butyl,tri-n-hexyl citrate, or the like phthalates, benzoates and citrates.

Optionally, a solvent miscible in water and most organic solvents at a concentration of 5 to 20 percent by weight, with the preferred example being *tert*-butanol at a concentration of 5 to 15 percent may be included.

Compounds which are generally suitable to catalyze the reaction between the activator and oxalate type esters are basic compounds, such as amines, hydroxides, alkoxides, carboxylic acid salts and phenolic salts. Preferred salts of carboxylic acids and phenols are derived from compounds having a pKa in the range of from about 1 to about 6 as measured in aqueous solution, for example tetrabutylammonium salicylate , sodium salicylate, ethyl-2-acetoxy salicylate, various tetraalkylammonium salicylates, lithium salicylate, lithium 5-t-butyl salicylate sodium-5-bromosalicylate, sodium-5-chlorosalicylate, and sodium-5-fluorosalicylate or the like, with the preferred catalyst being sodium salicylate.

EXAMPLES

Starting materials and solvents were purchased from Aldrich, Matrix, Synthonix, and Alfa Aesar. All of the desired compounds were analyzed via HPLC, and their spectra (absorption, chemiluminescent emission, and NMR) recorded.

Example 1

Procedure for producing 9,10-bis(2,3,4,5,6-pentafluorophenyl)anthracene (Figure 1)

To a suspension of 6.25 g of 9,10-anthraquinone in 60 mL of anhydrous 1,4-dioxane, was added 0.1 mole of pentafluorophenylmagnesium bromide in 30 mL of diethyl

ether prepared as described in *Organic Synthesis*, Coll. Vol. 6, p. 875. The mixture was brought to a reflux and held there overnight. The reaction was quenched in a mixture of 25 mL of saturated aqueous ammonium chloride and 25 mL of water. After bringing the pH of the aqueous portion of the solution to pH 3-4 using dilute aqueous hydrochloric acid, 100 mL of ethyl acetate was added. The layers were separated, and the aqueous layer was extracted with an additional 100 mL of ethyl acetate. The combined organic extracts were dried with magnesium sulfate and concentrated. The residue was recrystallized from toluene to give 8.66 g of off-white crystals.

The reduction of the diol was accomplished by taking 5.44 g of 9,10-bis(pentafluorophenyl)-9,10-dihydro-9,10-anthracenediol in 50 mL of acetic acid and refluxing it with 9 g of potassium iodide and 9 g of sodium hypophosphite for 4 hours. After cooling, white crystals were filtered off. The crude product was recrystallized using a 1:1 mixture of toluene and hexane to yield 2.00 g of 9,10-bis(pentafluorophenyl)anthracene with a melting point of 337-338°C.

This method was used for compounds depicted in Figures 1-88.

Example 2

Symmetrically and asymmetrically substituted anthracenes can be made via Reaction Scheme 2 and Reaction Scheme 3 or a variation thereof using the procedures in the following: patents and patent applications, US 2004/0161633 A1, US 6,815,094 B2, US, 2007/0176544 A1; literature references, *Org. Lett.* **2007**, *9*, 4893-4896. *J. Am. Chem. Soc.* **2008**, *130*, 1012-1016, and *J. Org. Chem.* **2008**, *73*, 5589-5591; and references therein.

This method was used for the symmetrically substituted compounds depicted in Figures 3, 6-8, 22-24, and 38-40 and most of the asymmetrically substituted compounds or a portion thereof.

Example 3

Procedure for producing 9-(4-methoxy-2,3,5,6-tetrafluorophenyl)-10-phenylanthracene (Figure 106)

This compound was made using the method depicted in Reaction Scheme 4. A flask with a magnetic stir bar was charged with 1.00 g of potassium carbonate, 0.15 g of dicyclohexylphosphinodimethoxybiphenyl (S-Phos), and 0.04 g of palladium acetate. The

reaction vessel was evacuated and backfilled with argon three times. A solution of 1.29 g of 2,3,5,6-tetrafluoroanisole in 8 mL of isopropyl acetate was added via syringe, and the reaction mixture was stirred for one minute. A solution of 9-bromo-10-phenylanthracene in 4 mL in isopropyl acetate was added. The reaction mixture was heated to 80°C and held at that temperature overnight. The reaction was filtered and the crude material purified via column chromatography on silica gel using 5% diethyl ether in heptane to yield 350 mg of a white solid with a melting point of 153-154°C.

This method was used to attach pentafluorophenyl, 2,3,5,6-tetrafluorophenyl, and 2,3,5,6-tetrafluoro-4-methoxyphenyl groups to a 9-haloanthracene or a 9-halo-10-arylanthracene as described in *Org. Lett.* **2006**, *8*, 5097-5100 and references therein.

Example 4

The light output of the compounds was also tested. The process for producing chemiluminesence is described as follows;

(A) A quantity of butyl benzoate is heated to 70° C and purged with nitrogen gas and brought to room temperature under nitrogen. To a suitable vessel are added 85.81 parts by weight of butyl benzoate and 14.0 parts by weight of bis(2,4,5-trichloro-6-carbopentoxyphenyl)oxalate, with stirring, until the oxalate is dissolved. To the resultant solution is then added 0.19 parts by weight of the blue/violet fluorescer. The solution is allowed to cool and stored under nitrogen. The resultant solution is called Solution A.

(B) To a second vessel are added 86.7 parts by weight of dimethyl phthalate and 10.0 parts by weight of t-butyl alcohol. To this mixture are added 3.3 parts by weight of 70% hydrogen peroxide and 0.0072 parts of sodium salicylate. The resultant solution is called Solution B. Optionally, Solution B can be made by combining 96.7 parts of triethylcitrate, 0.0100 parts of sodium salicylate, and 3.3 parts of 70% hydrogen peroxide.

(C) To 4.7 parts by weight of Solution A is added 5.6 parts by weight of Solution B with thorough mixing. The result is the generation of a blue/violet chemiluminescent light.

The emission spectra for several of anthracene fluorescers are shown in Figure 661. This figure illustrates the enhanced percentage of light in the region where the

emission maximum is from about 390 nm to less than438 nm for compounds described herein.

All patents and publications mentioned in this specification are indicative of the levels of those skilled in the art to which the invention pertains. All patents and publications are herein incorporated by reference to the same extent as if each individual publication was specifically and individually indicated to be incorporated by reference.

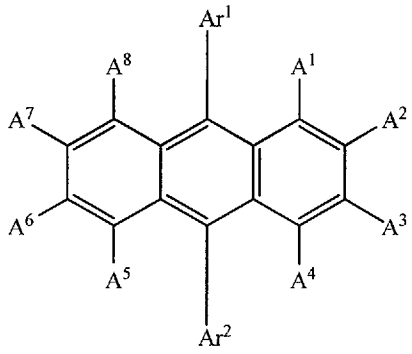
It is to be understood that while a certain form of the invention is illustrated, it is not to be limited to the specific form or arrangement herein described and shown. It will be apparent to those skilled in the art that various changes may be made without departing from the scope of the invention and the invention is not to be considered limited to what is shown and described in the specification and any drawings/figures included herein.

One skilled in the art will readily appreciate that the present invention is well adapted to carry out the objectives and obtain the ends and advantages mentioned, as well as those inherent therein. The embodiments, methods, procedures and techniques described herein are presently representative of the preferred embodiments, are intended to be exemplary and are not intended as limitations on the scope. Changes therein and other uses will occur to those skilled in the art which are encompassed within the spirit of the invention and are defined by the scope of the appended claims. Although the invention has been described in connection with specific preferred embodiments, it should be understood that the invention as claimed should not be unduly limited to such specific embodiments. Indeed, various modifications of the described modes for carrying out the invention which are obvious to those skilled in the art are intended to be within the scope of the following claims.

CLAIMS

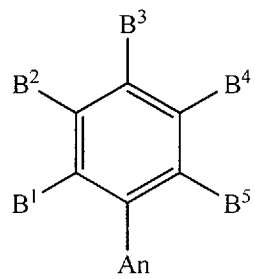
What is claimed is:

Claim 1. An anthracene compound represented by Formula (1):



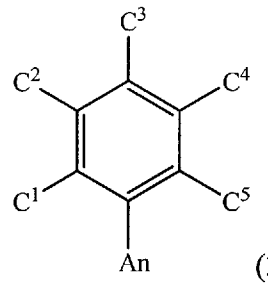
(1)

wherein Ar^1 has a structure represented by Formula 2, where An shows the attachment to the anthracene ring as described in Formula 1,

$Ar^1 =$ 

(2)

wherein Ar^2 has a structure represented by Formula 3, where An shows the attachment to the anthracene ring as described in Formula 1,

$Ar^2 =$  (3)

wherein each of A^1, A^2, A^3, A^4, A^5, A^6, A^7, and A^8 are selected from the group consisting of hydrogen and fluorine;

wherein at least two of the substituents, B^1, B^2, B^3, B^4, and B^5, as shown in Formula 2, are not hydrogen, wherein each of B^1, B^2, B^4, and B^5 are selected from the group consisting of hydrogen and fluorine, and B^3 is selected from the group consisting of hydrogen, fluorine, trifluoromethyl, and an alkoxy group with 1-10 carbons; and

wherein at least two of the substituents, C^1, C^2, C^3, C^4, and C^5, as shown in Formula 3, are not hydrogen, wherein each of C^1, C^2, C^4, and C^5 are selected from the group consisting of hydrogen and fluorine, and C^3 is selected from the group consisting of hydrogen, fluorine, trifluoromethyl, and an alkoxy group with 1-10 carbons.

Claim 2. The anthracene compound of claim 1 wherein:

Ar^1 and Ar^2 are different from each other; and

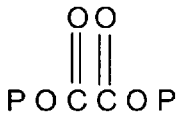
wherein each of C^1, C^2, C^3, C^4, and C^5 are selected from the group consisting of hydrogen, fluorine, trifluoromethyl, and an alkoxy group with 1-10 carbons.

Claim 3. A chemiluminescent composition containing the anthracene compound of claim 1, which composition is adapted to be reacted with a hydrogen peroxide solution to provide chemiluminescent light.

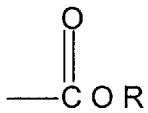
Claim 4. The chemiluminescent composition as set forth in claim 3, further comprising a solvent.

Claim 5. The chemiluminescent composition as set forth in claim 4, wherein the solvent is selected from the group consisting of dibutyl phthalate, butyl benzoate, propylene glycol dibenzoate, ethylhexyl diphenyl phosphate and mixtures comprising at least one of the foregoing.

Claim 6. The chemiluminescent composition as set forth in claim 3, containing an oxalate compound which is a bis(phenyl) oxalate ester having the formula:



in which the phenyl groups(P) are substituted by at least one carbalkoxy group of the formula



in which R is (a) an alkyl group (1-18 carbons, straight chain, branched chain, cyclic) or (b) a substituted alkyl group, where said substituents are selected from the group consisting of fluoro, chloro, trifluoromethyl, alkoxy, cyano, carbalkoxy, and phenyl; and in which (2) the phenyl groups P, are substituted by at least two additional substituents selected from the group consisting of fluoro, chloro, bromo, cyano, trifluoromethyl, carbalkoxy, nitro, alkoxy, alkoxy methyl, methyl, and higher alkyl, said additional substituents being selected so that the sum of their Hammett sigma constants for phenols lies between 1.0 and 2.

Claim 7. The chemiluminescent composition as set forth in claim 6 wherein the oxalate is bis(2,4,5-trichloro-6-carbopentoxyphenyl)oxalate.

Claim 8. A chemiluminescent system comprising the chemiluminescent composition of claim 3, in combination with a peroxide-containing component, whereby a blue/violet chemiluminescent light having an emission maximum from about 390nm to less than 438 nm is produced.

Claim 9. The chemiluminescent system of claim 8 wherein a blue/violet light having an emission maximum in the region from about 400nm to about 420 nm is produced.

Claim 10. The chemiluminescent system as set forth in claim 8, wherein the peroxide-containing component contains a solvent selected from the group consisting of tertiary alcohols, triethyl citrate, dimethyl phthalate, and mixtures comprising at least one of the foregoing.

Claim 11. The chemiluminescent system as set forth in claim 8, wherein the peroxide-containing component further contains a catalyst.

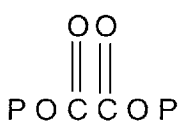
Claim 12. The chemiluminescent system as set forth in claim 11, wherein the catalyst is a salicylate.

Claim 13. A chemiluminescent composition containing the anthracene compound of claim 2, which composition is adapted to be reacted with a hydrogen peroxide solution to provide chemiluminescent light.

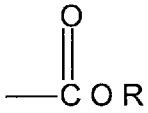
Claim 14. The chemiluminescent composition as set forth in claim 13, further comprising a solvent.

Claim 15. The chemiluminescent composition as set forth in claim 14, wherein the solvent is selected from the group consisting of dibutyl phthalate, butyl benzoate, propylene glycol dibenzoate, ethylhexyl diphenyl phosphate and mixtures comprising at least one of the foregoing.

Claim 16. The chemiluminescent composition as set forth in claim 13, containing an oxalate compound which is a bis(phenyl) oxalate ester having the formula:



in which the phenyl groups(P) are substituted by at least one carbalkoxy group of the

formula 

in which R is (a) an alkyl group (1-18 carbons, straight chain, branched chain, cyclic) or (b) a substituted alkyl group, where said substituents are selected from the group consisting of fluoro, chloro, trifluoromethyl, alkoxy, cyano, carbalkoxy, and phenyl; and in which (2) the phenyl groups P, are substituted by at least two additional substituents selected from the group consisting of fluoro, chloro, bromo, cyano, trifluoromethyl, carbalkoxy, nitro, alkoxy, alkoxy methyl, methyl, and higher alkyl, said additional substituents being selected so that the sum of their Hammett sigma constants for phenols lies between 1.0 and 2.

Claim 17. The chemiluminescent composition as set forth in claim 16 wherein the oxalate is bis(2,4,5-trichloro-6-carbopentoxyphenyl)oxalate.

Claim 18. A chemiluminescent system comprising the chemiluminescent composition of claim 13, in combination with a peroxide-containing component, whereby a blue/violet chemiluminescent light having an emission maximum from about 390nm to less than 438 nm is produced.

Claim 19. The chemiluminescent system of claim 18 wherein a blue/violet light having an emission maximum in the region from about 400nm to about 420 nm is produced.

Claim 20. The chemiluminescent system as set forth in claim 18, wherein the peroxide-containing component contains a solvent selected from the group consisting of tertiary alcohols, triethyl citrate, dimethyl phthalate, and mixtures comprising at least one of the foregoing.

Claim 21. The chemiluminescent system as set forth in claim 18, wherein the peroxide-containing component further contains a catalyst.

Claim 22. The chemiluminescent system as set forth in claim 21, wherein the catalyst is a salicylate.

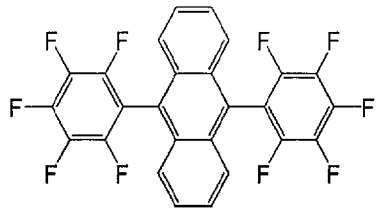


Figure 1

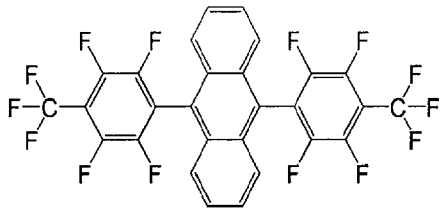


Figure 2

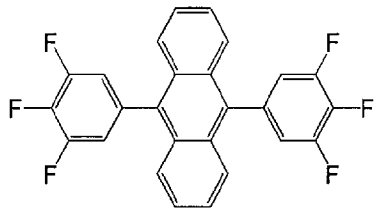


Figure 3

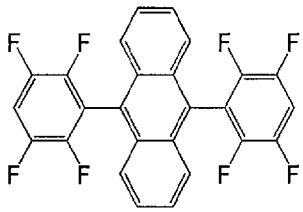


Figure 4

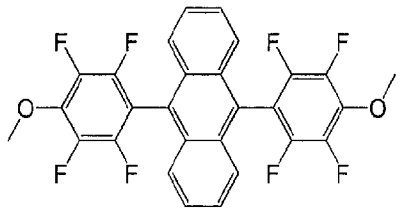


Figure 5

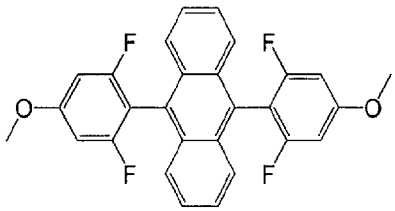


Figure 6

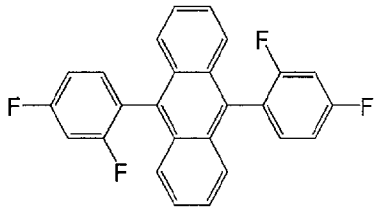


Figure 7

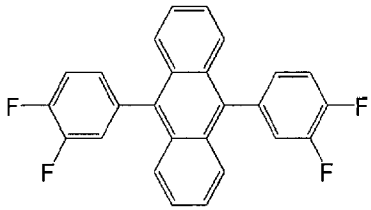


Figure 8

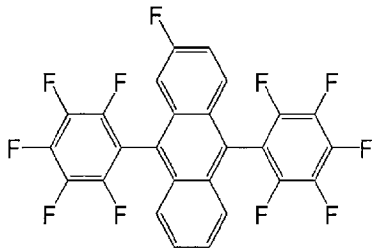


Figure 9

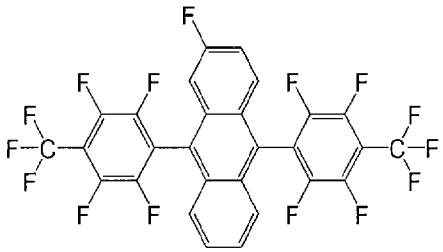


Figure 10

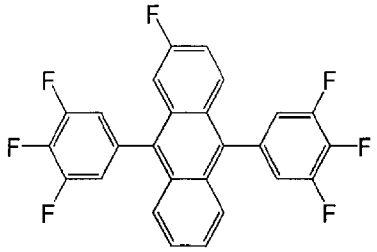


Figure 11

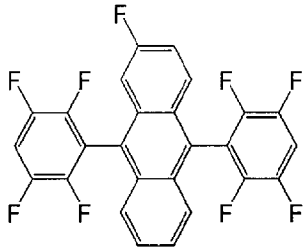


Figure 12

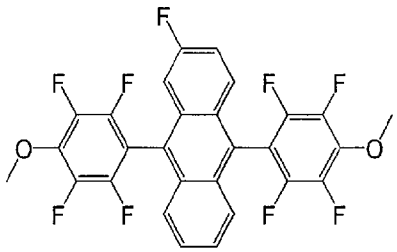


Figure 13

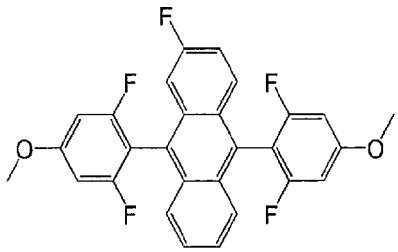


Figure 14

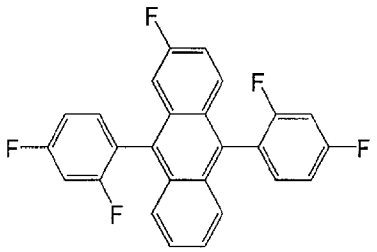


Figure 15

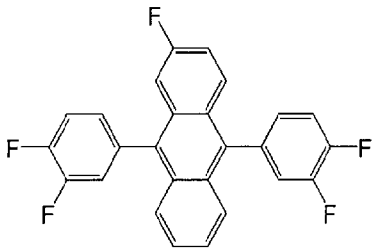


Figure 16

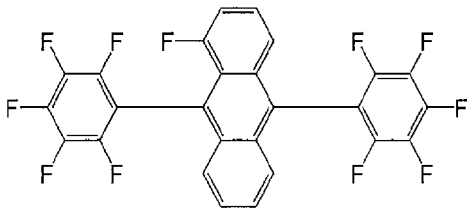


Figure 17

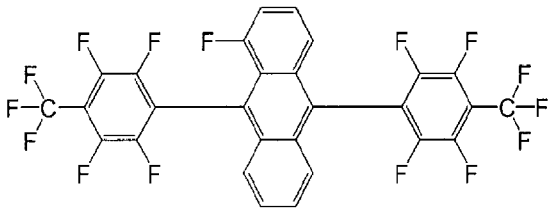


Figure 18

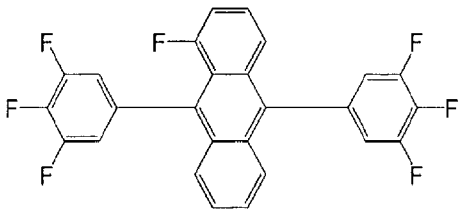


Figure 19

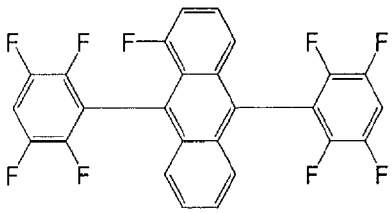


Figure 20

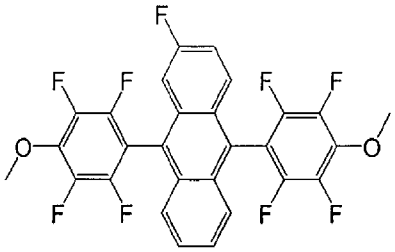


Figure 21

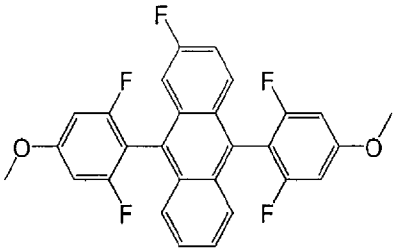


Figure 22

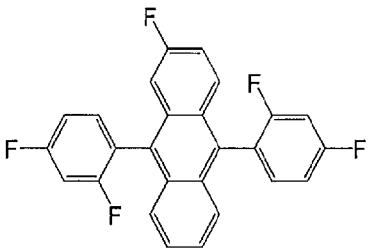


Figure 23

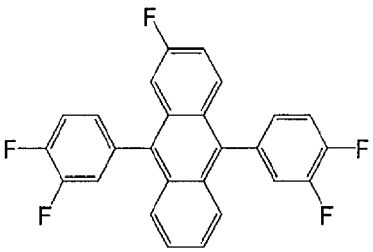


Figure 24

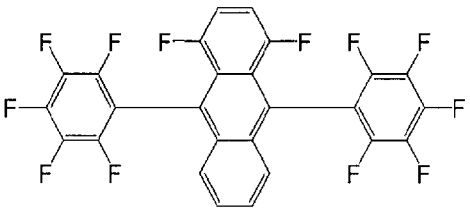


Figure 25

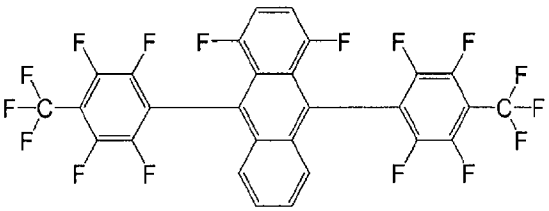


Figure 26

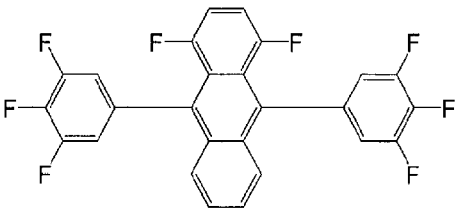


Figure 27

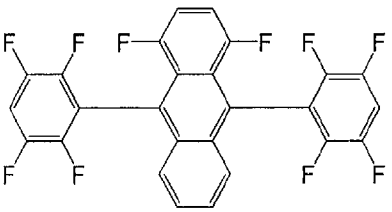


Figure 28

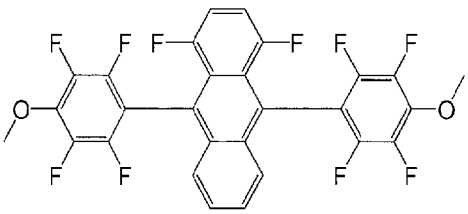


Figure 29

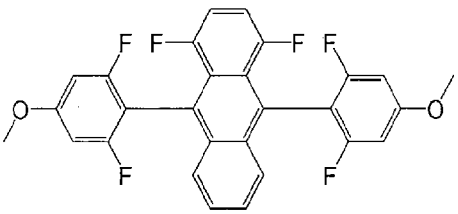


Figure 30

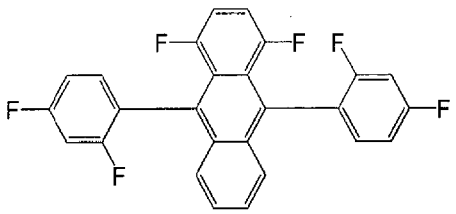


Figure 31

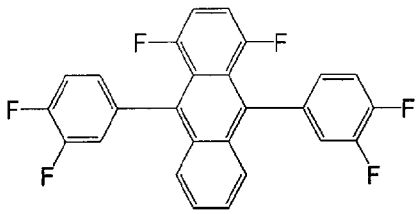
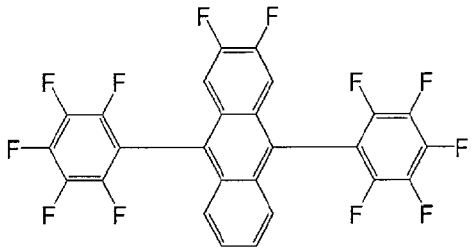


Figure 32



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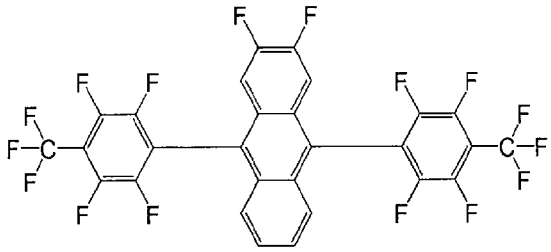

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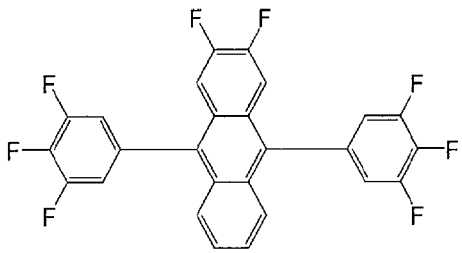

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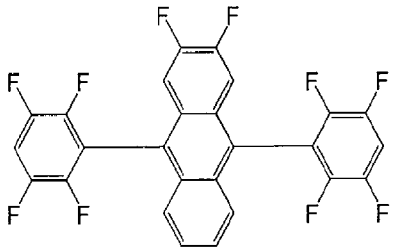

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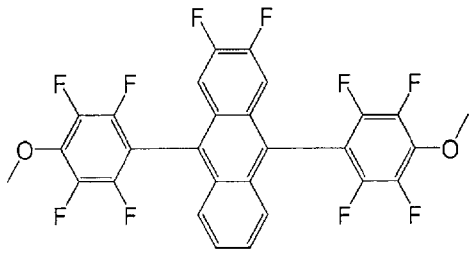

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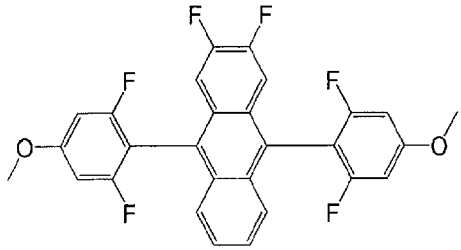

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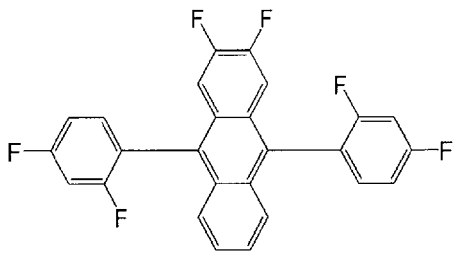

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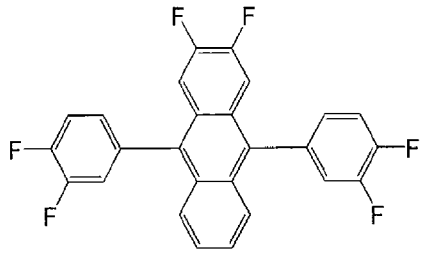

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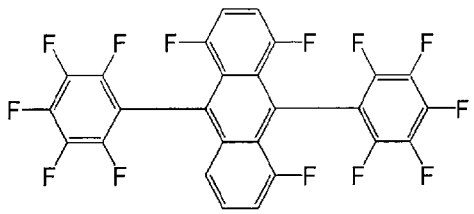

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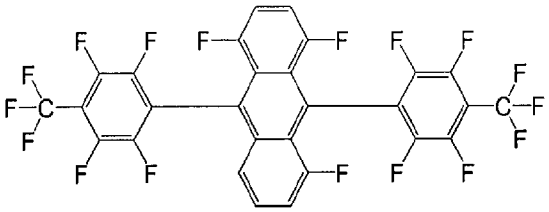

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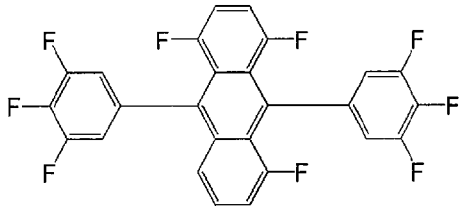

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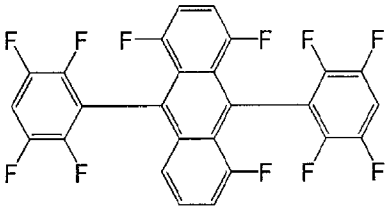

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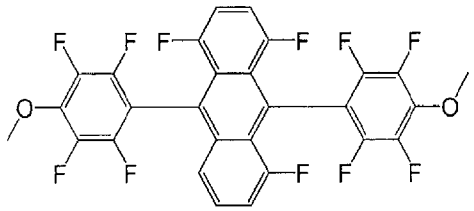

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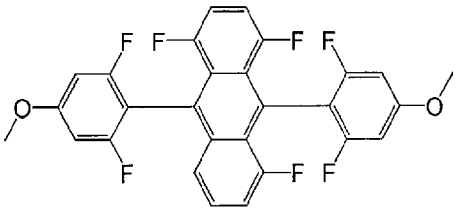

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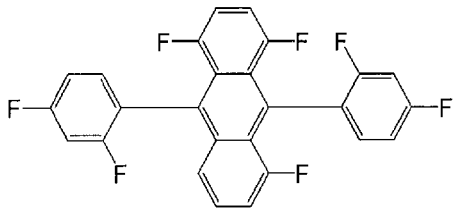

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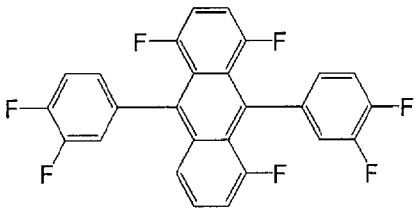

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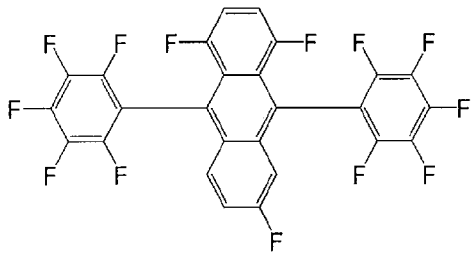

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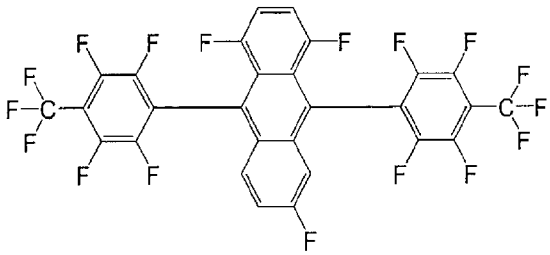

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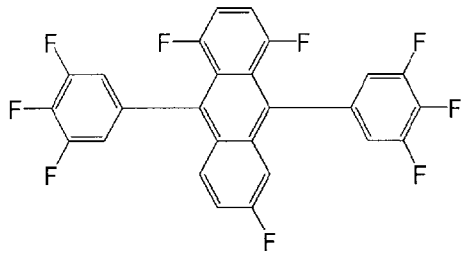

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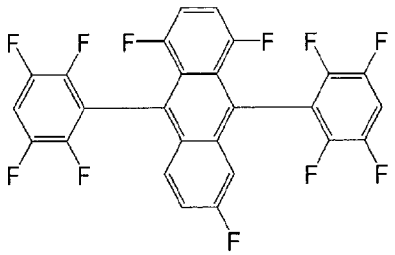

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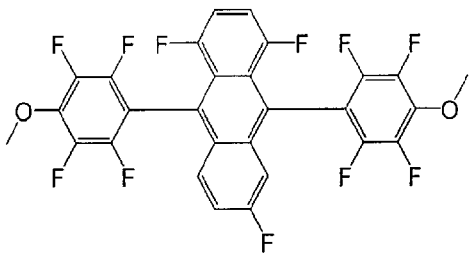

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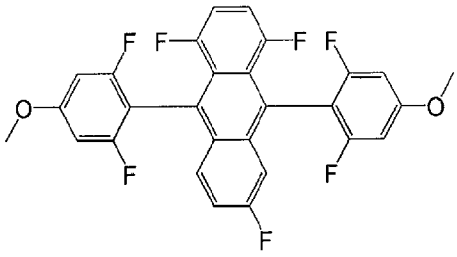

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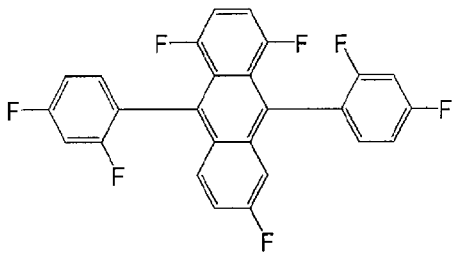

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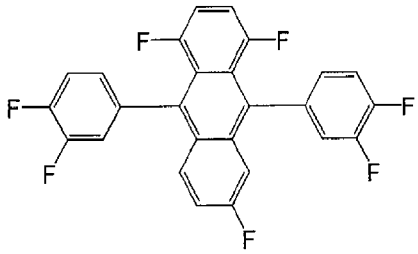

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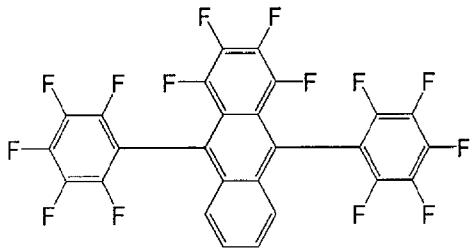

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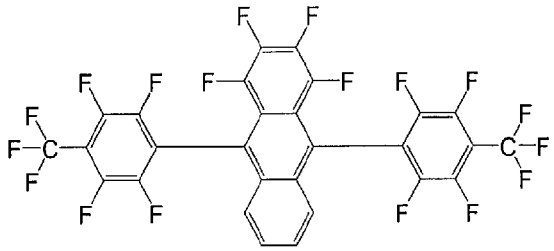

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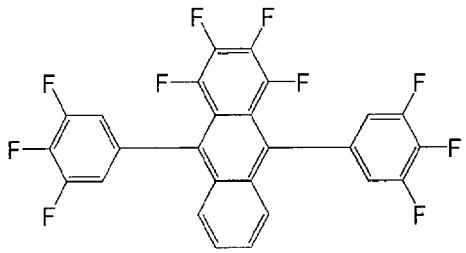

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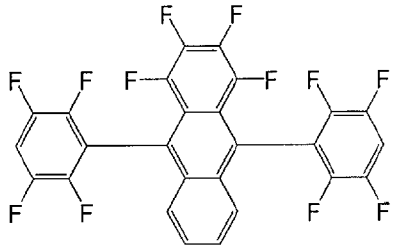

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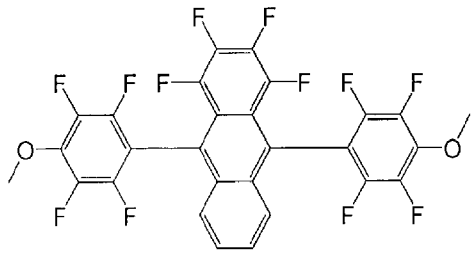

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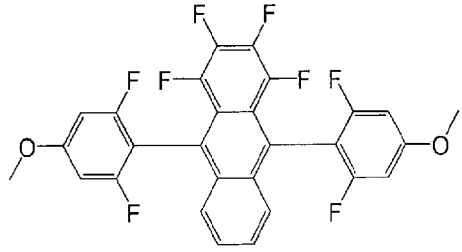

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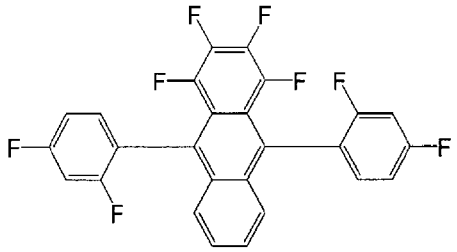

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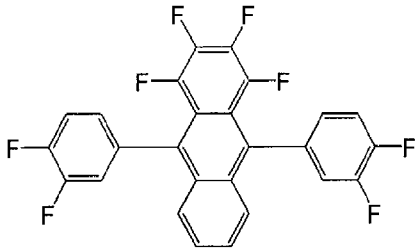

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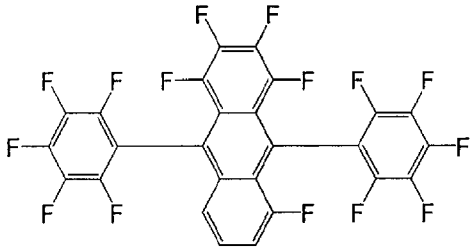

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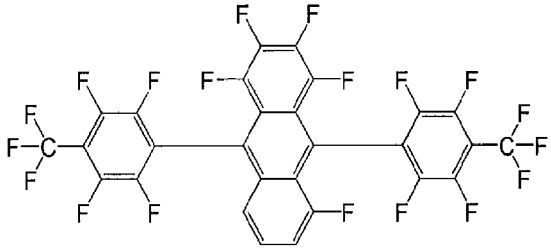

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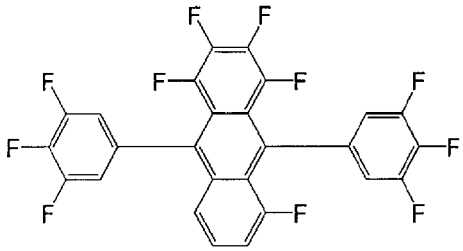

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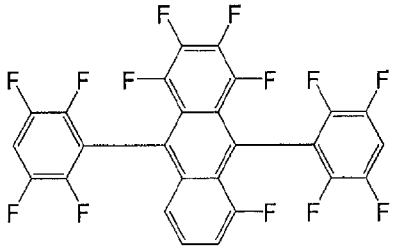

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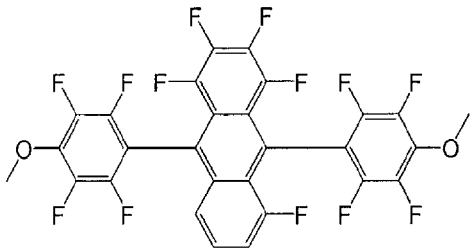

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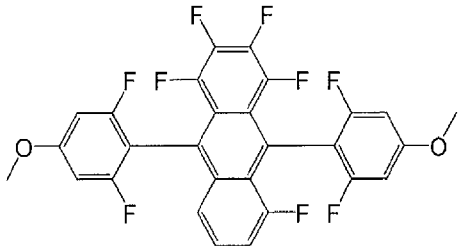

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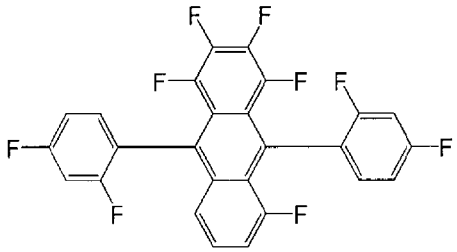

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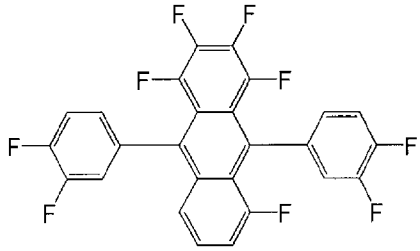

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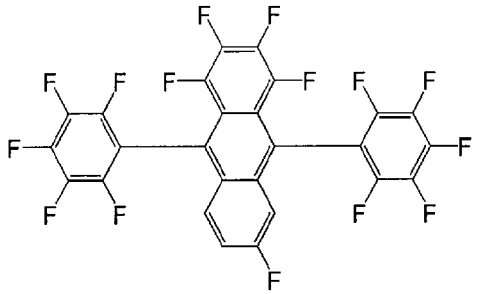

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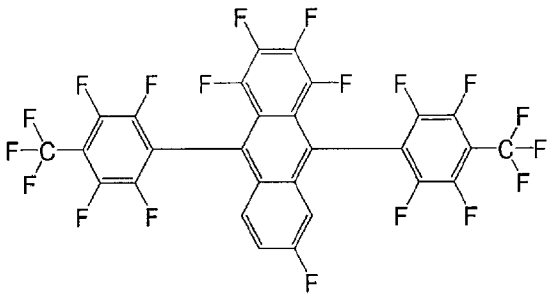

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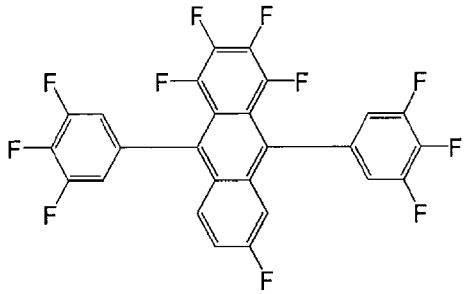

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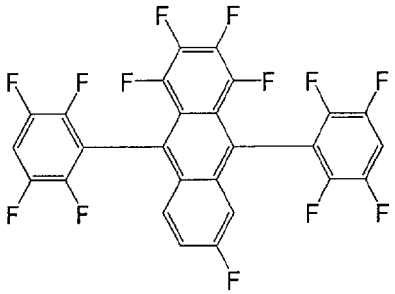

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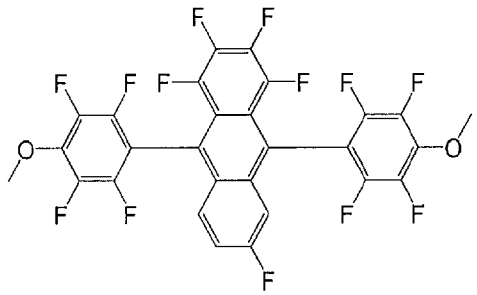

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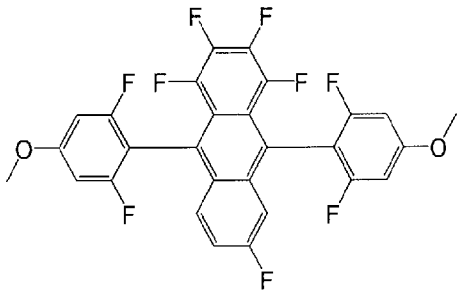

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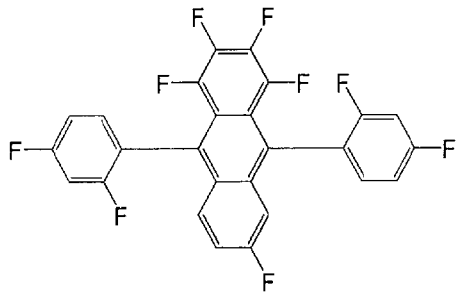

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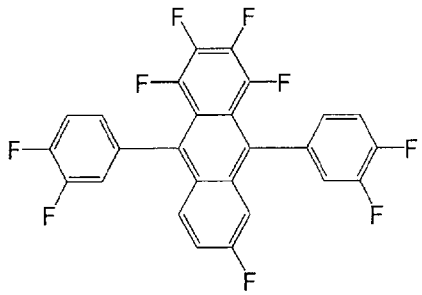

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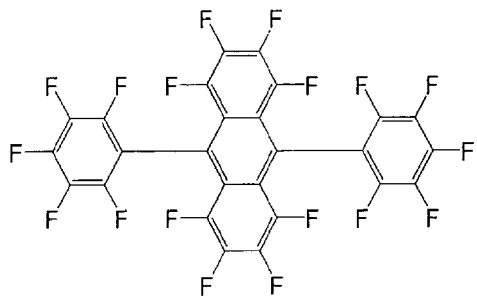

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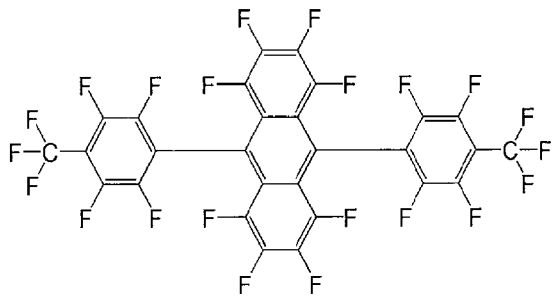

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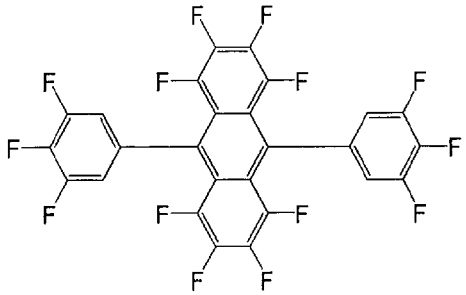

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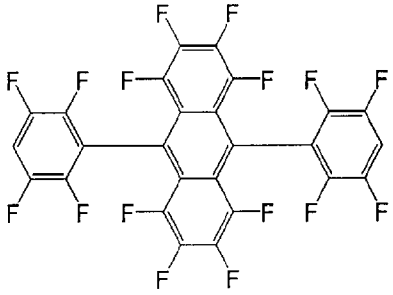

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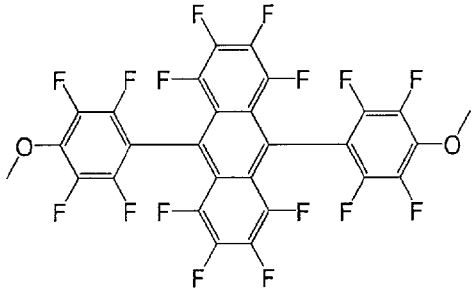

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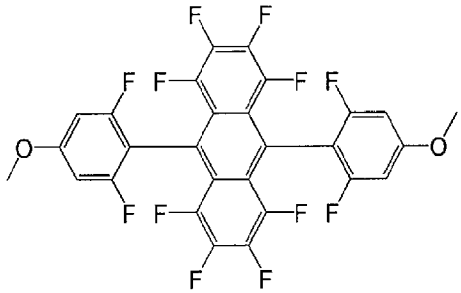

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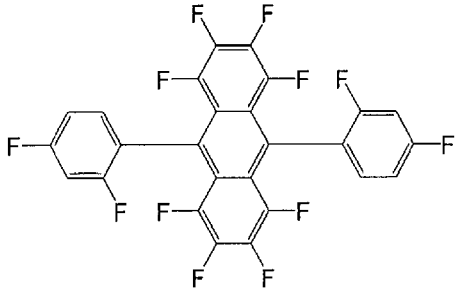

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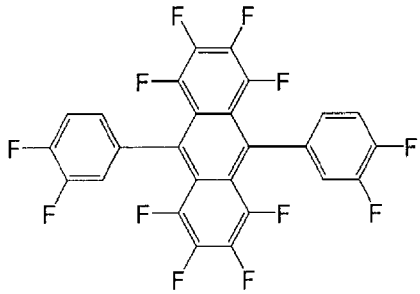

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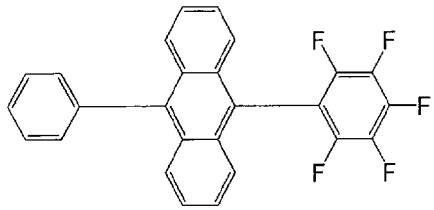

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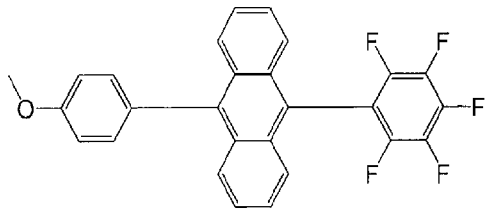

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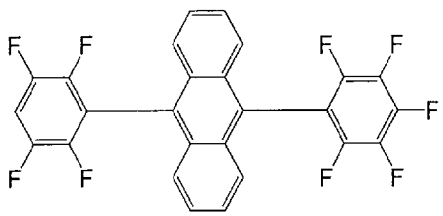

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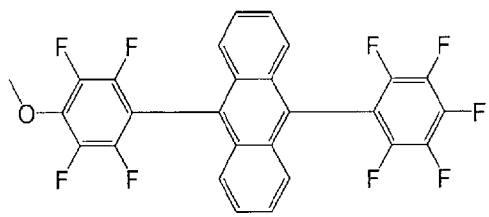

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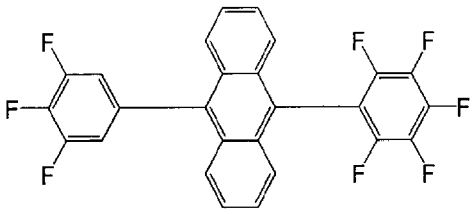

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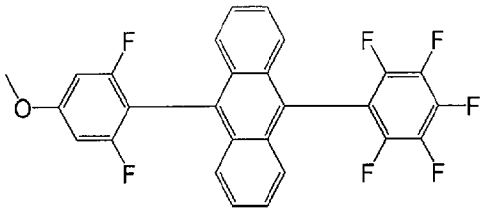

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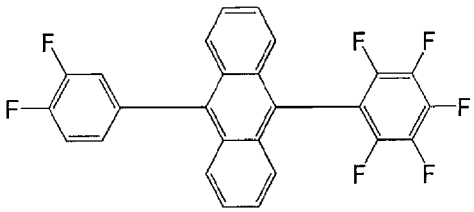

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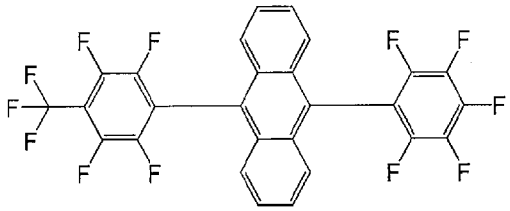

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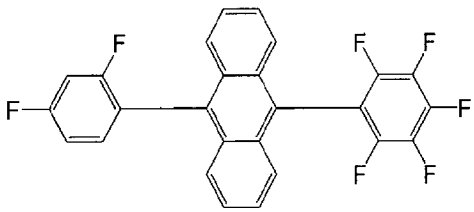

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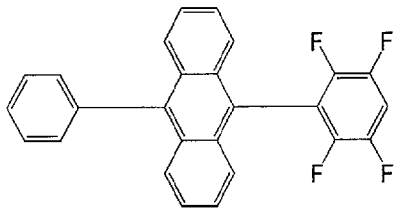

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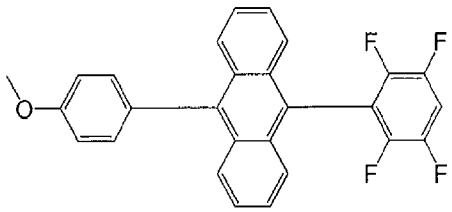

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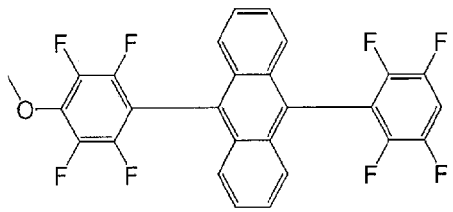

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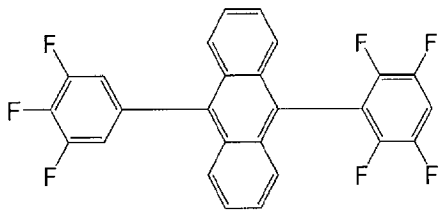

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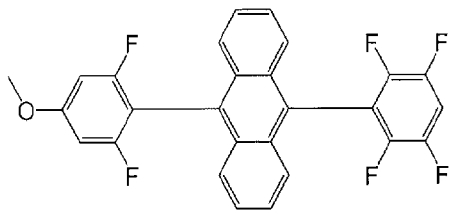

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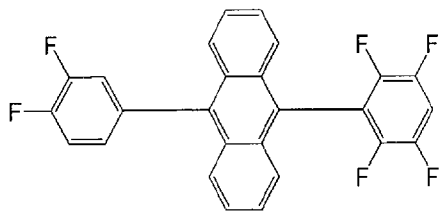

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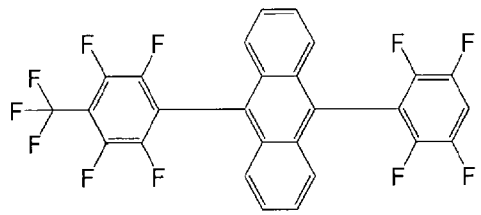

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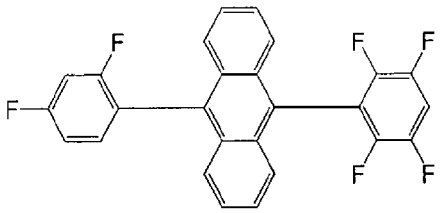

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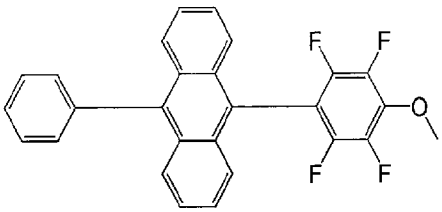

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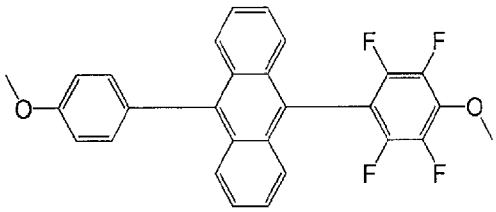

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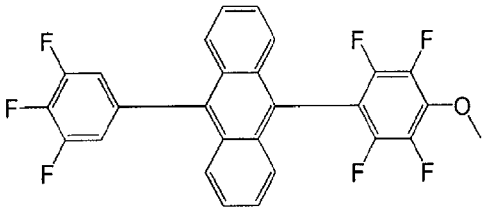

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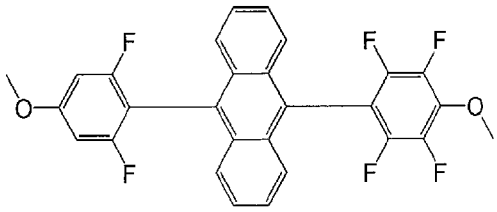

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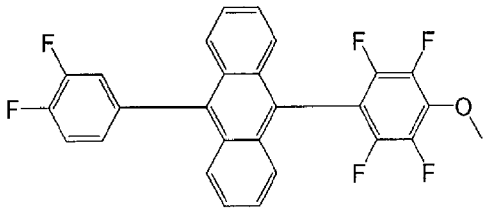

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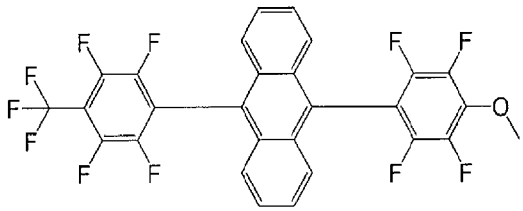

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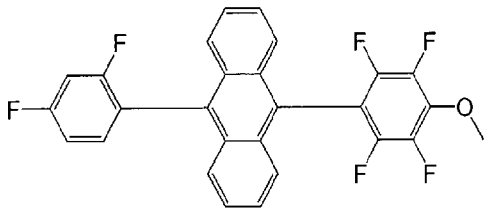

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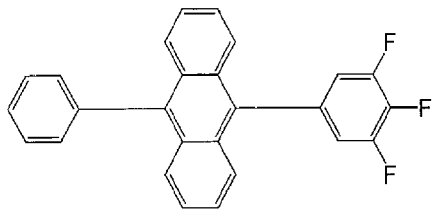

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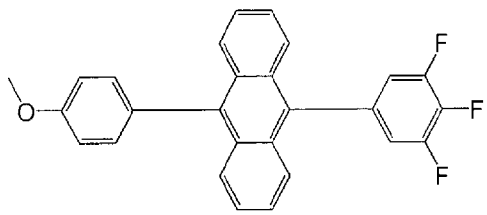

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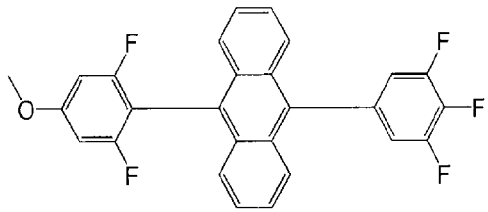

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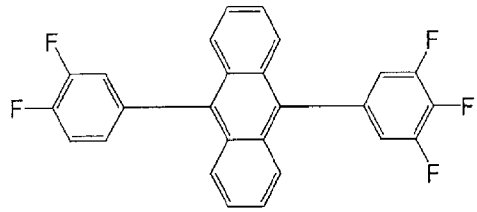

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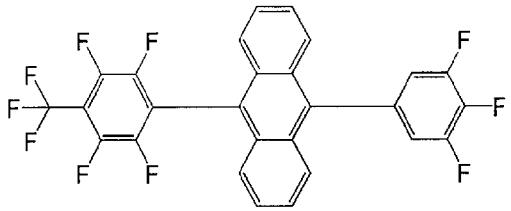

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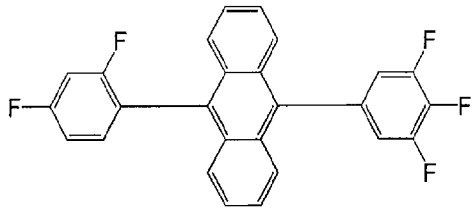

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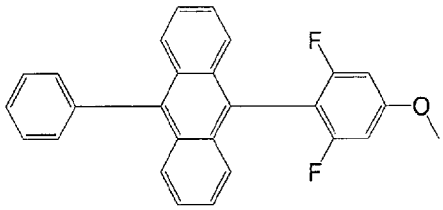

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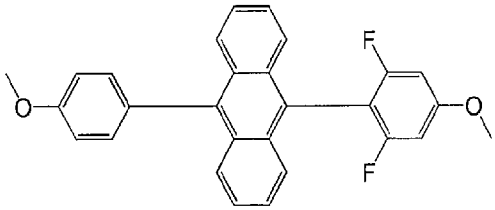

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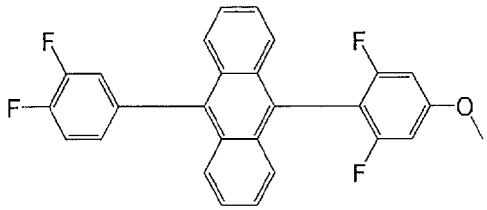

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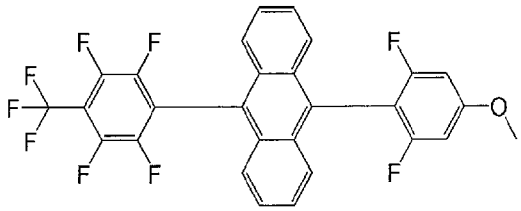

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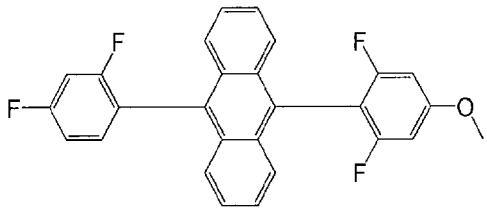

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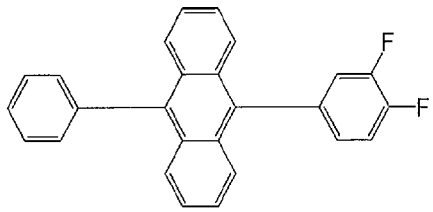

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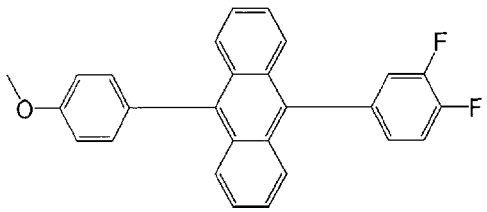

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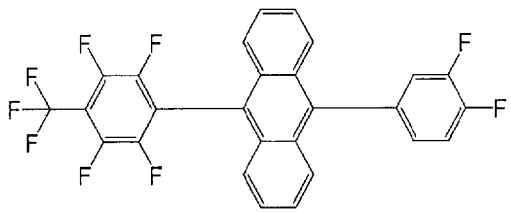

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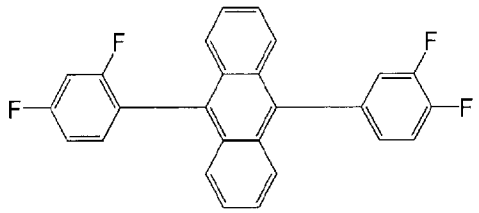

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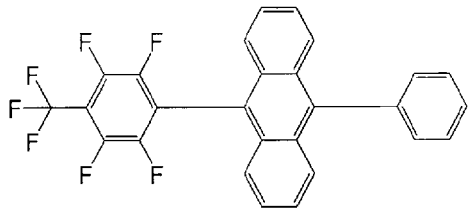

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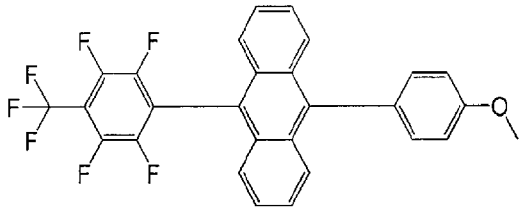

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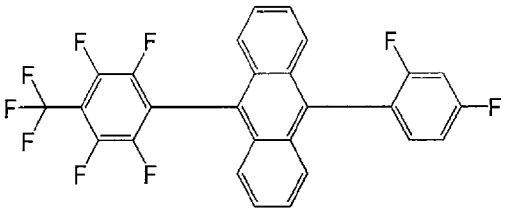

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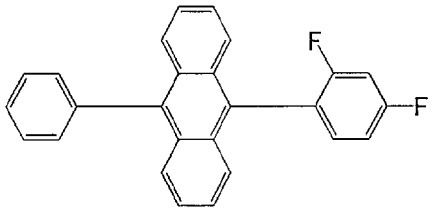

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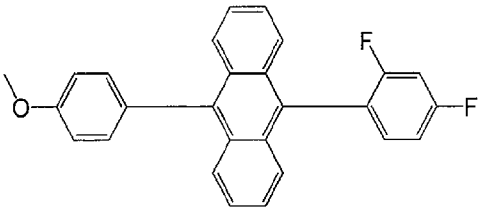

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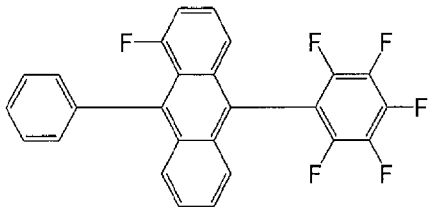

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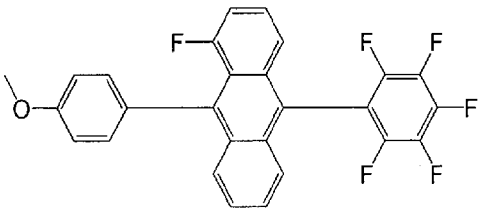

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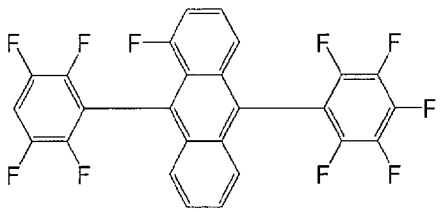

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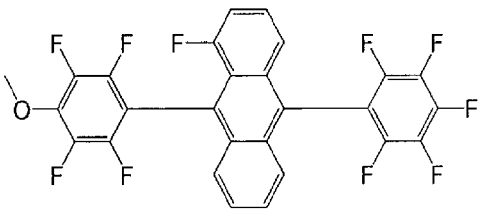

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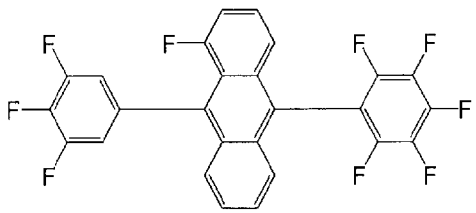

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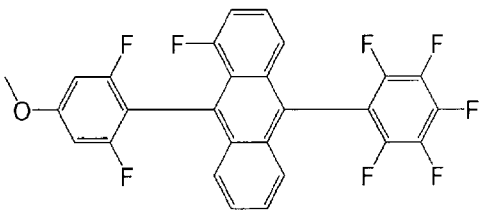

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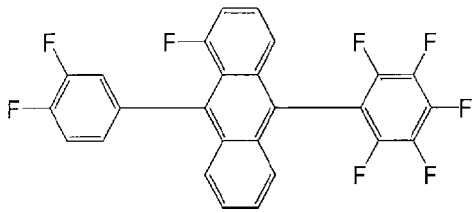

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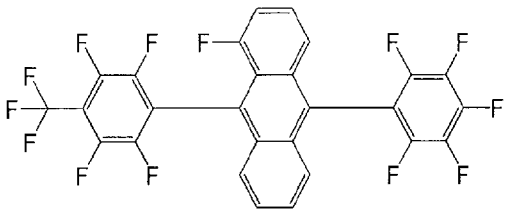

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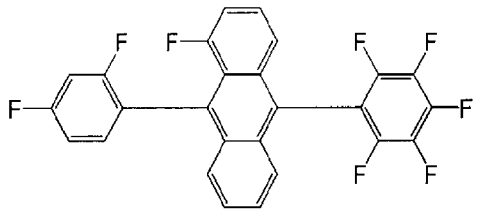

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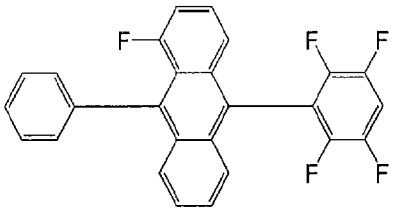

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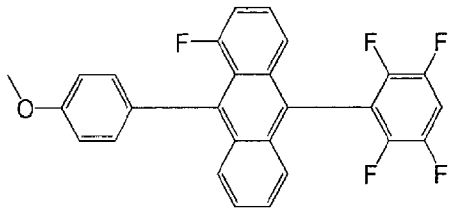

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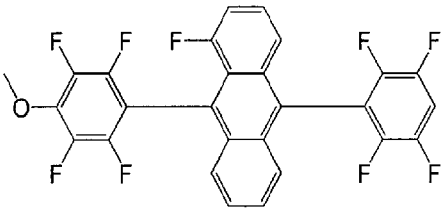

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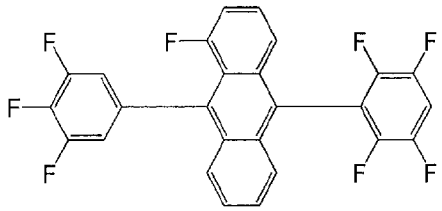

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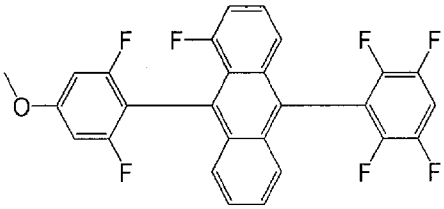

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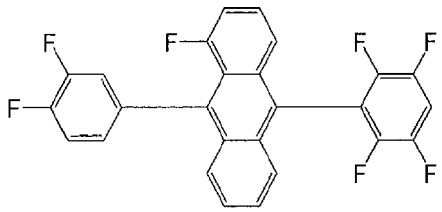

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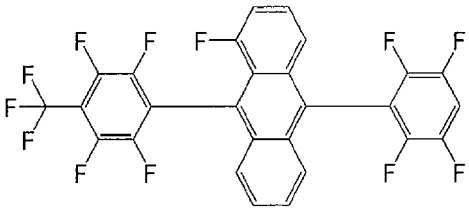

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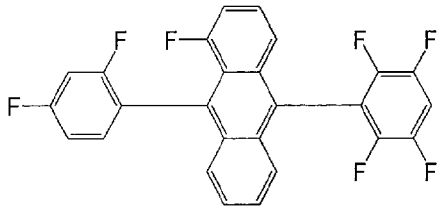

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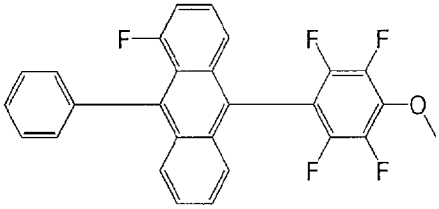

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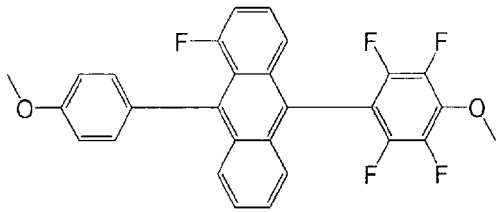

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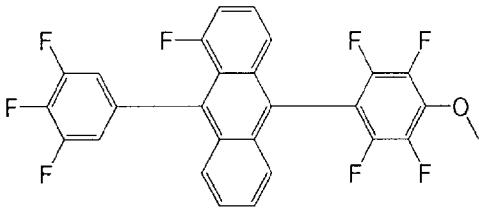
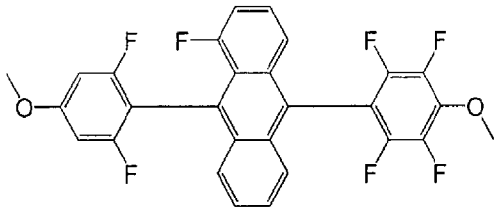


Figure 152



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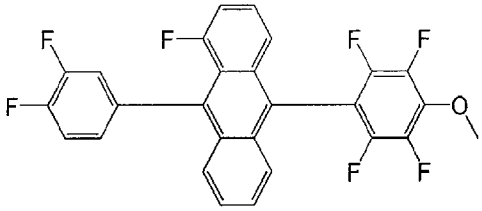

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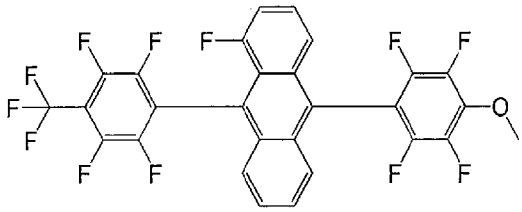

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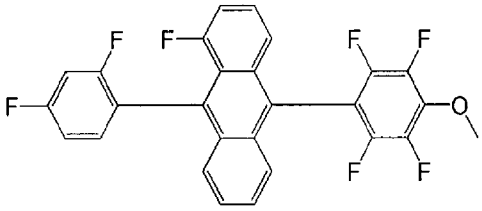

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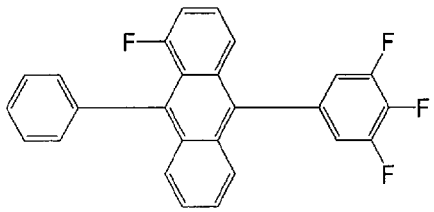

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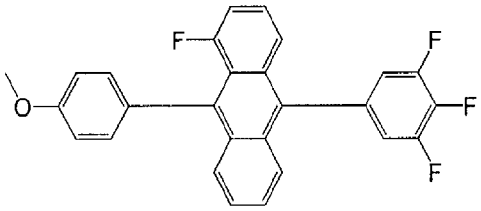

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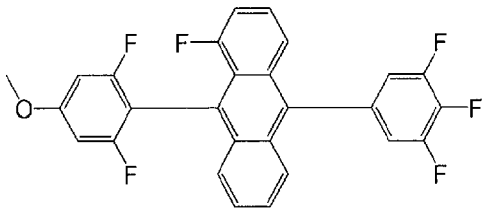

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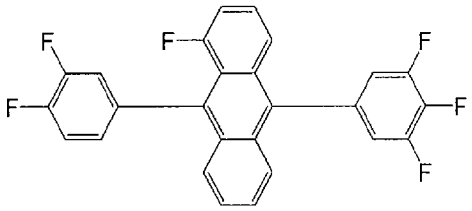

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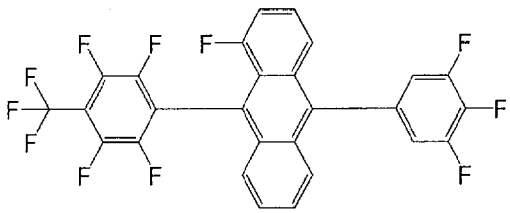

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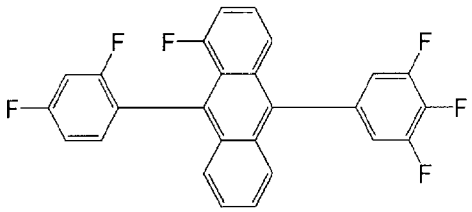

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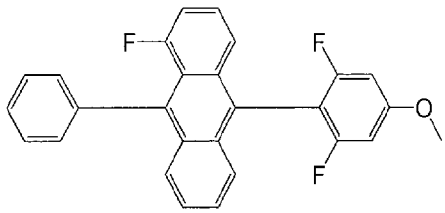

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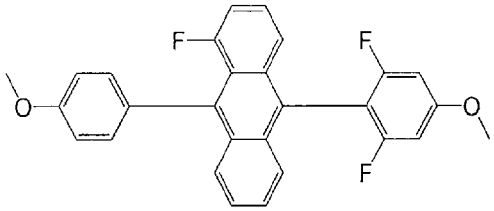

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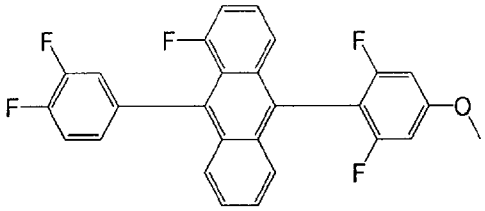

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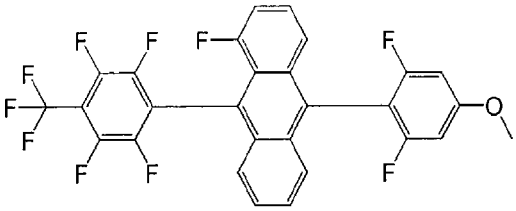

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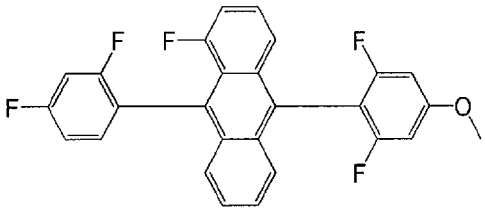

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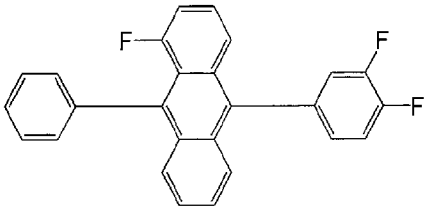

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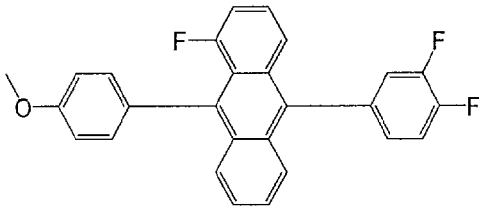

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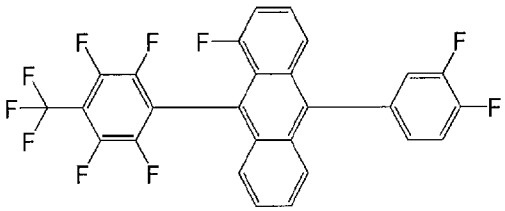

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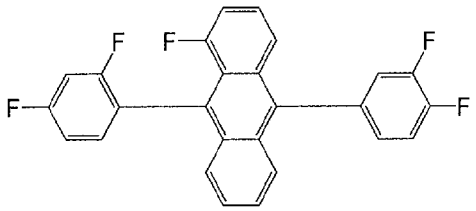

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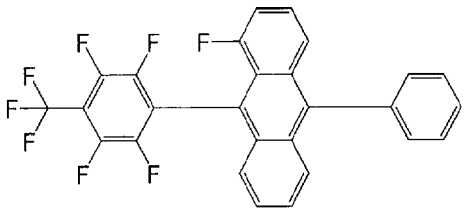

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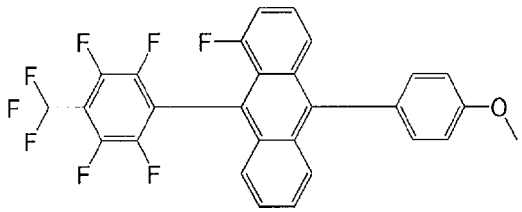

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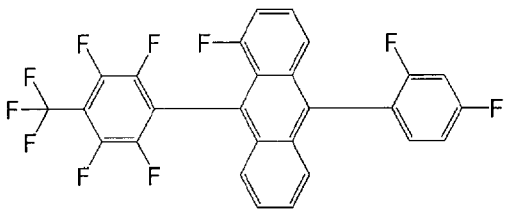

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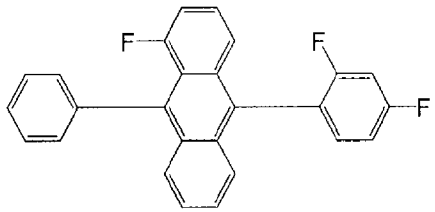

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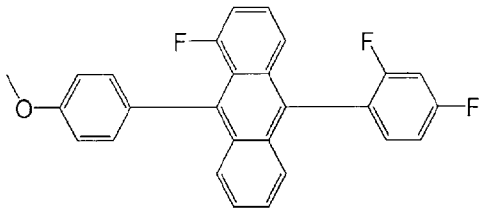

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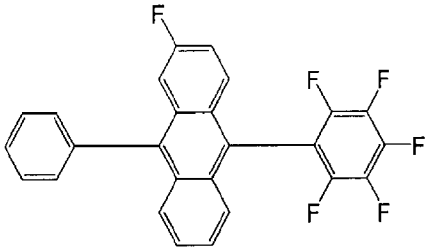

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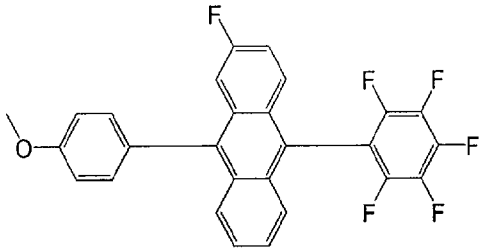

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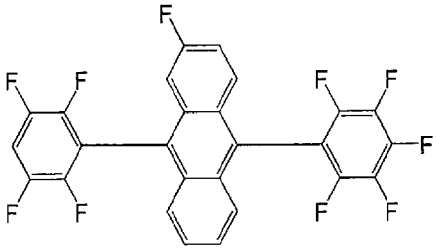

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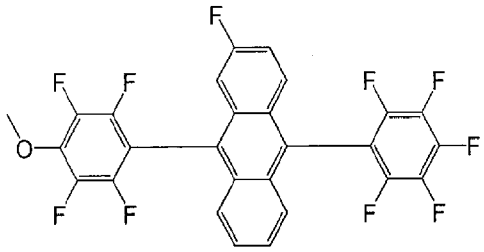

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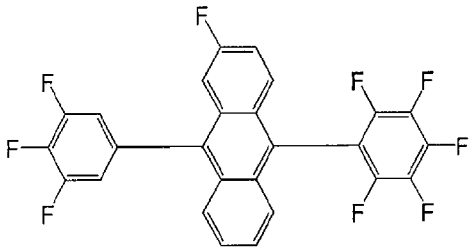

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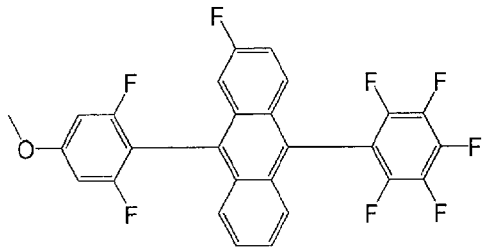

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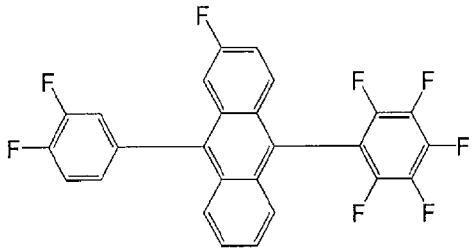

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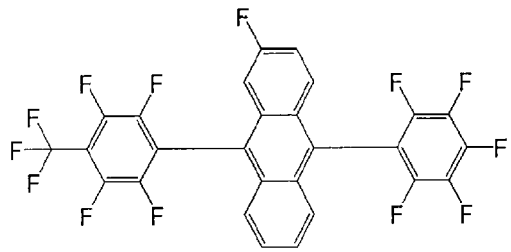

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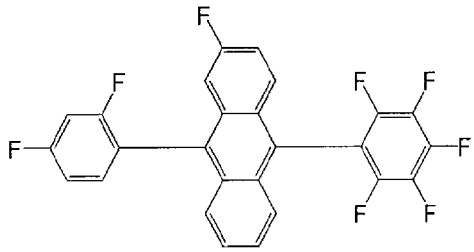

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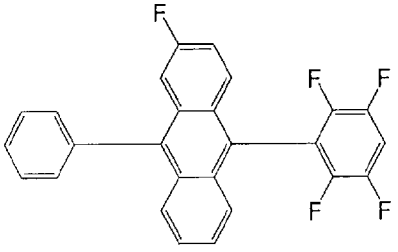

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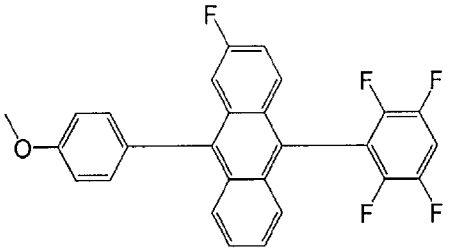

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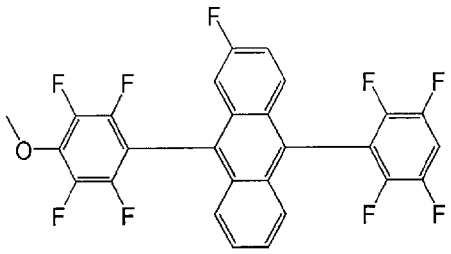

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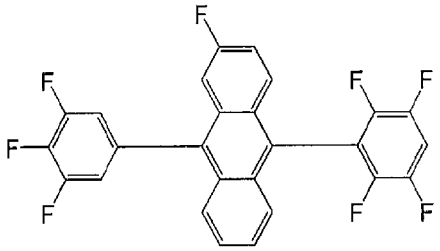

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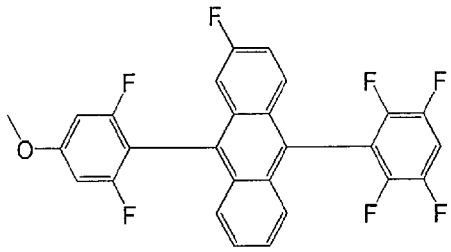

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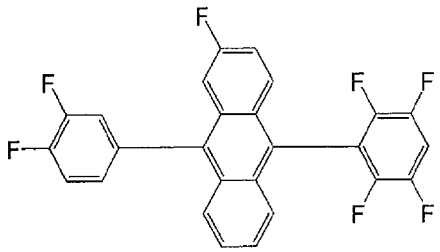

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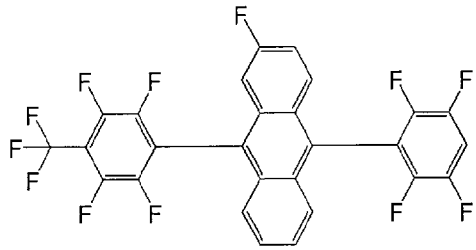

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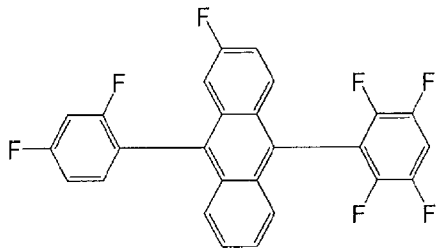

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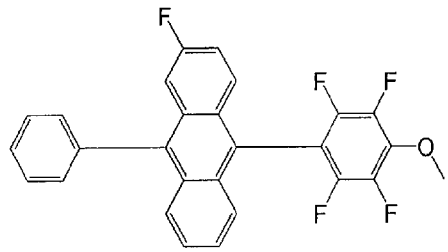

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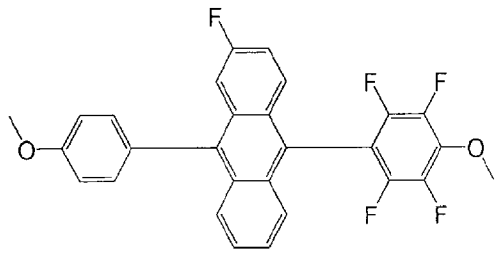

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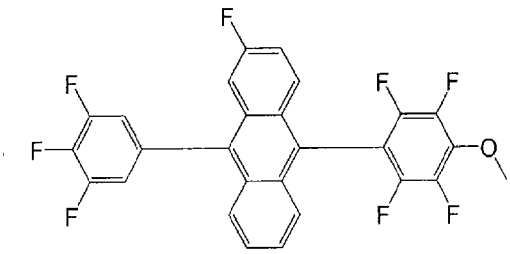

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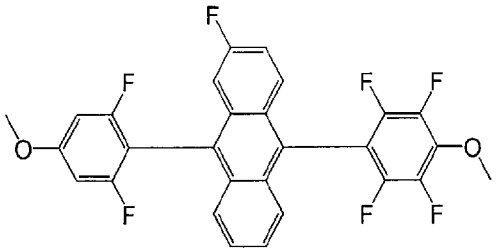

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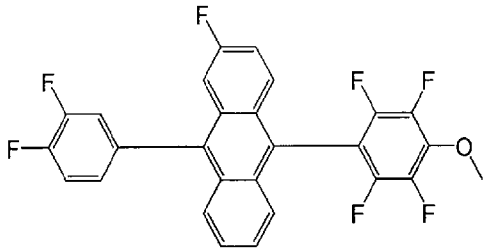

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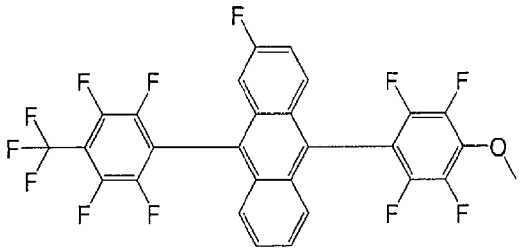

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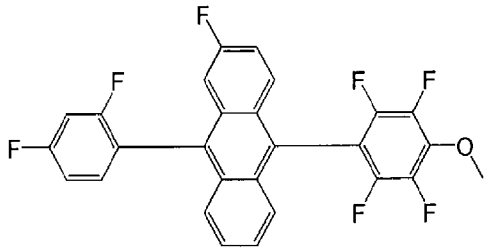

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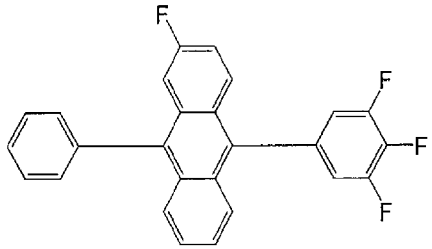

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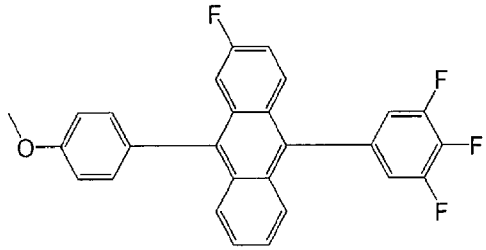

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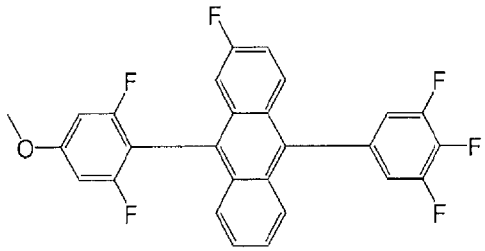

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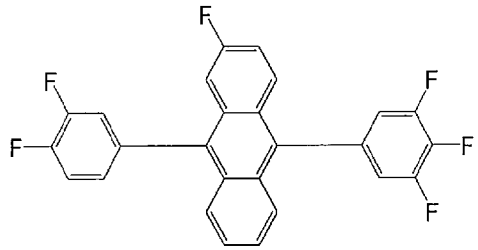

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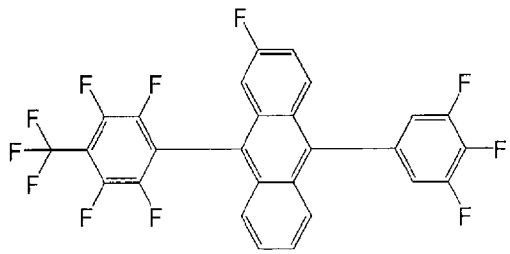

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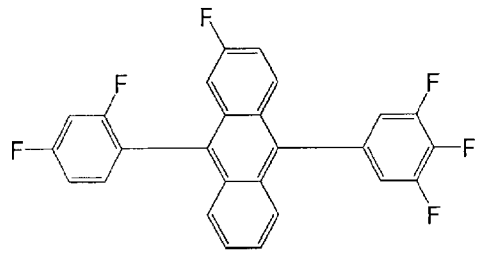

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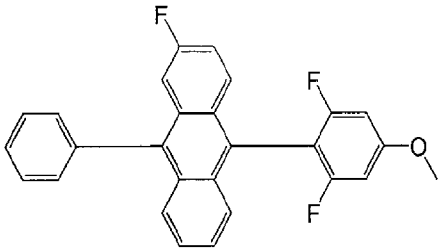

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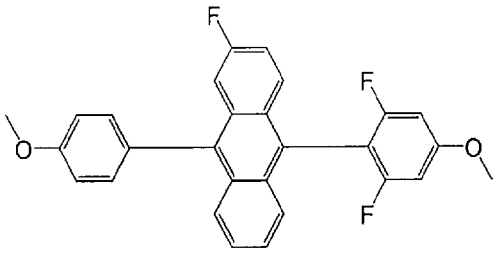

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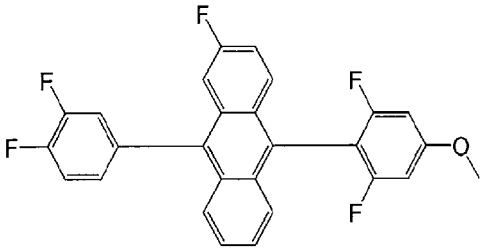

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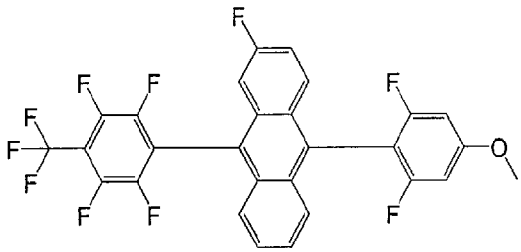

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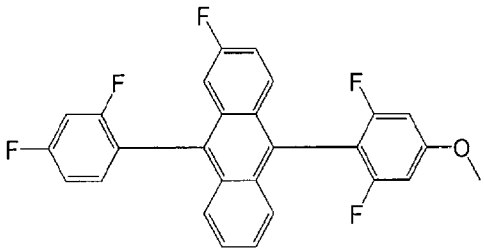

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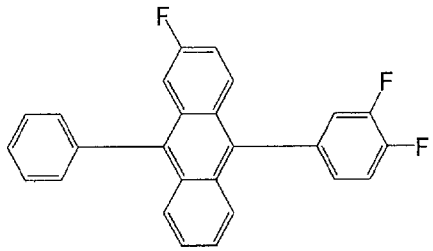

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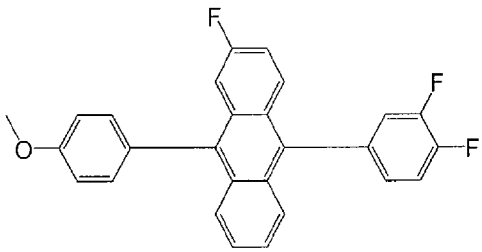

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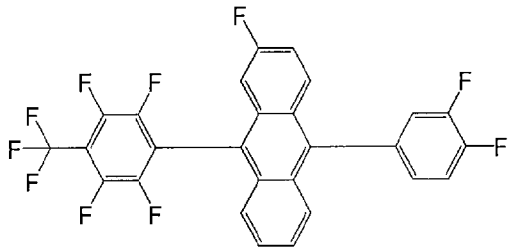

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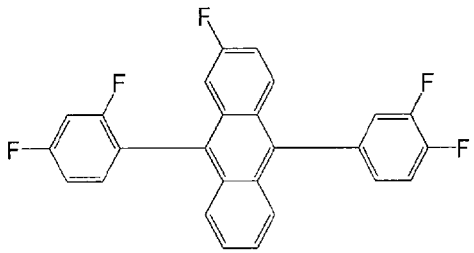

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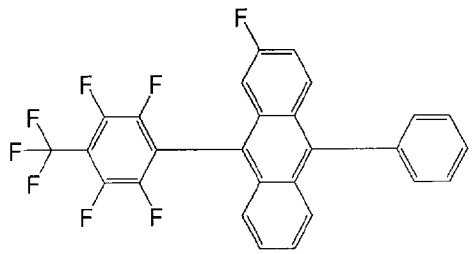

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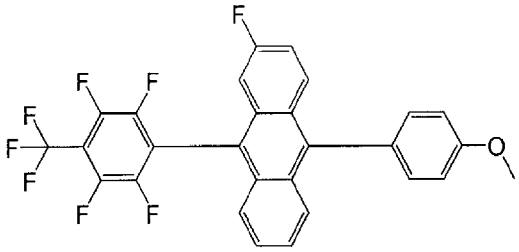

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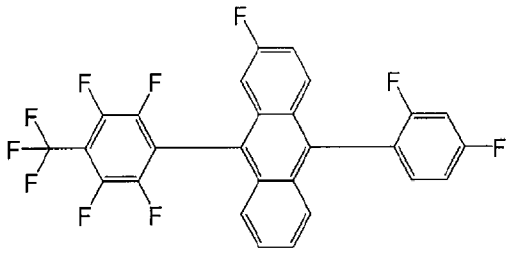

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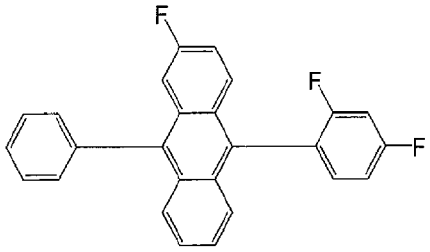

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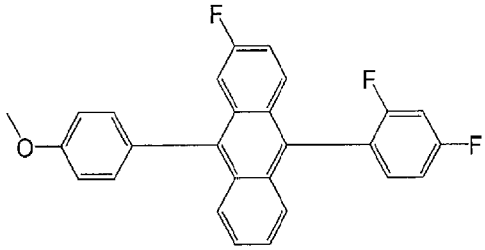

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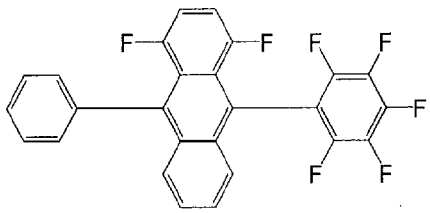

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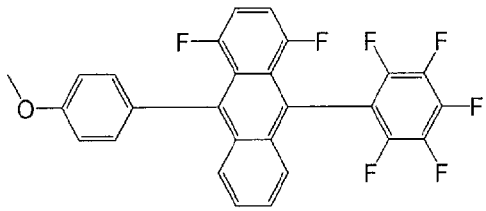

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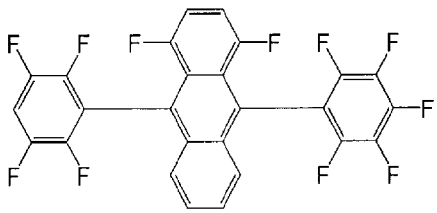

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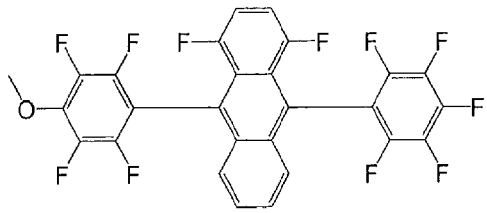

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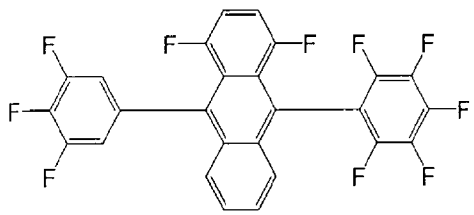

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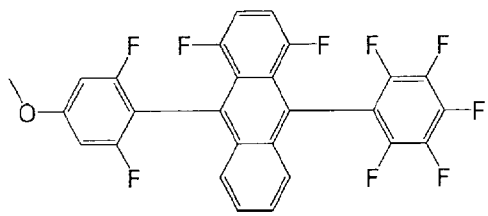

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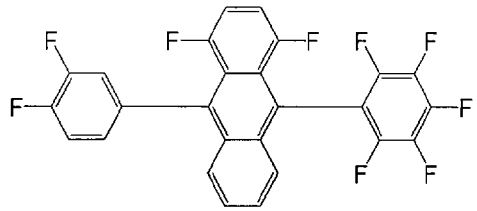

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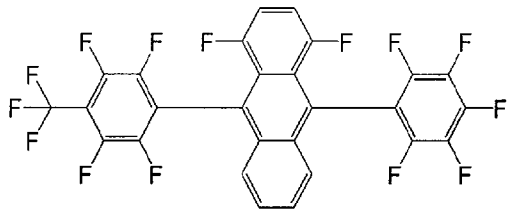

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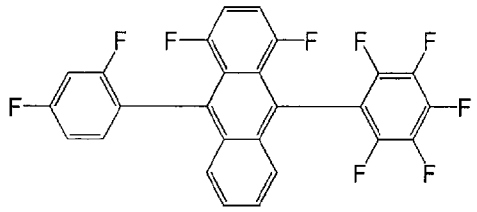

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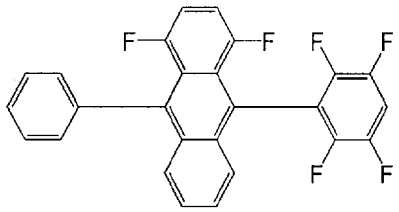

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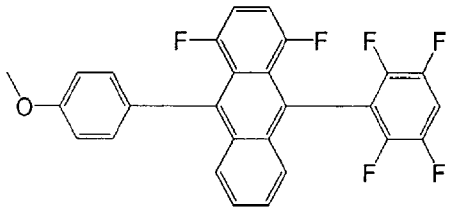

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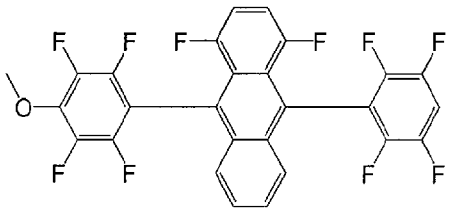

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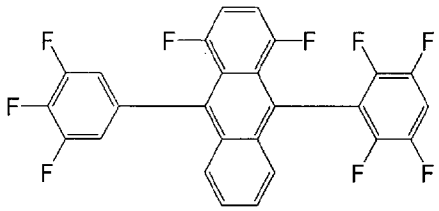

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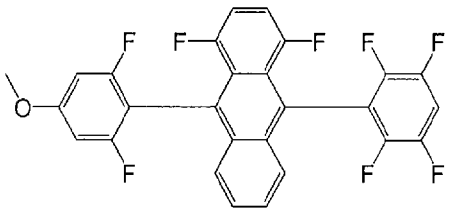

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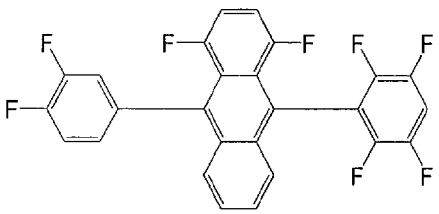

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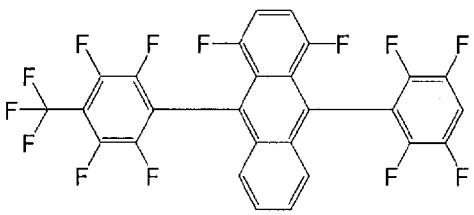

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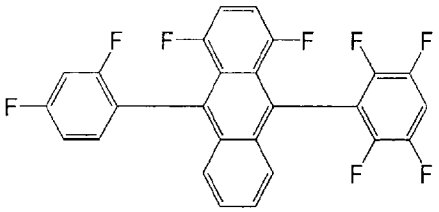

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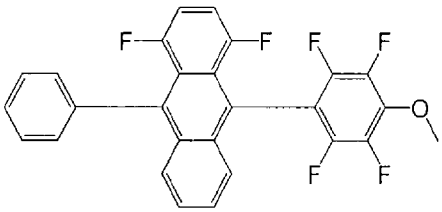

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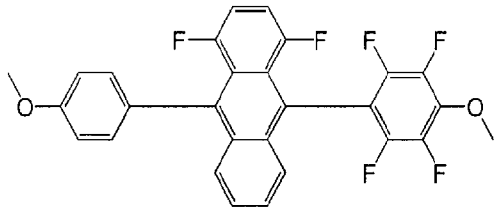

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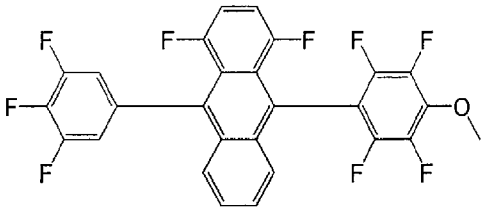

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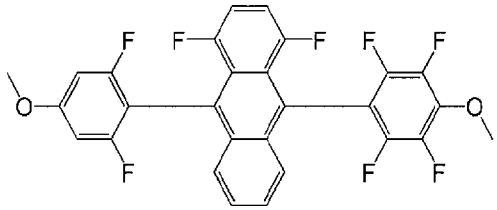

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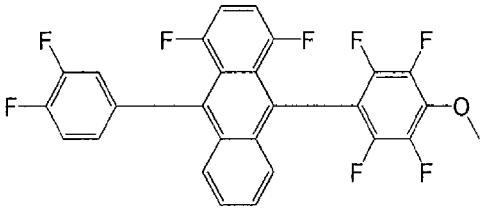

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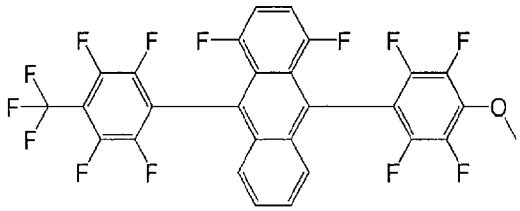

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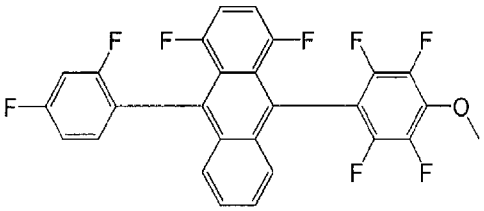

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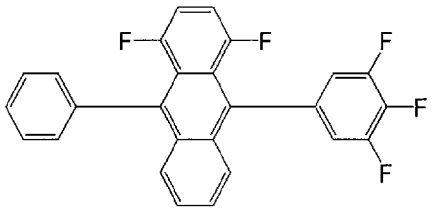

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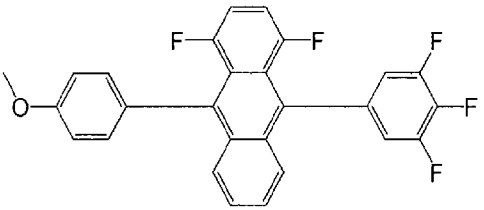

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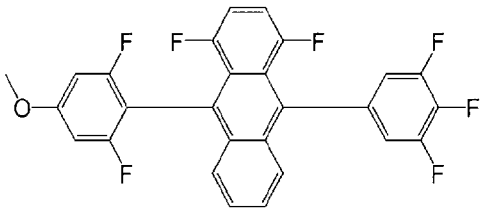

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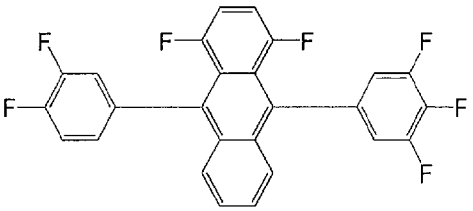

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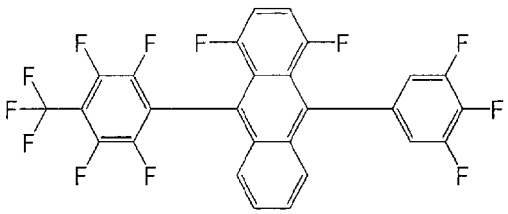

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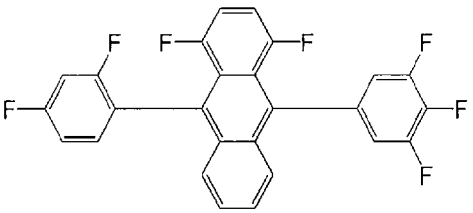

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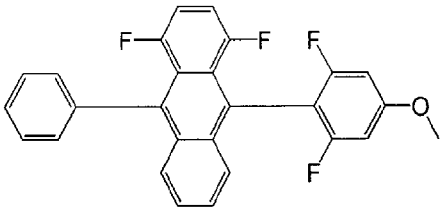

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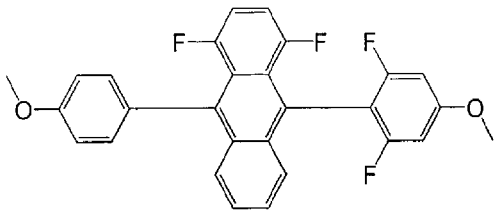

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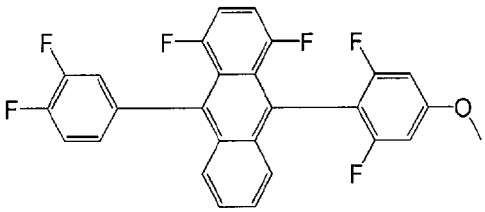

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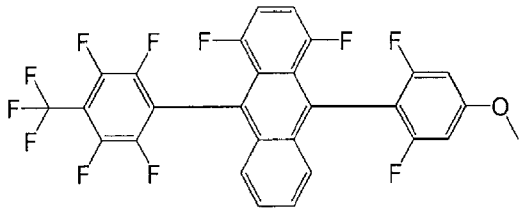

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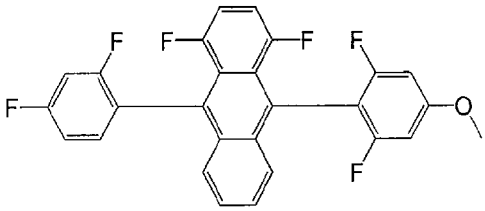

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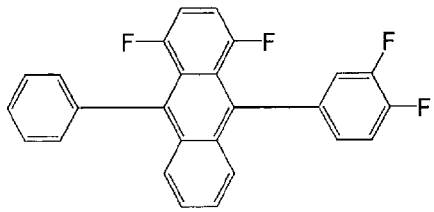

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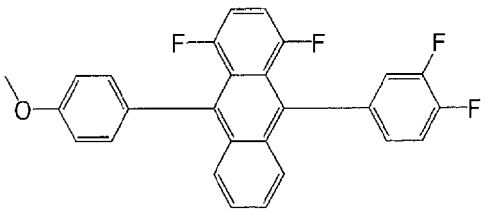

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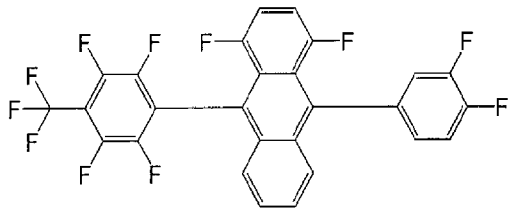

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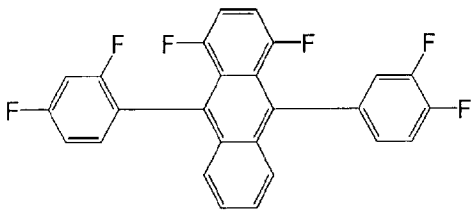

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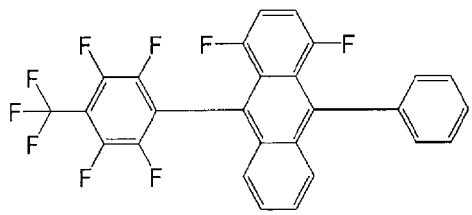

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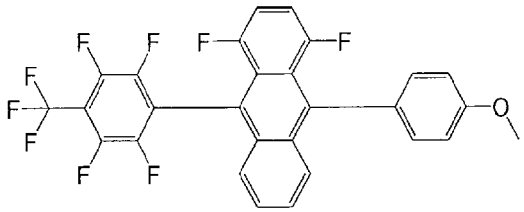

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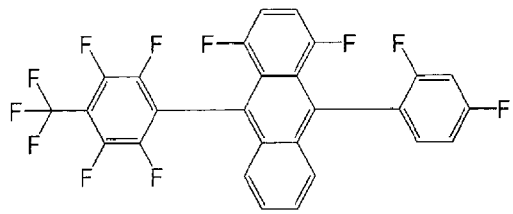

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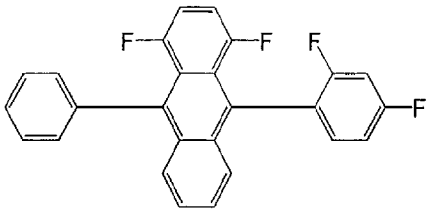

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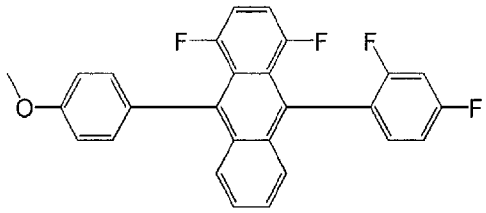

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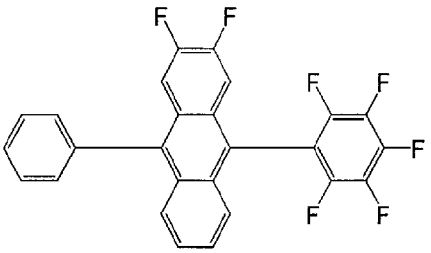

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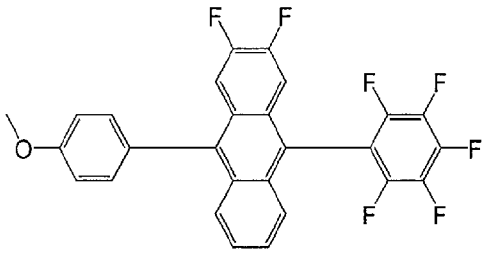

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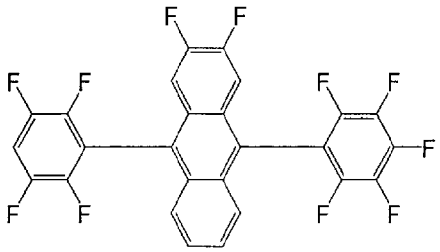

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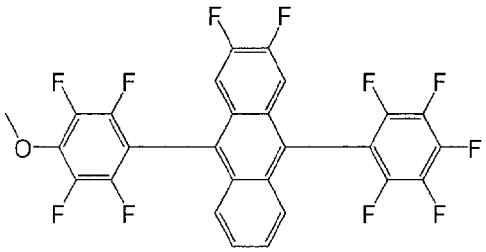

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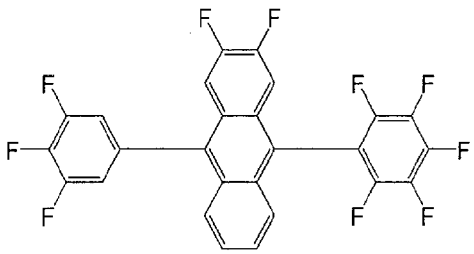

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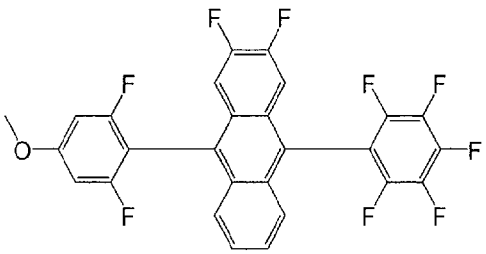

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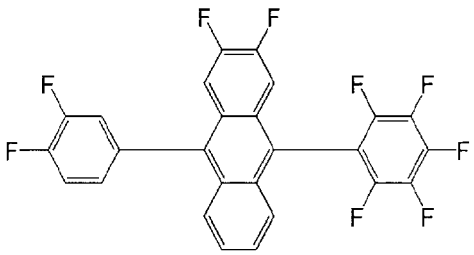

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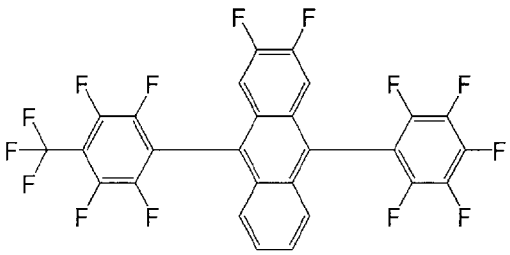

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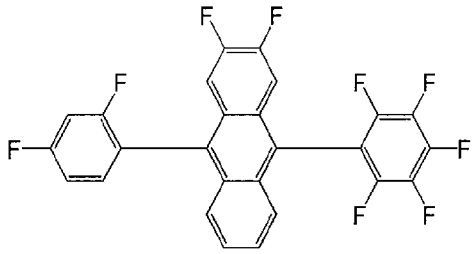

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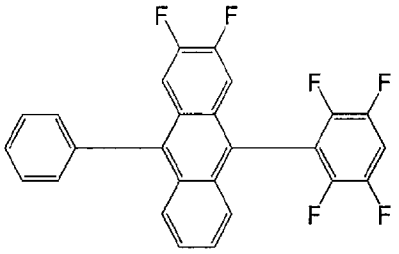

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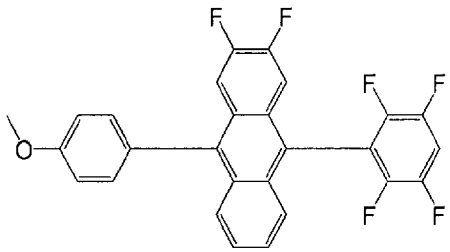

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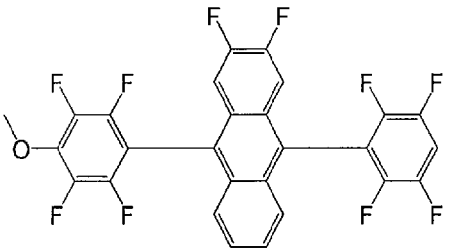

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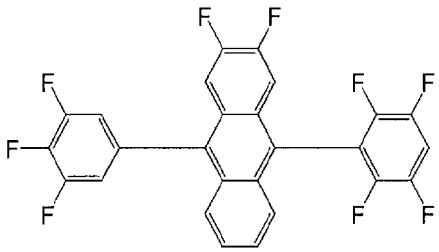

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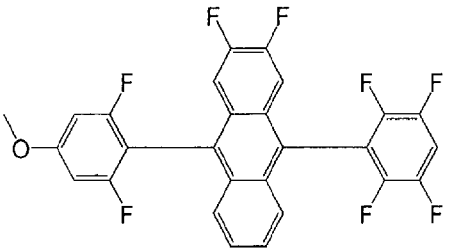

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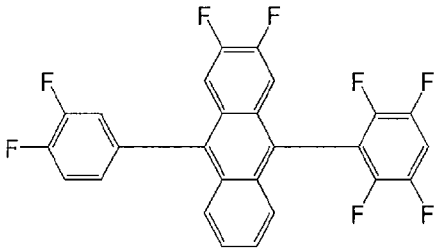

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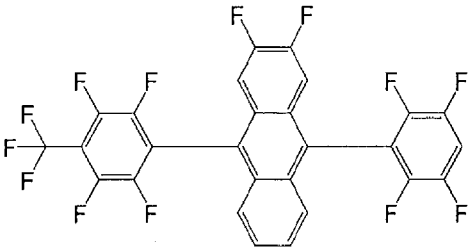

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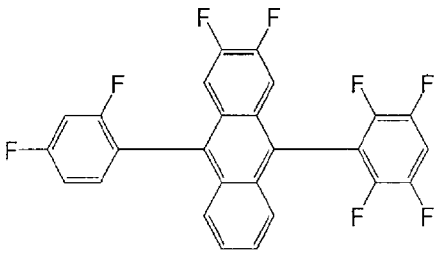

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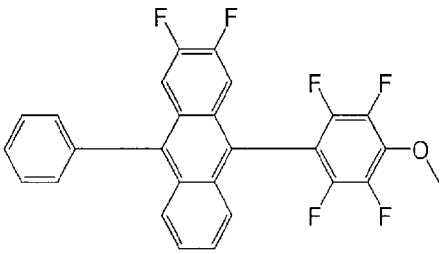

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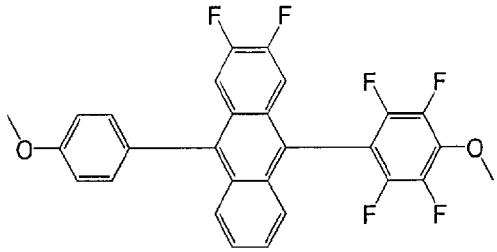

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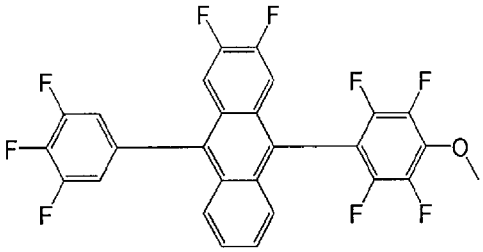

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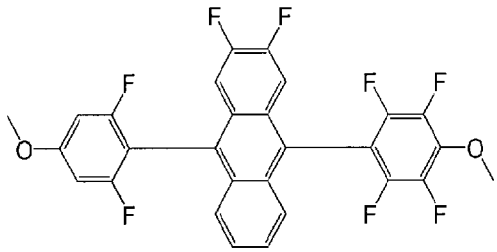

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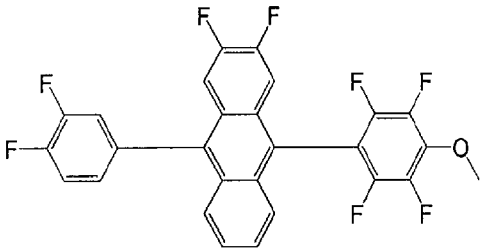

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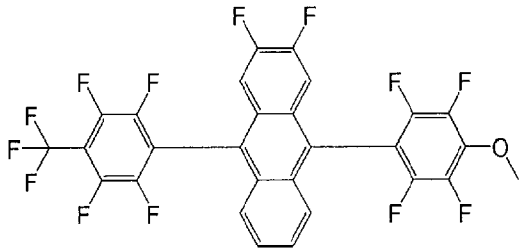

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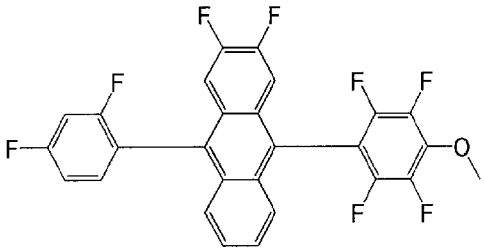

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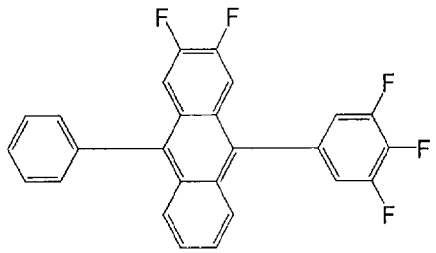

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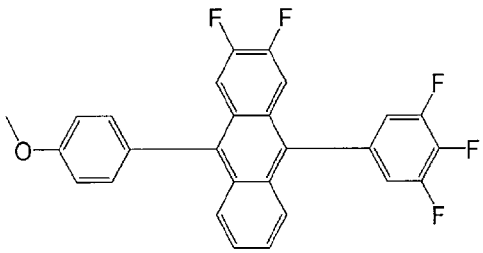

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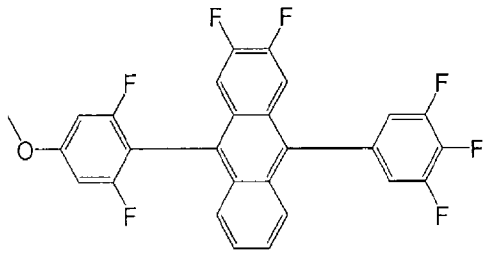

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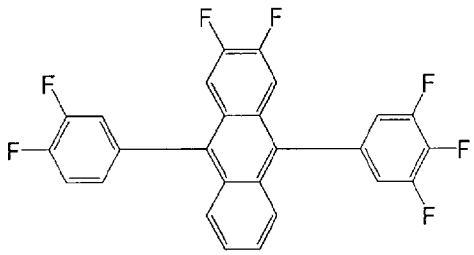

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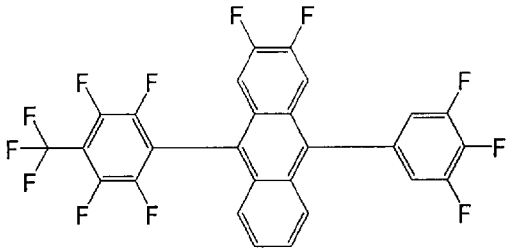

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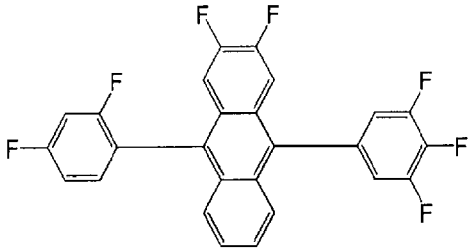

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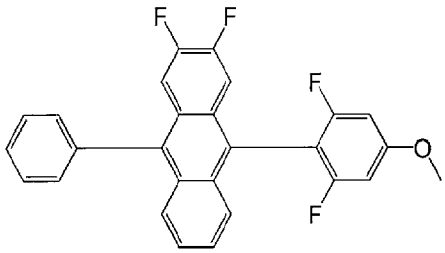

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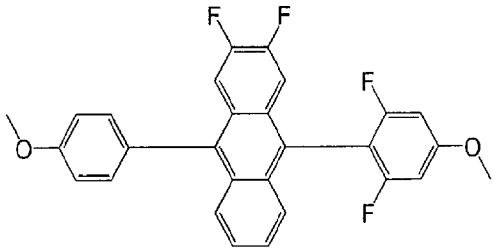

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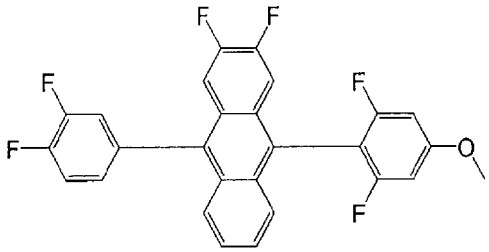

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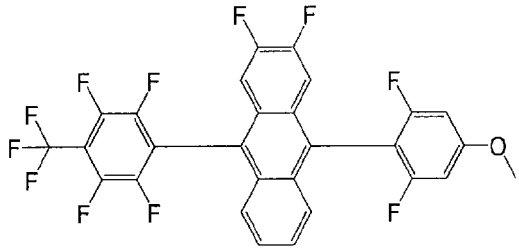

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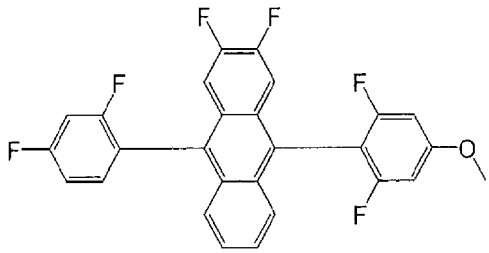

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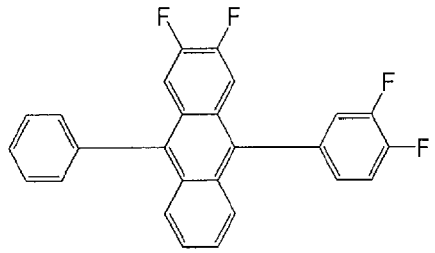

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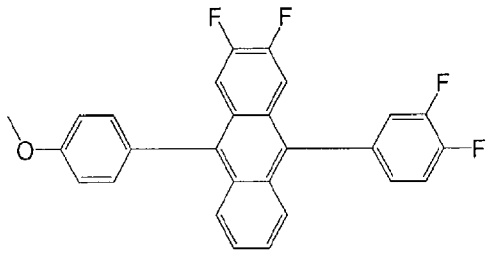

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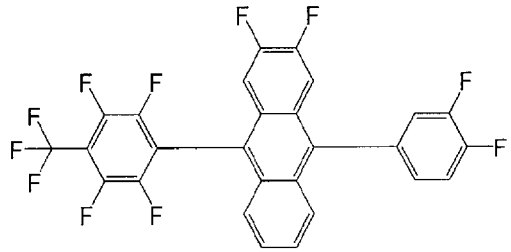

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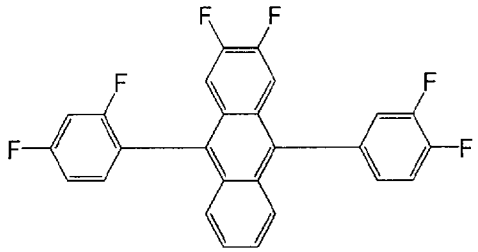

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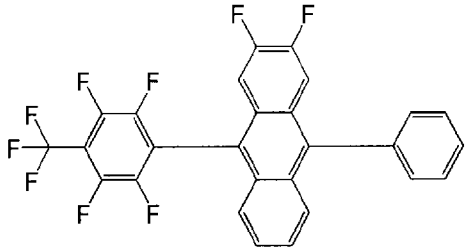

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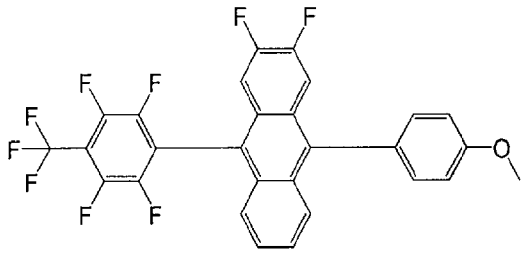

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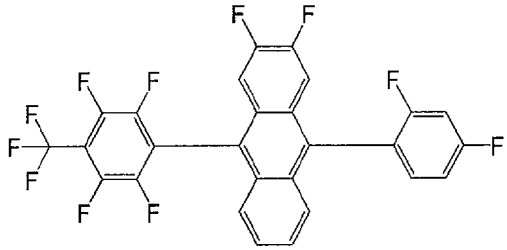

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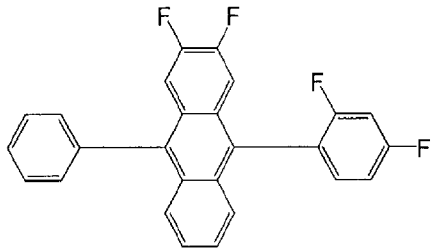

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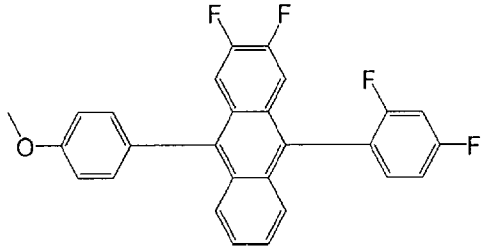

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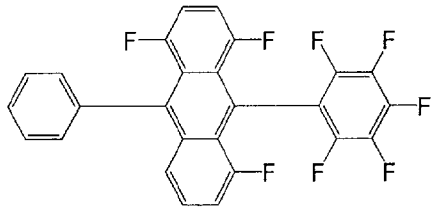

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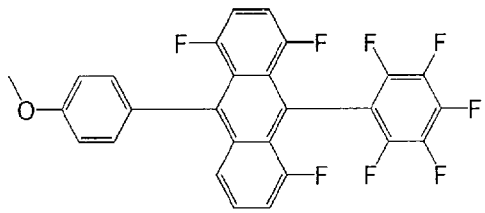

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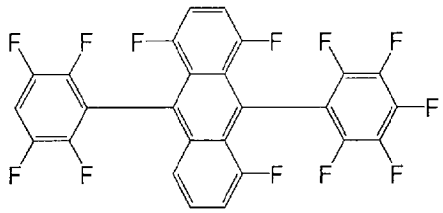

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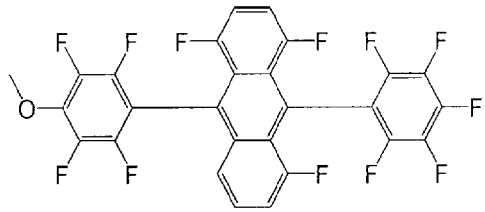

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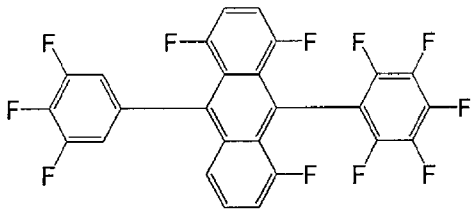

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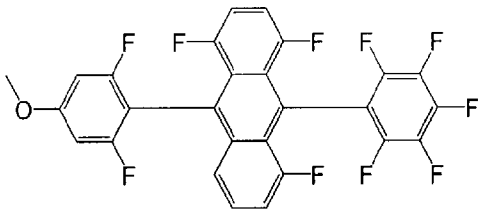

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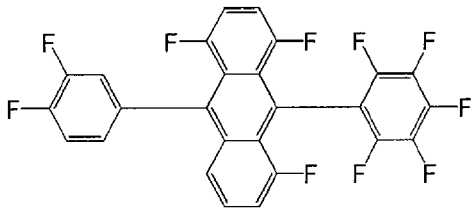

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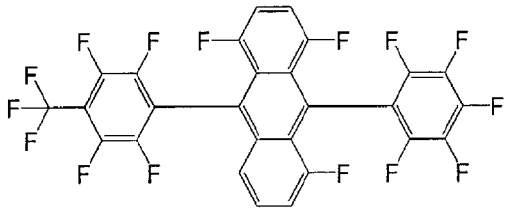

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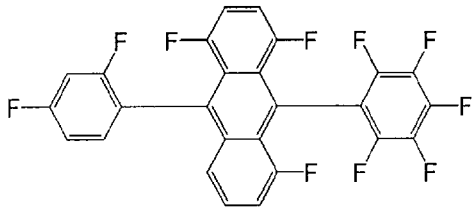

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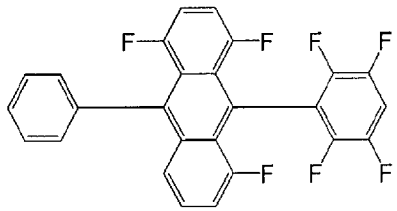

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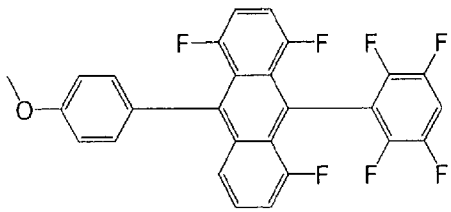

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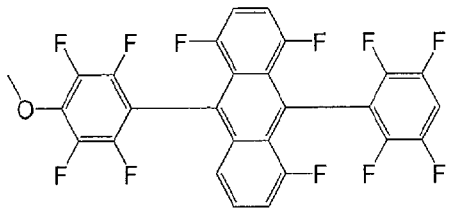

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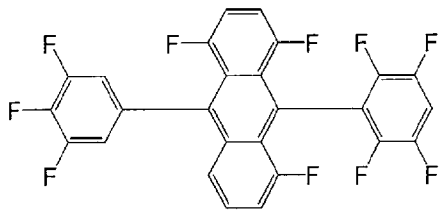

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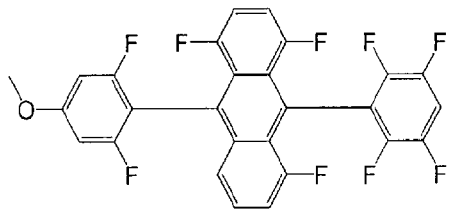

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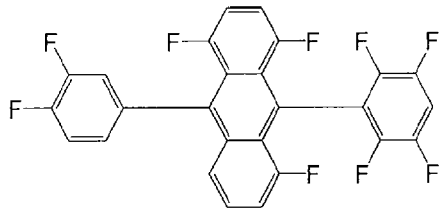

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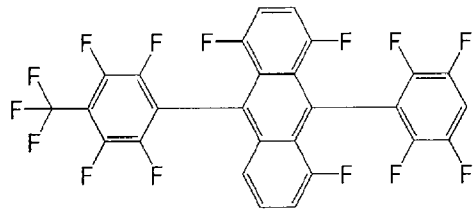

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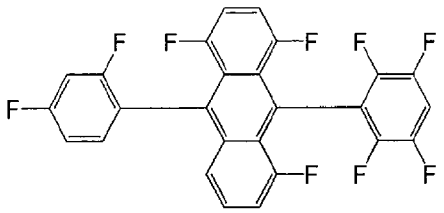

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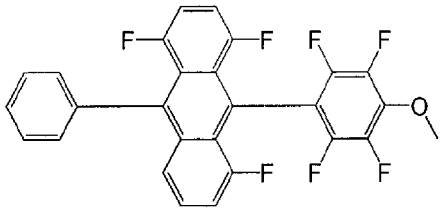

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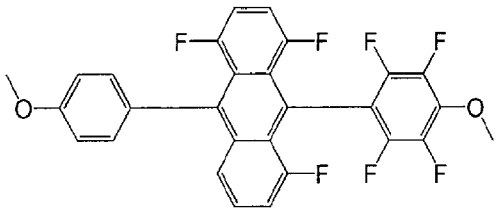

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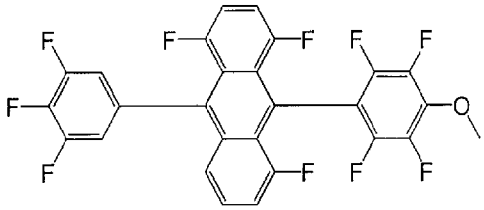

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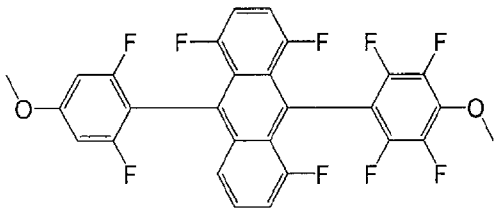

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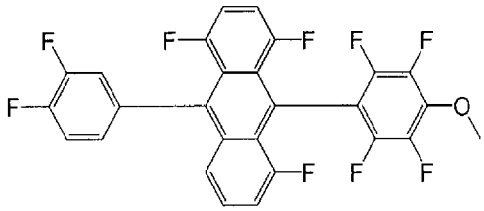

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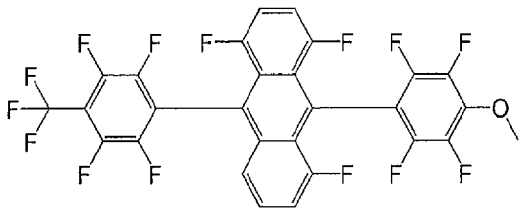

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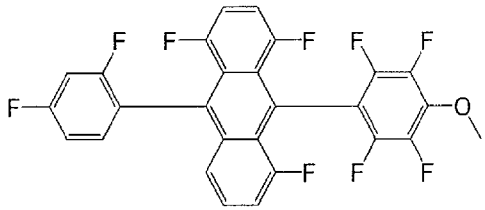

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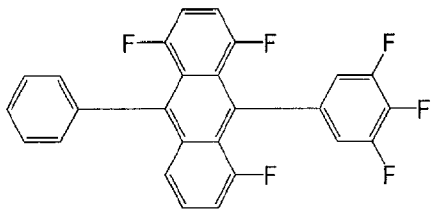

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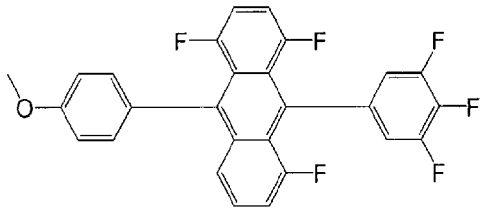

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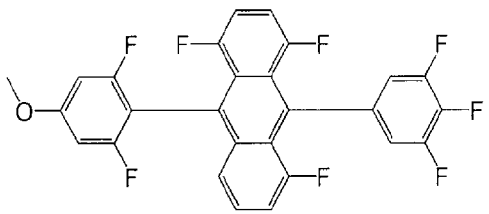

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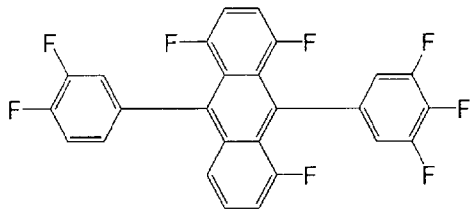

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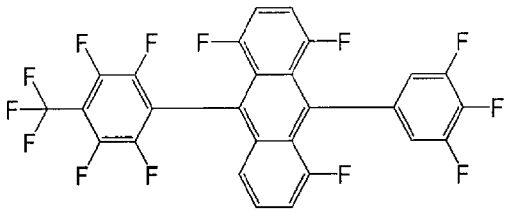

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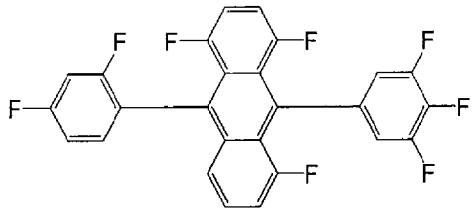

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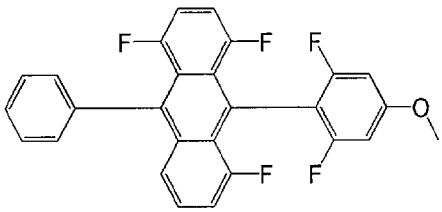

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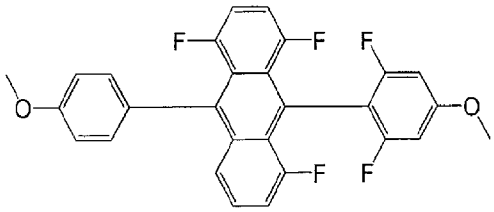

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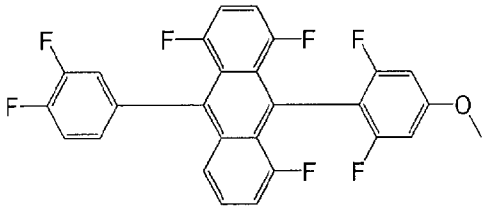

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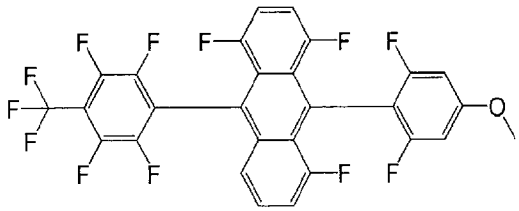

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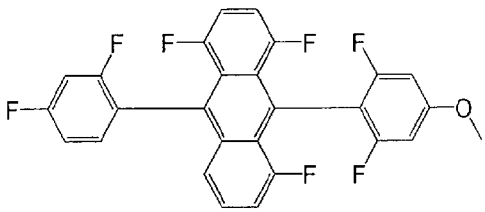

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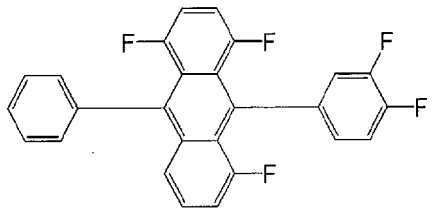

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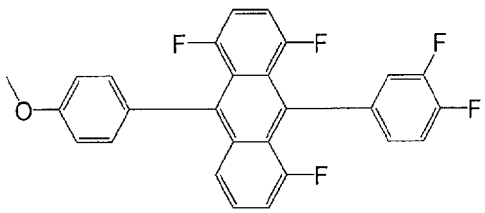

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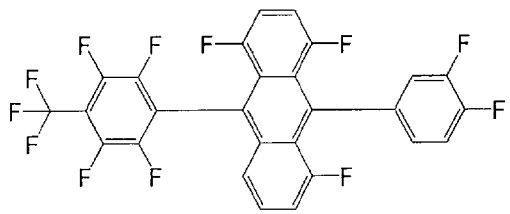

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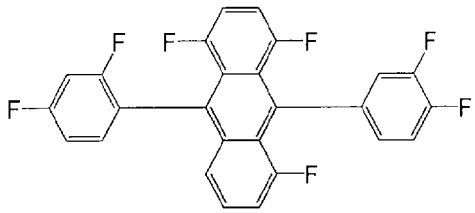

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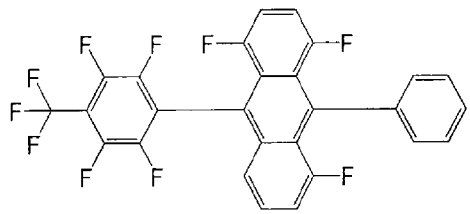

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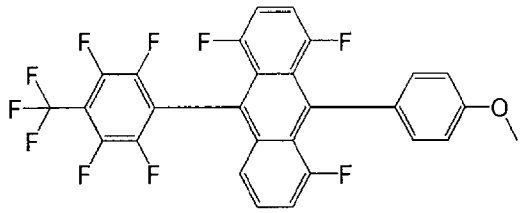

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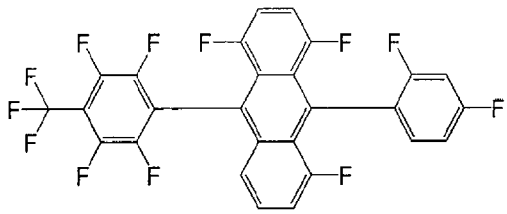

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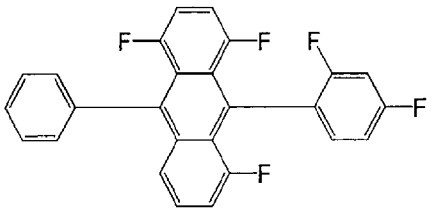

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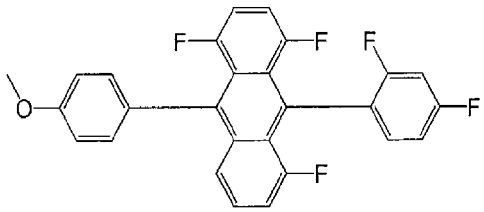

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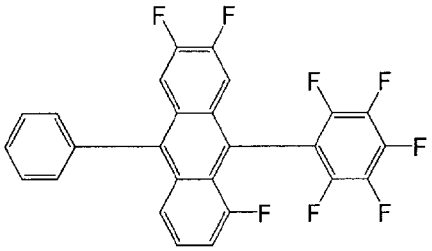

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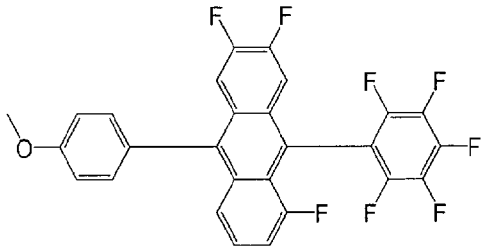

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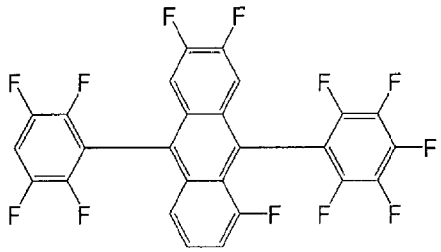

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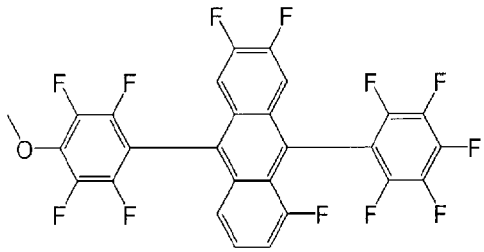

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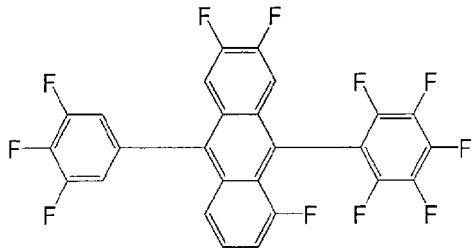

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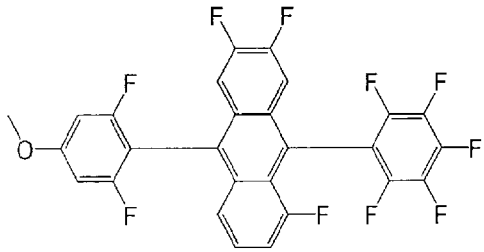

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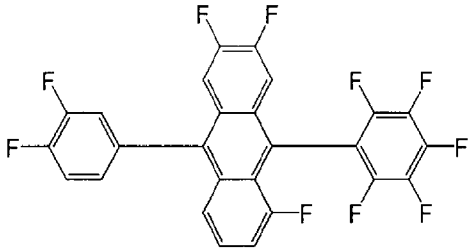

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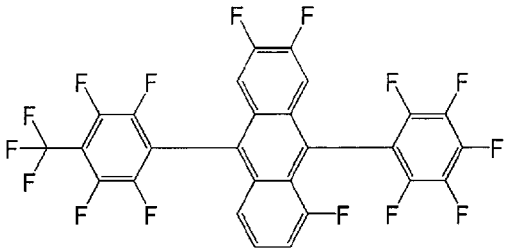

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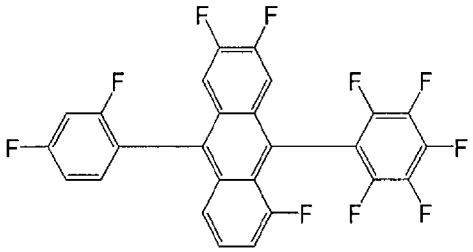

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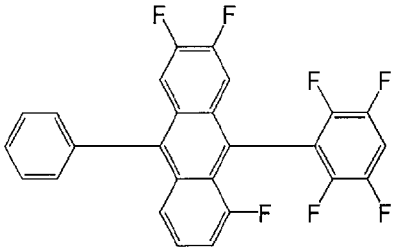

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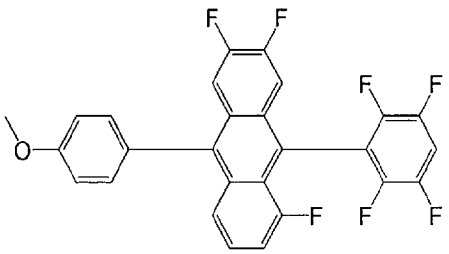

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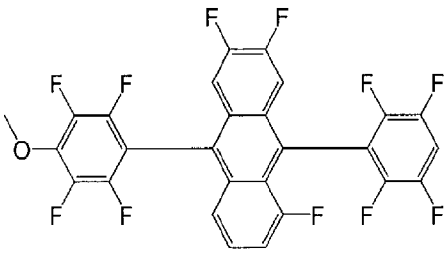

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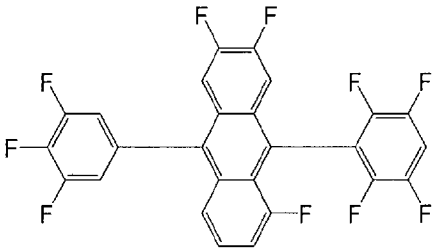

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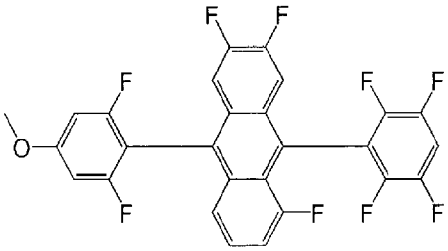

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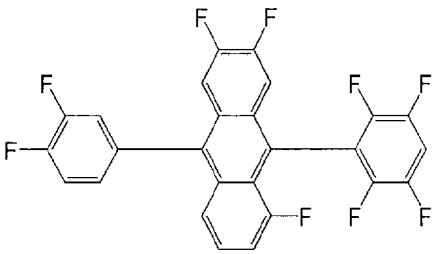

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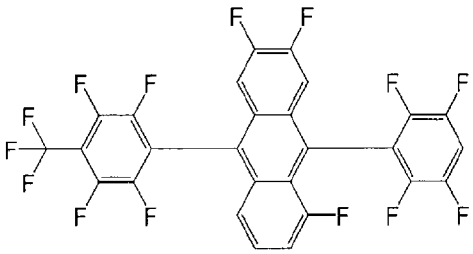

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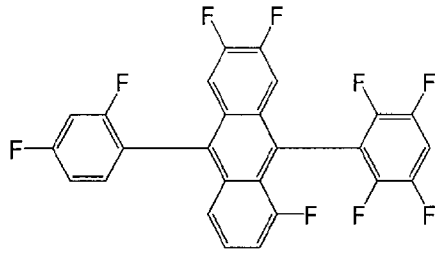

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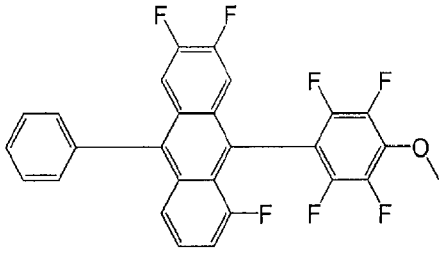

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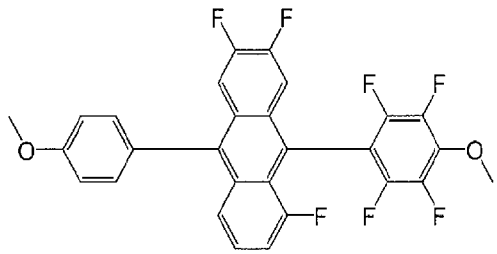

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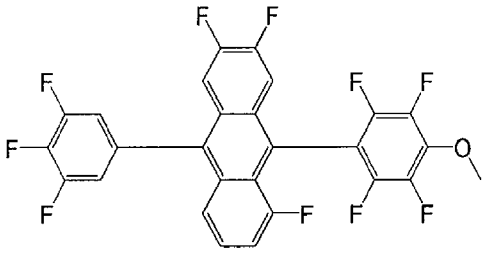

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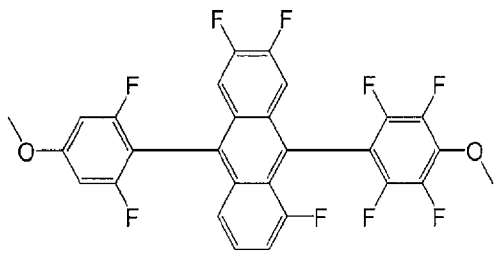

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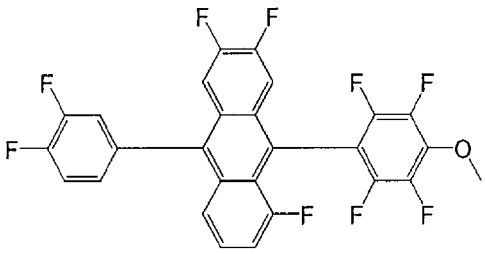

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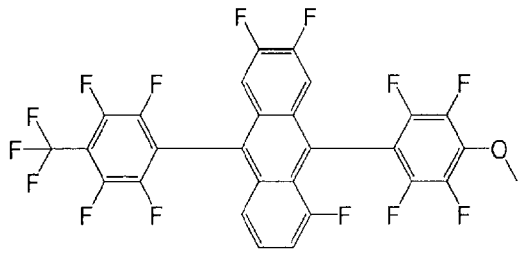

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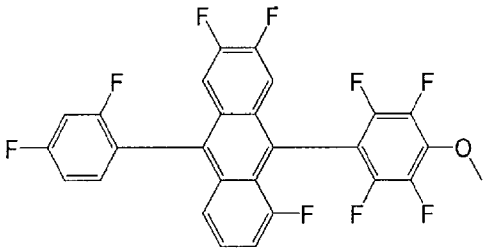

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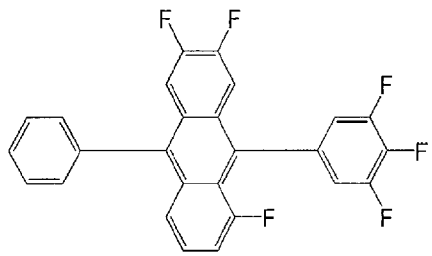

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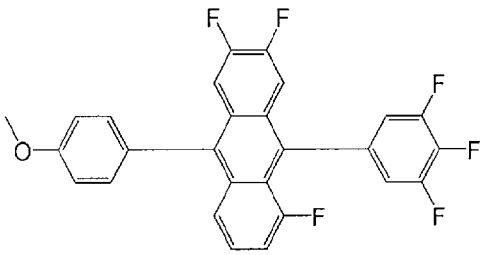

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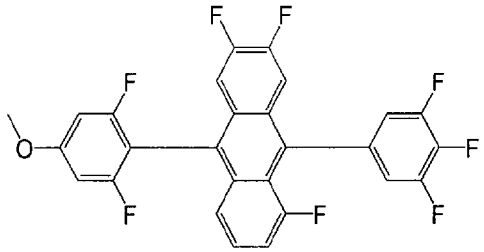

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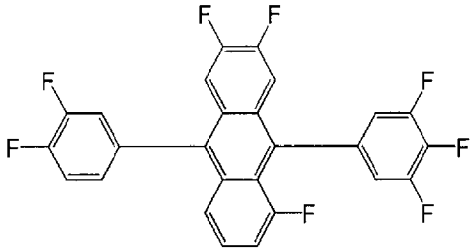

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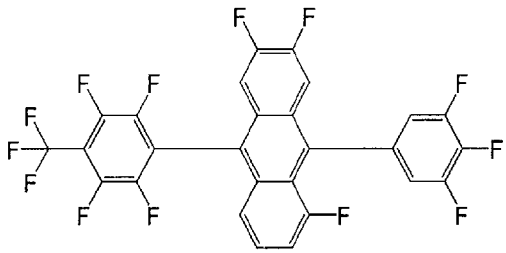

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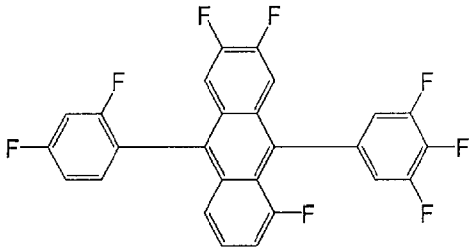

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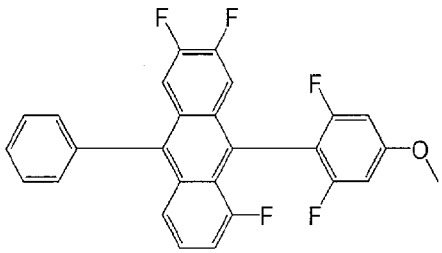

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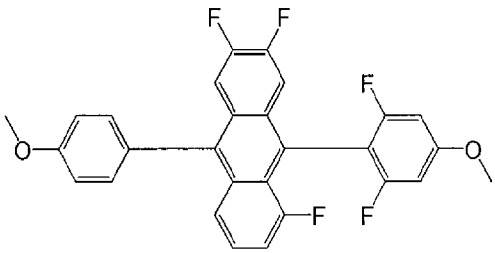

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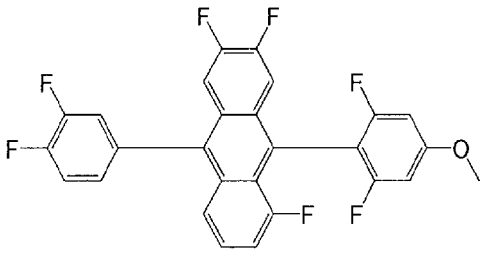

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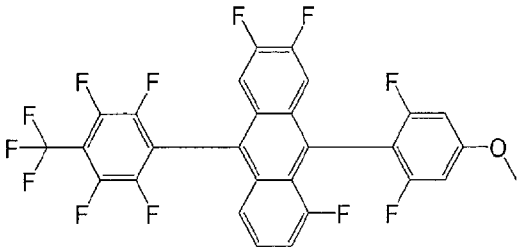

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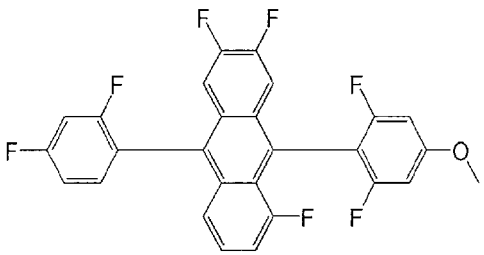

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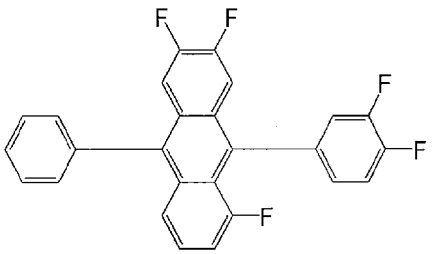

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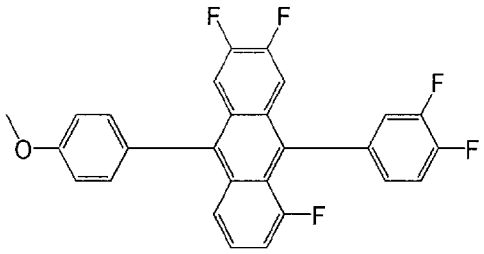

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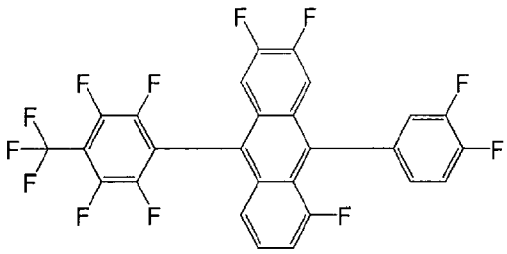

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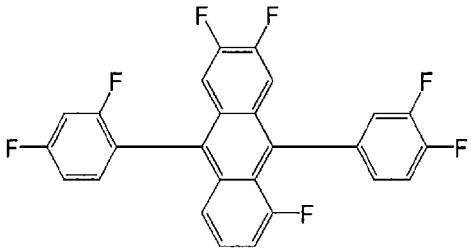

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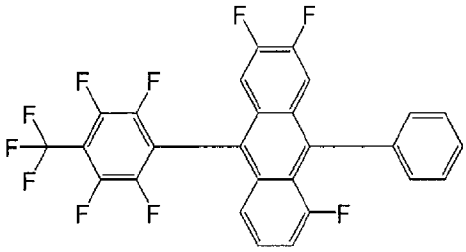
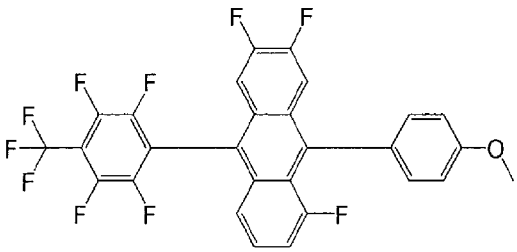


Figure 392



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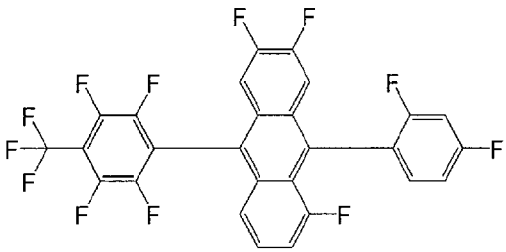

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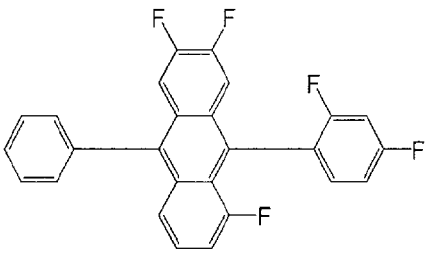

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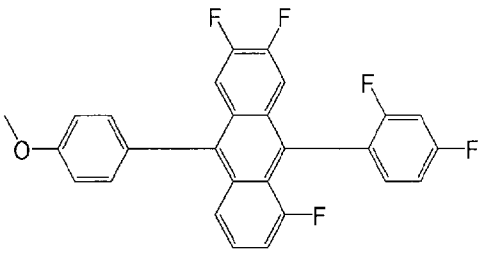

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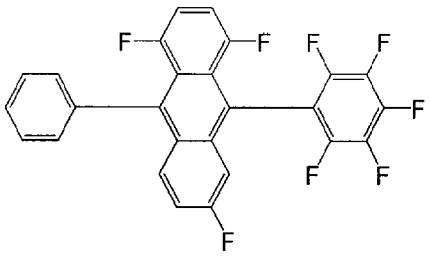

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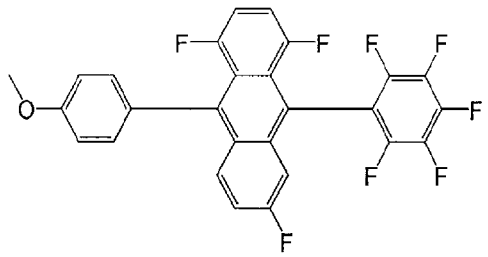

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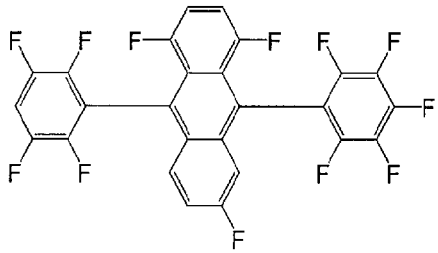

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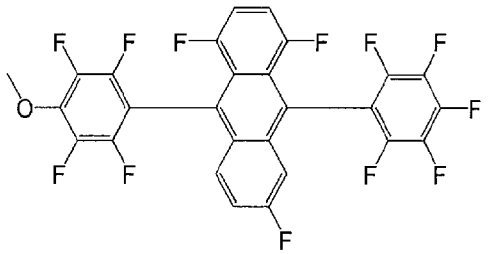

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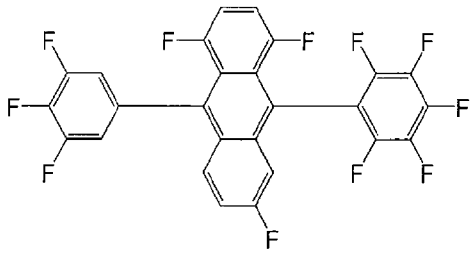

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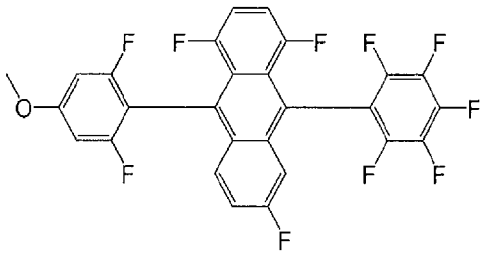

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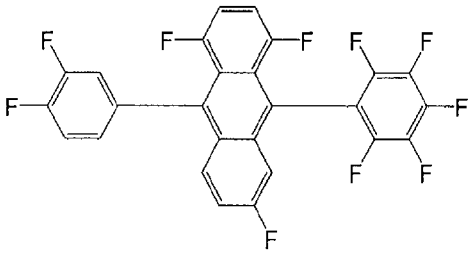

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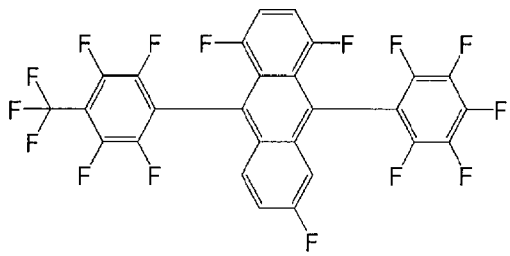

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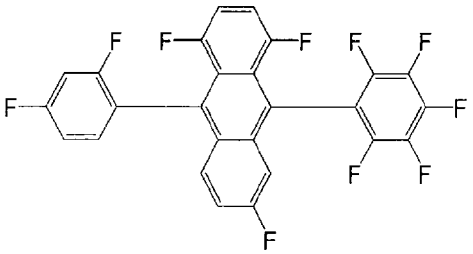

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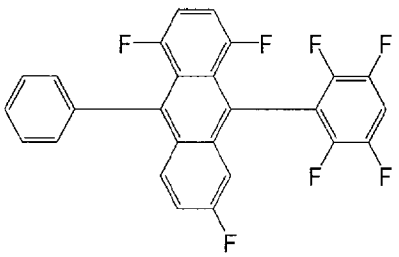

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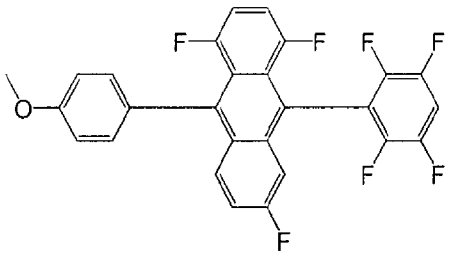

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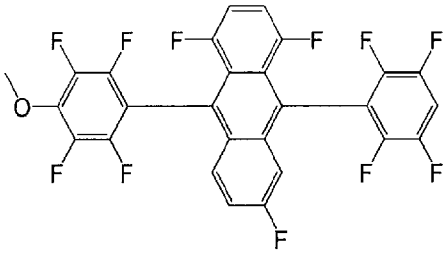

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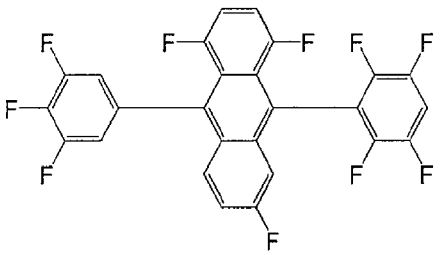

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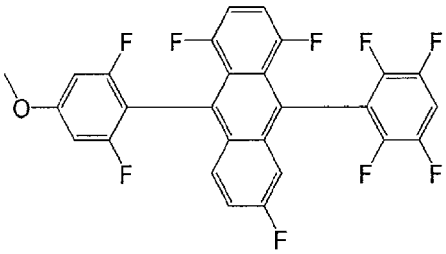

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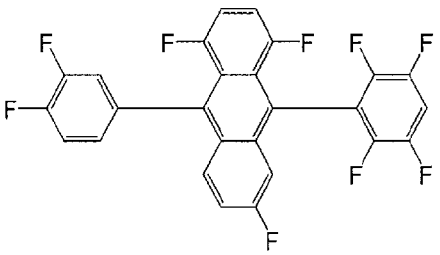

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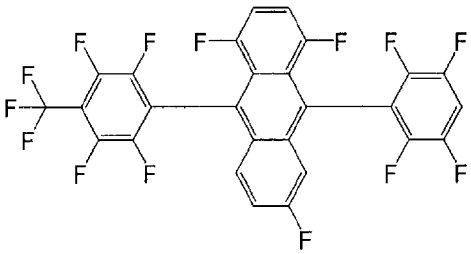

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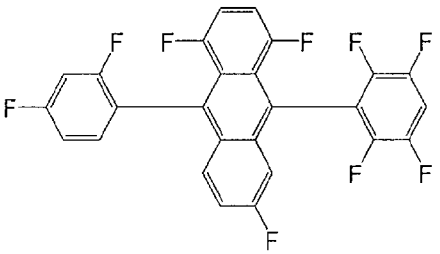

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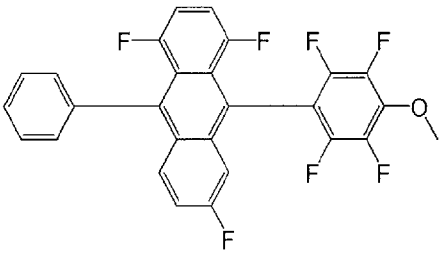

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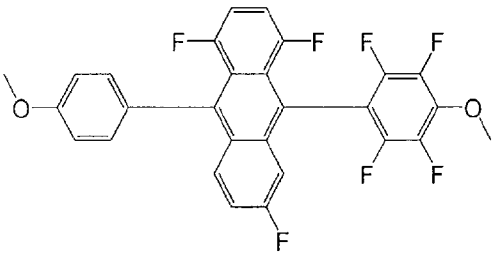

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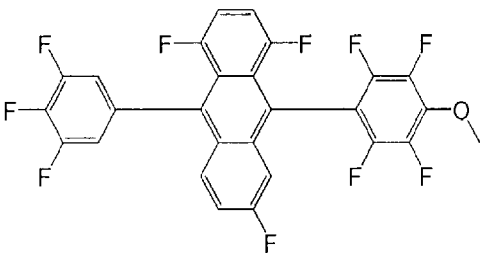

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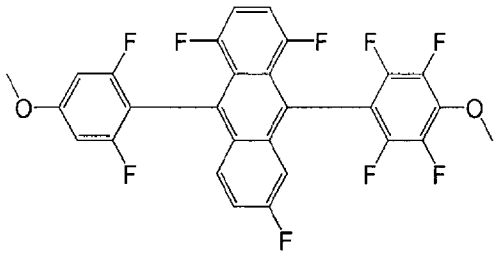

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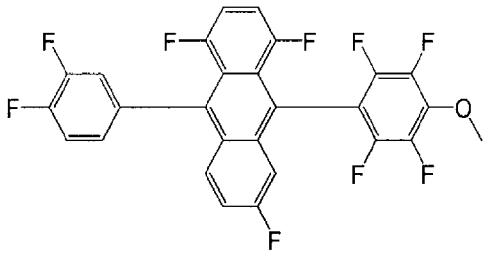

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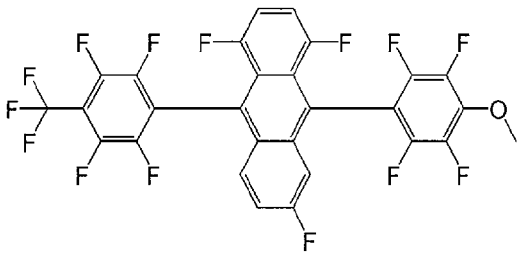

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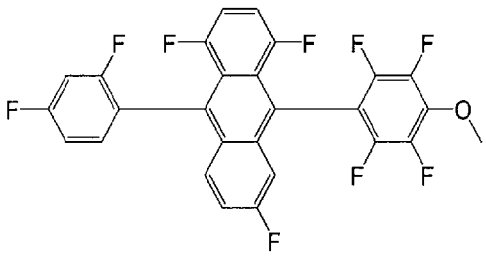

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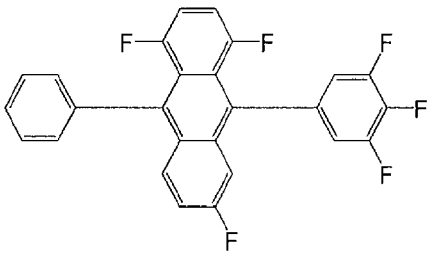

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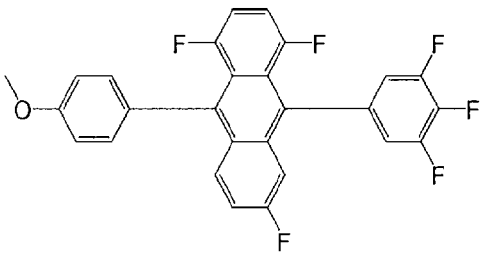

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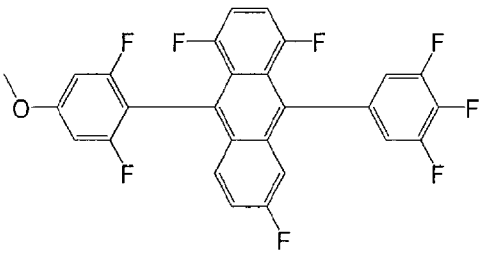

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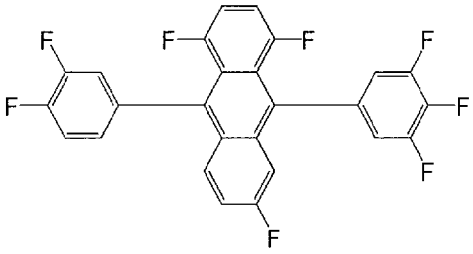

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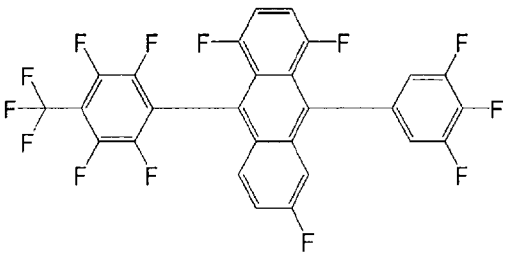

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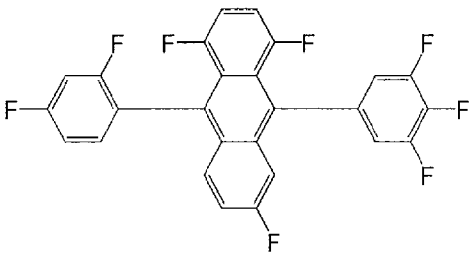

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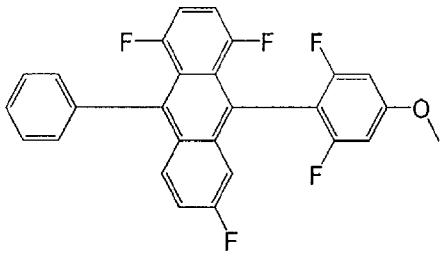

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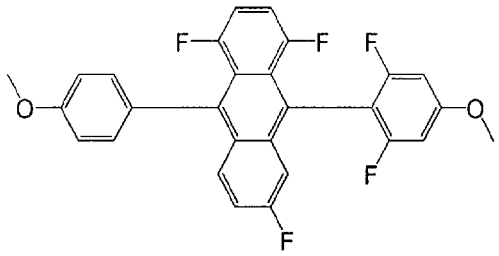

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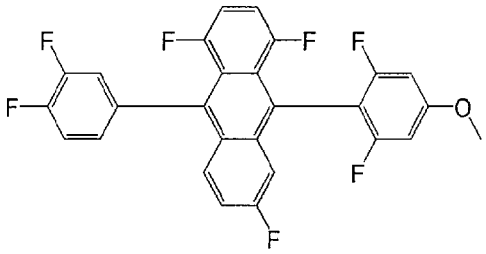

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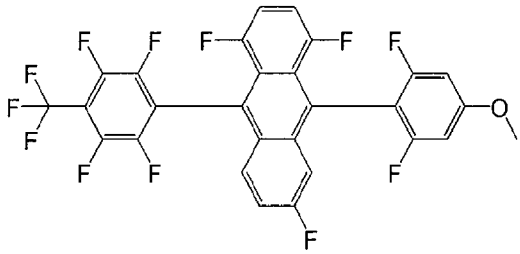

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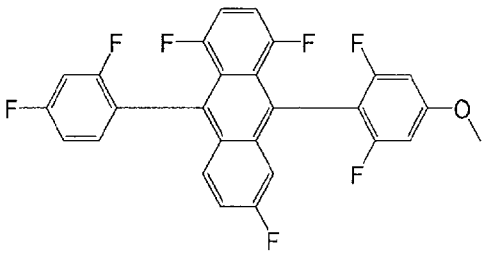

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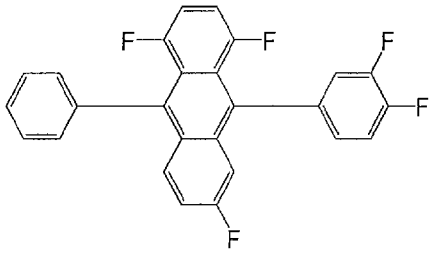

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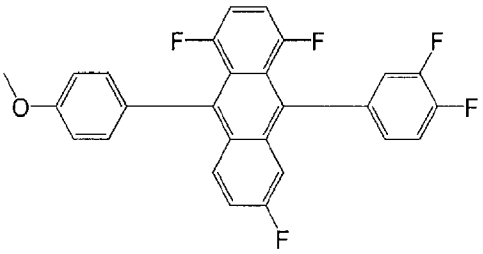

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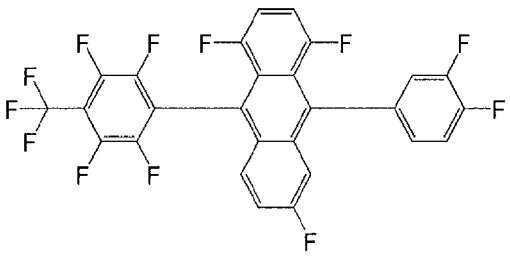

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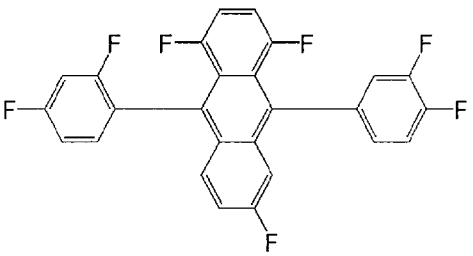

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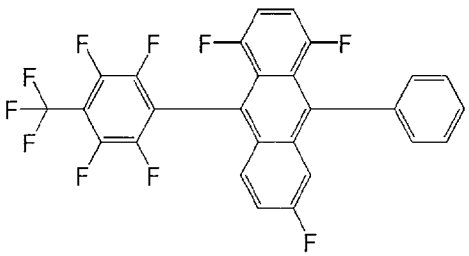

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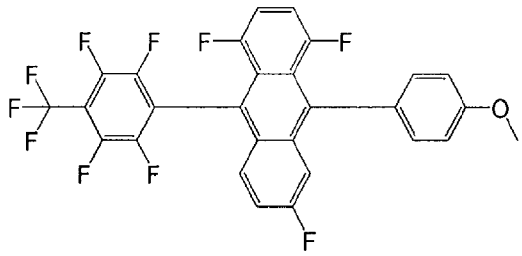

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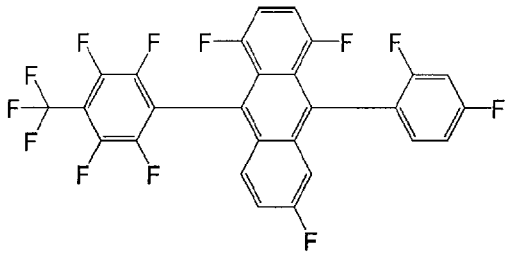

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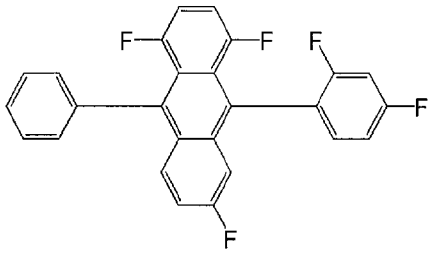

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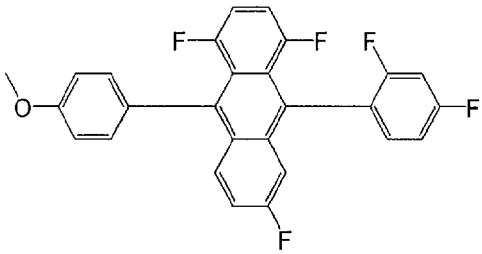

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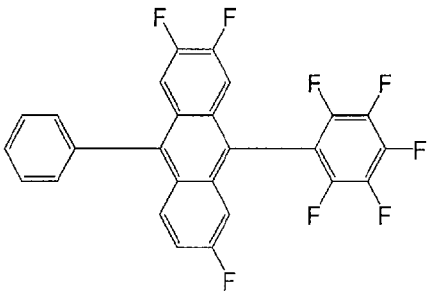

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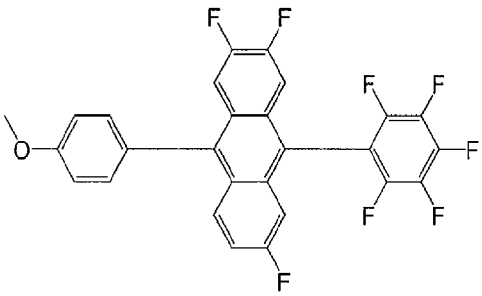

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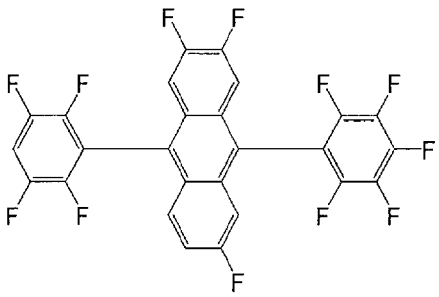

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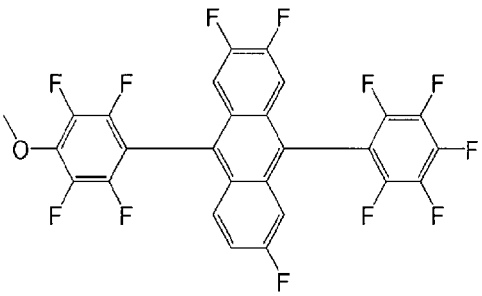

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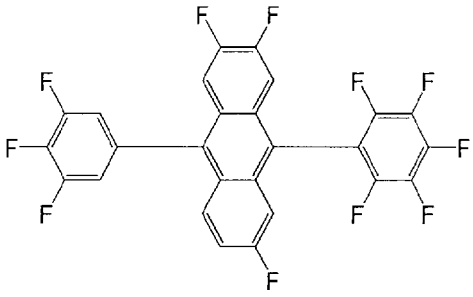

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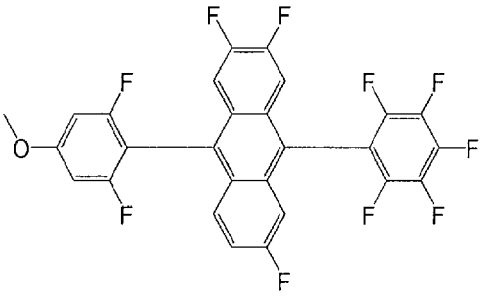

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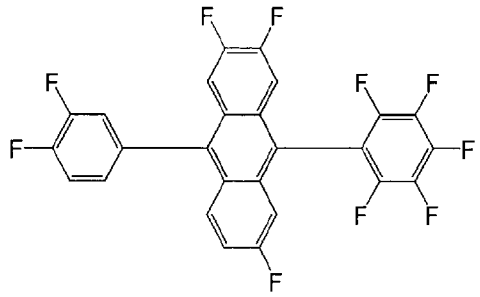

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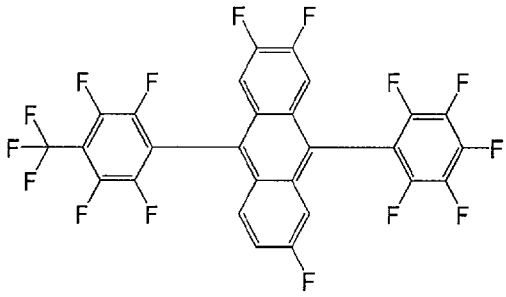

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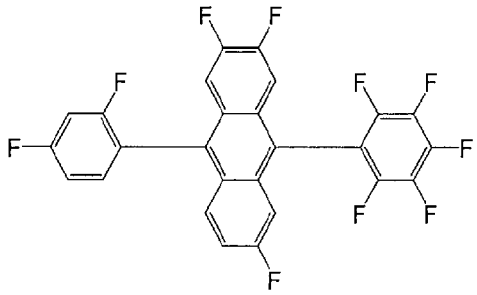

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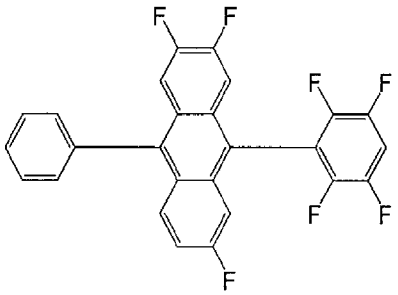

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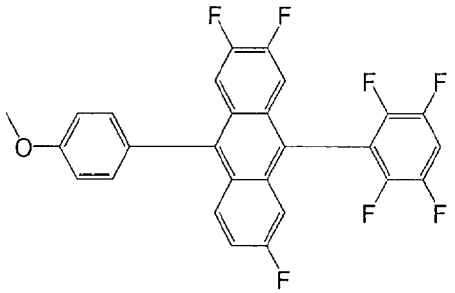

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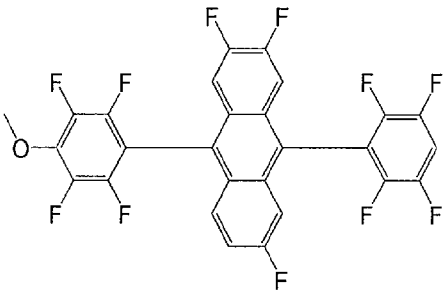
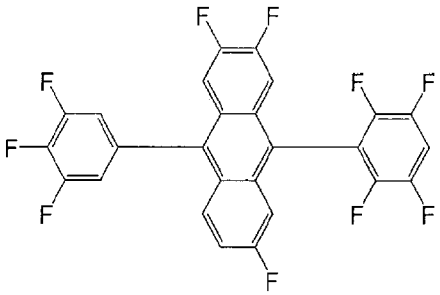


Figure 452



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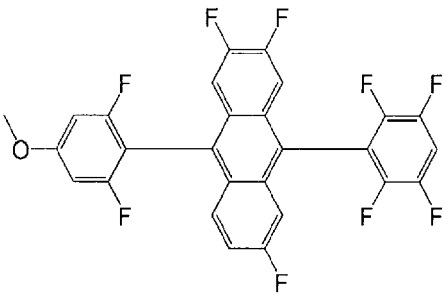

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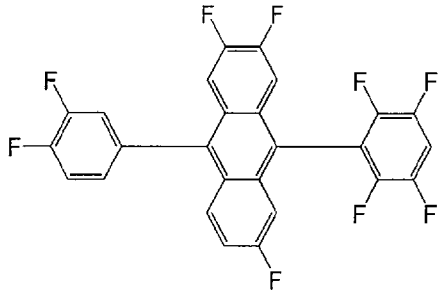

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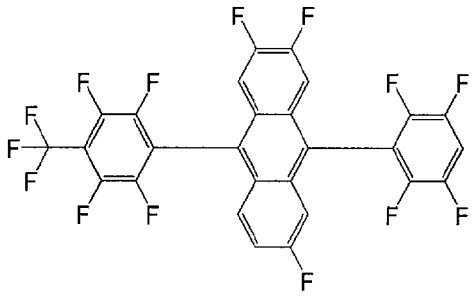

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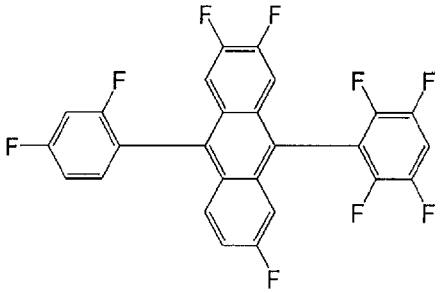

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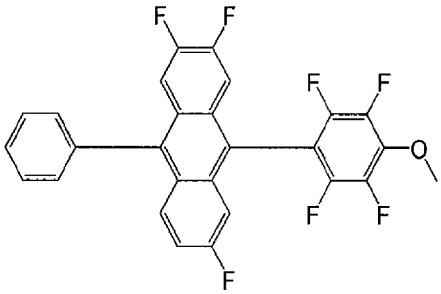

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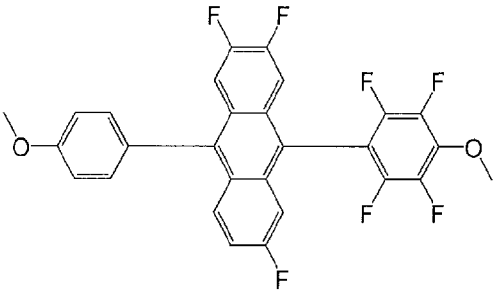

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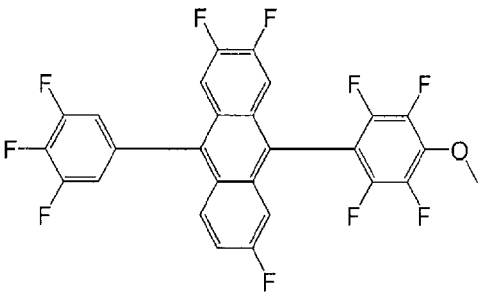

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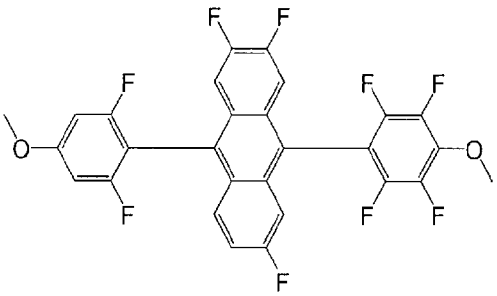

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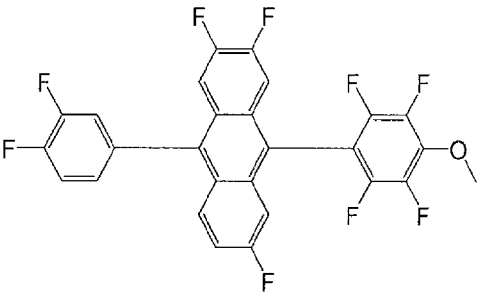

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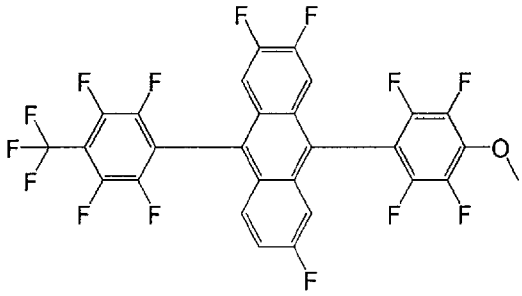

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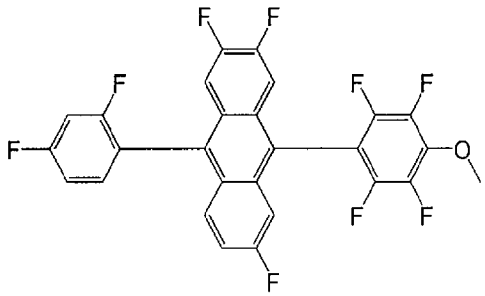

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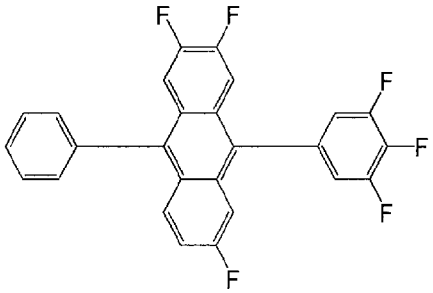

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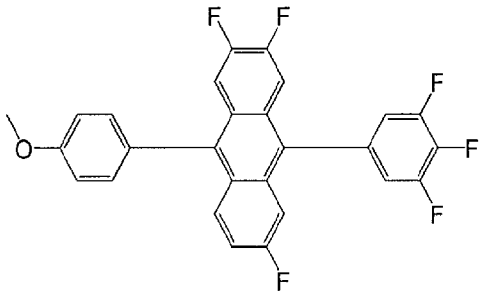

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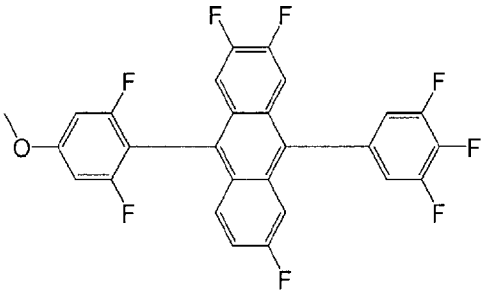

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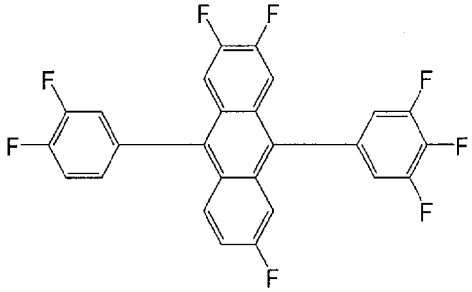

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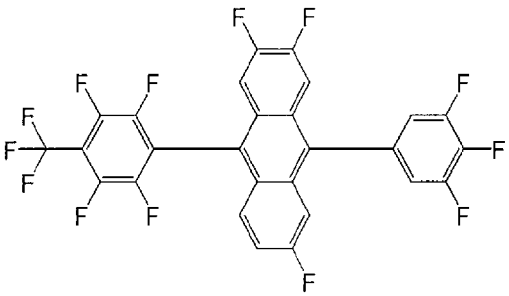

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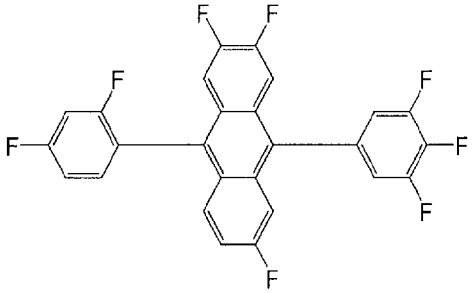

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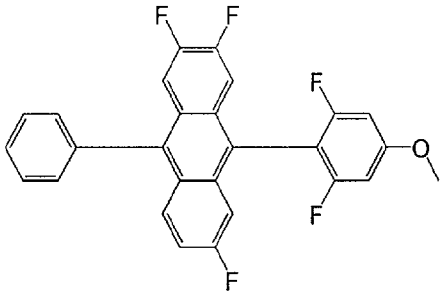

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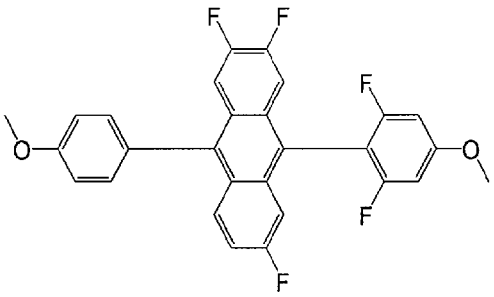

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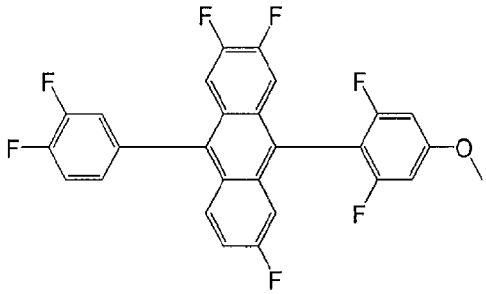

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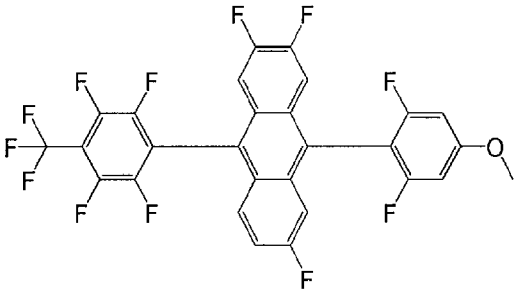

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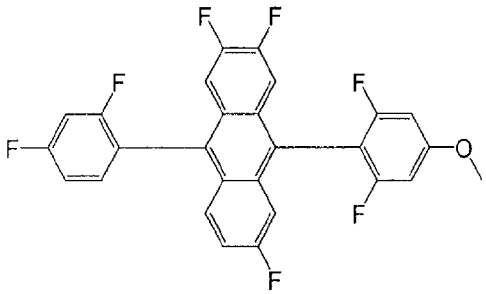

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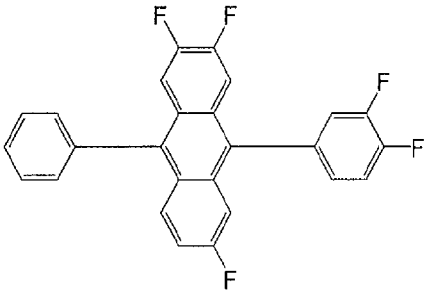

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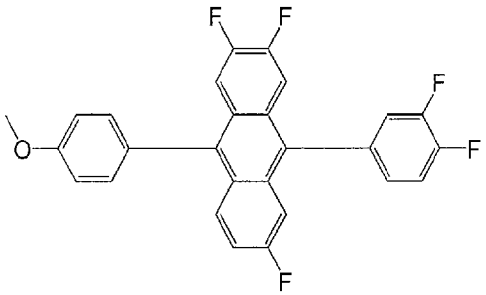

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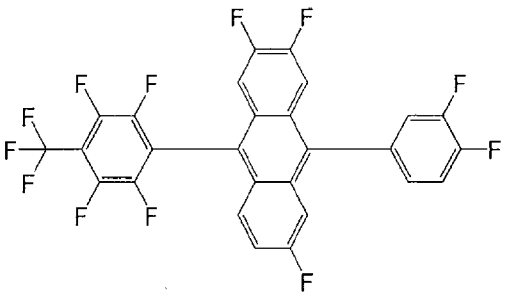

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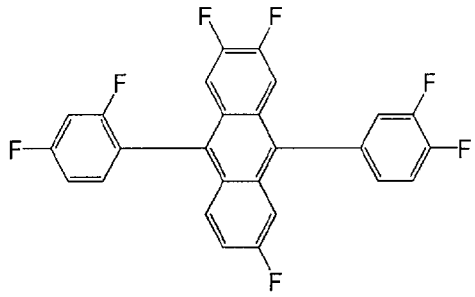

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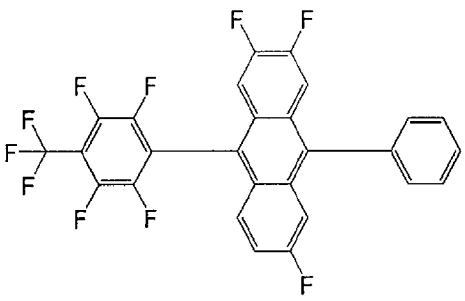

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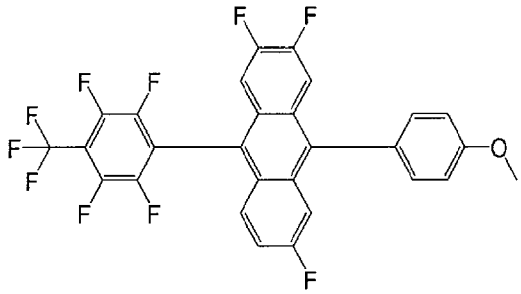

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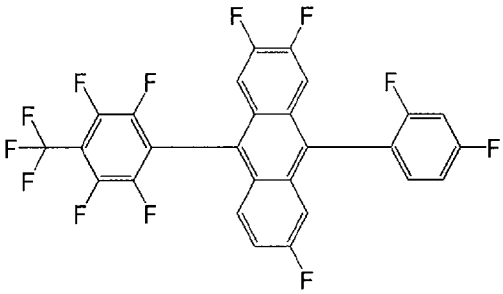

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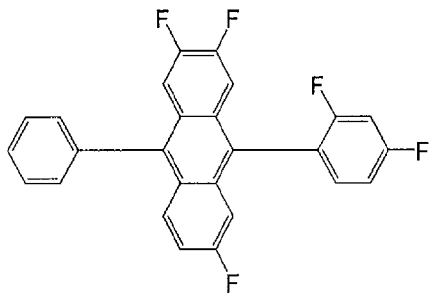

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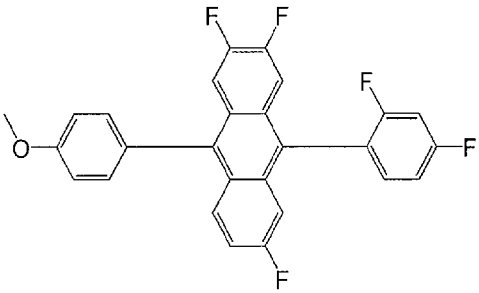

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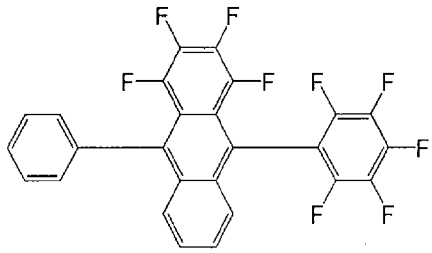

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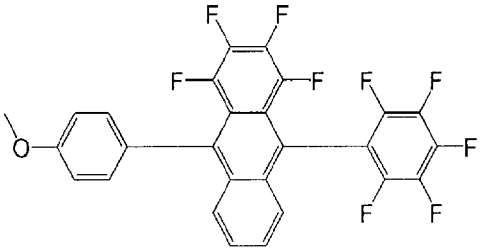

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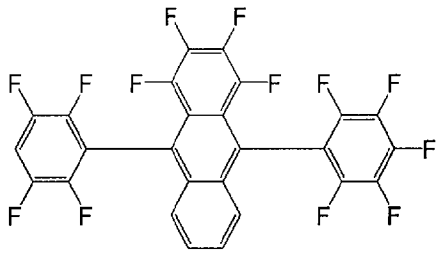

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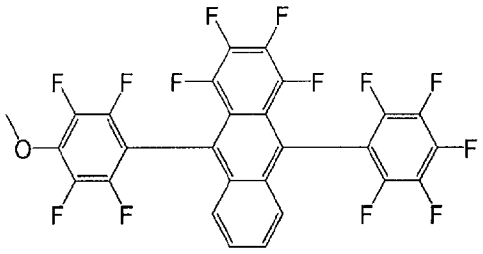

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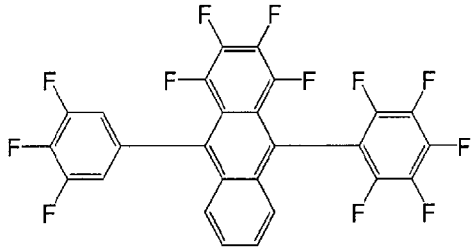

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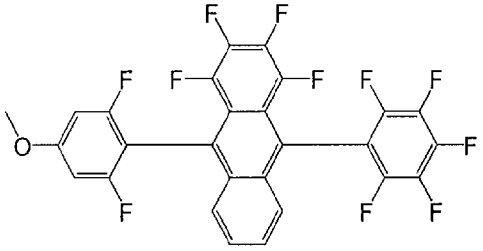

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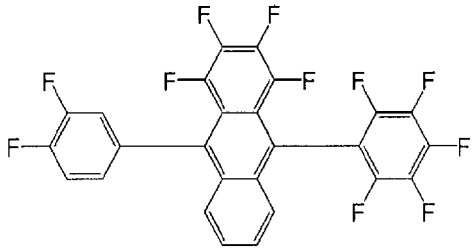

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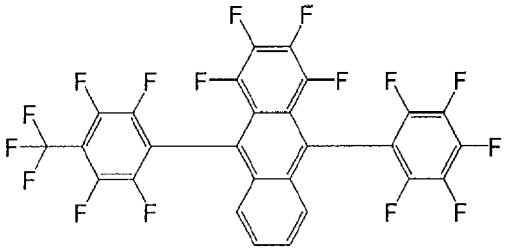

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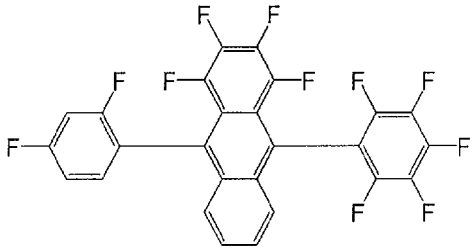

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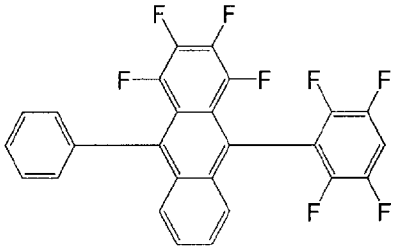

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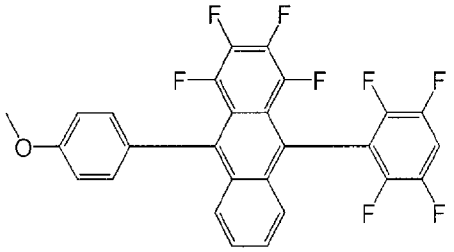

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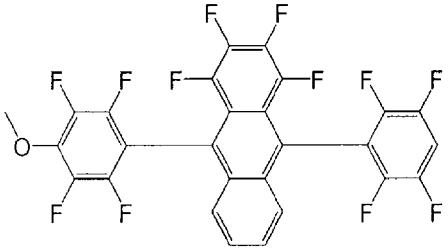

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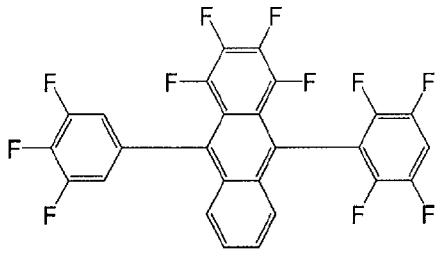

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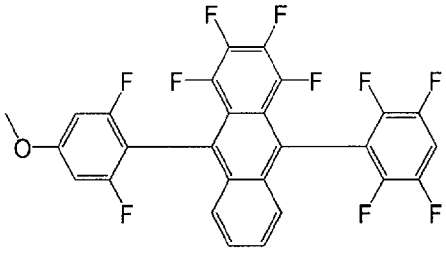

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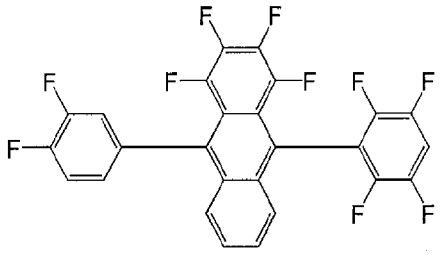

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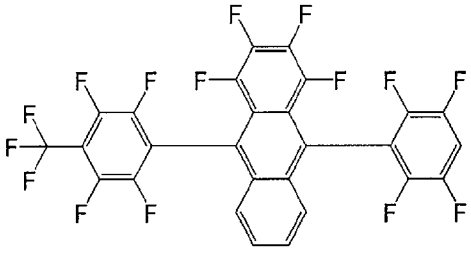

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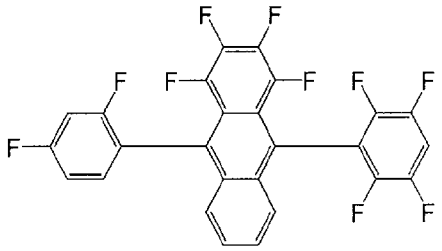

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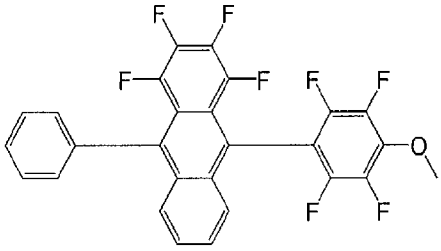

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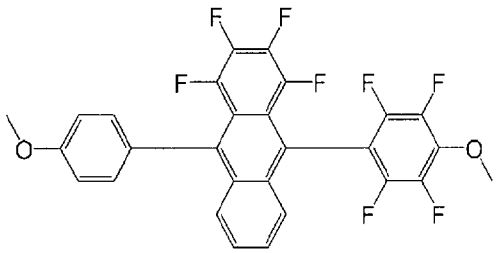

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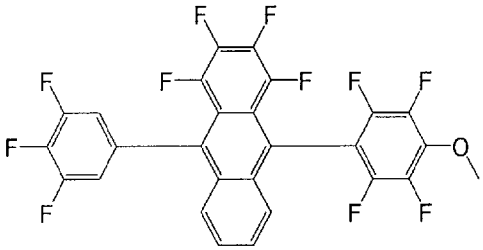

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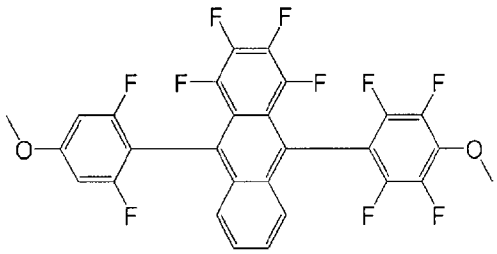

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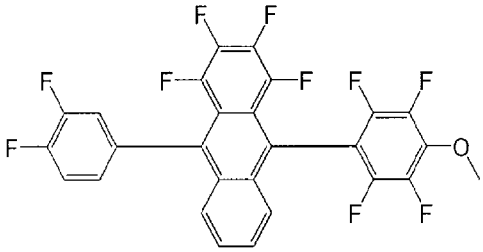

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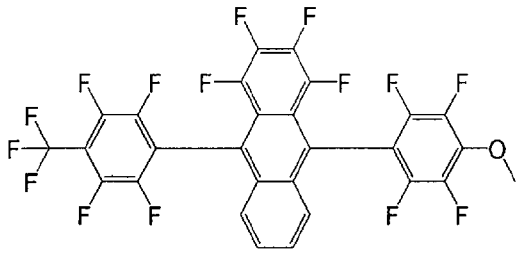

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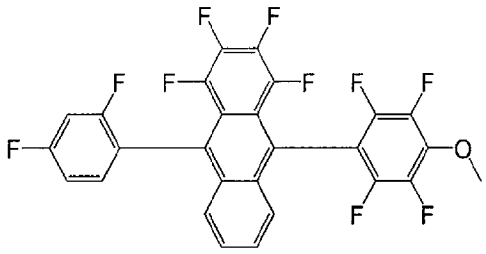

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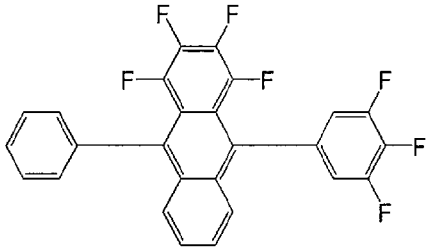

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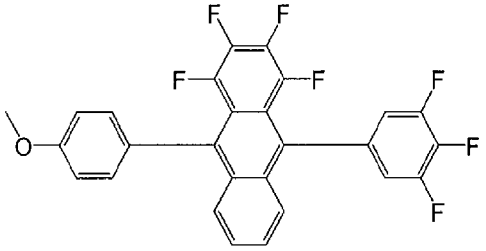

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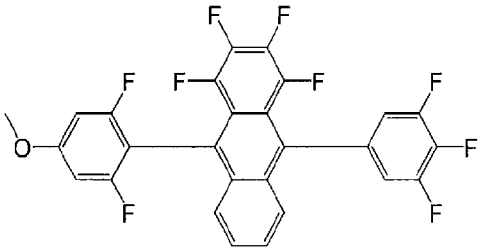

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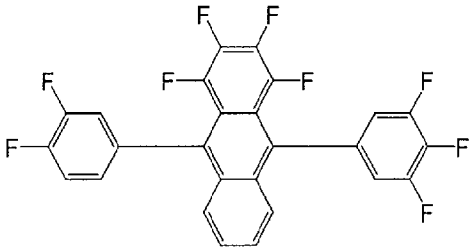

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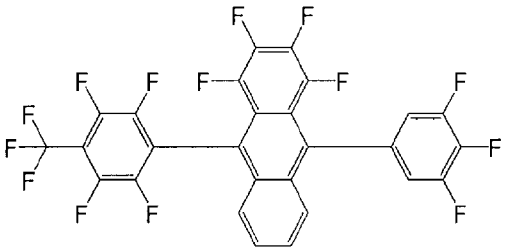

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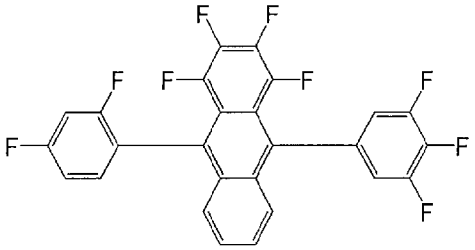

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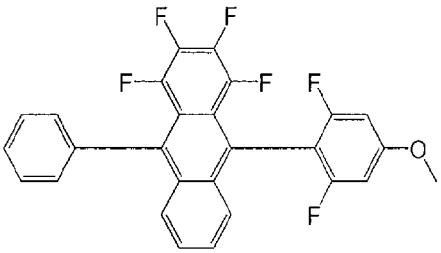

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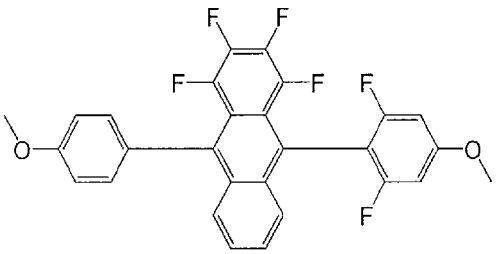

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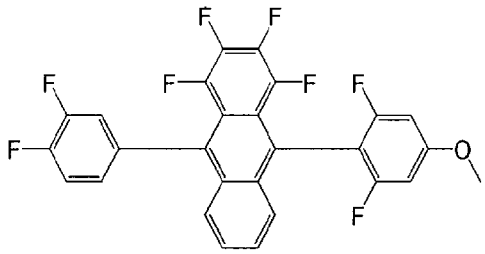

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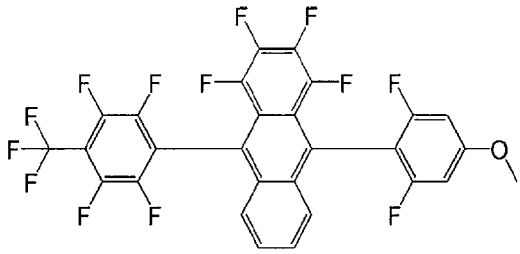

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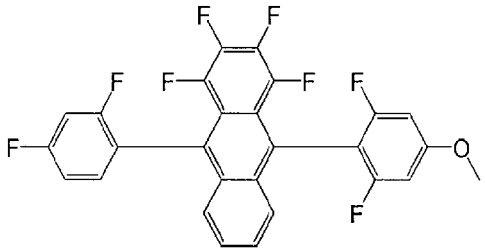

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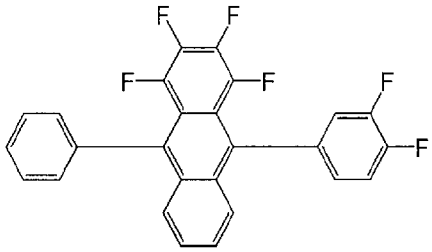

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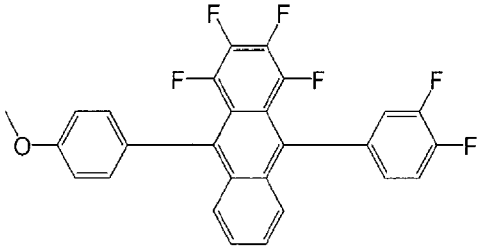

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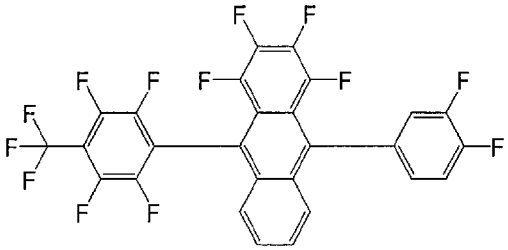

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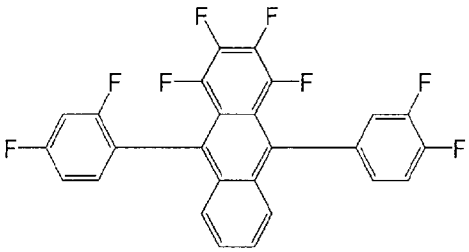

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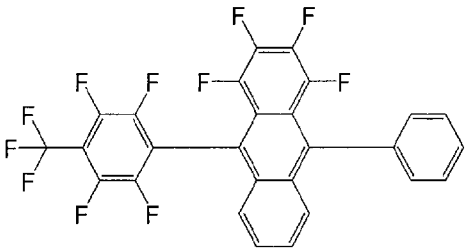

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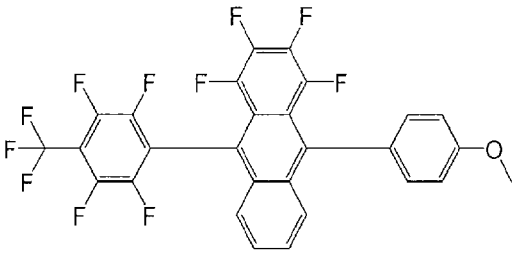

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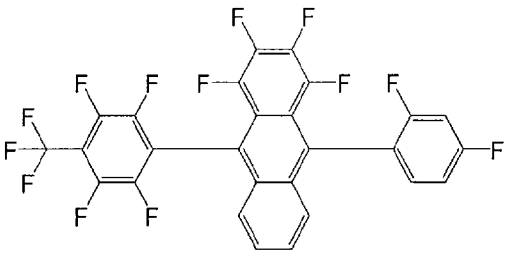

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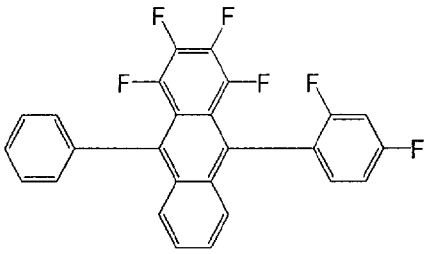

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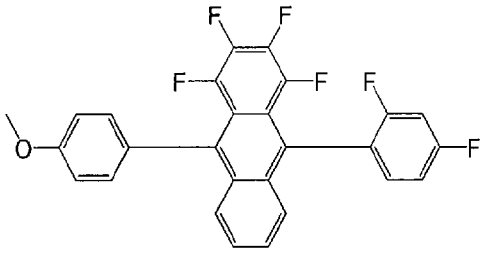

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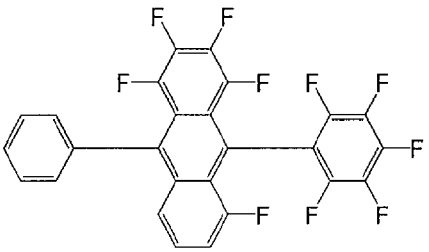

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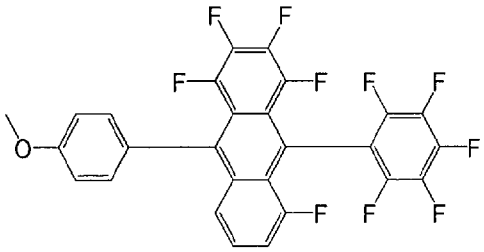

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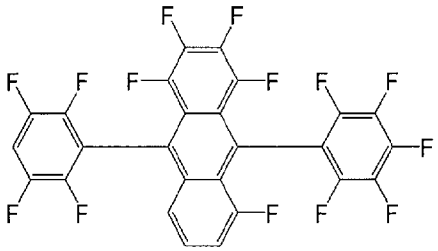

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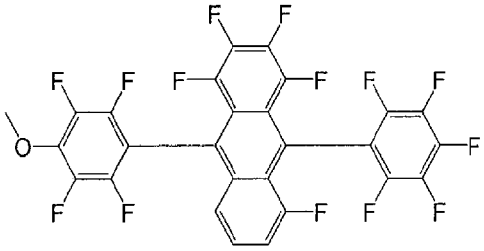

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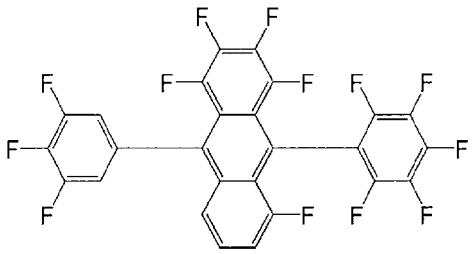

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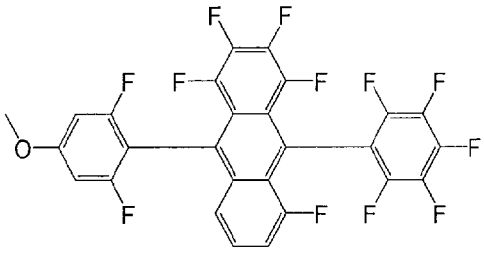

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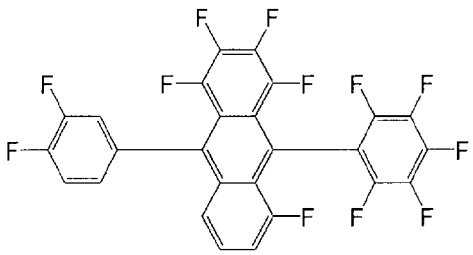

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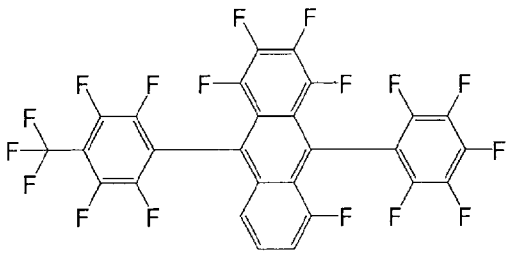

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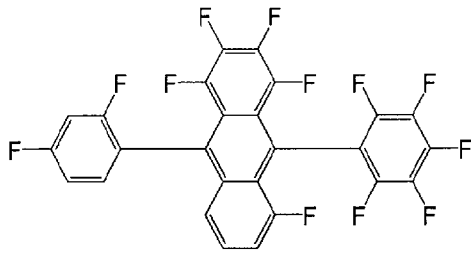

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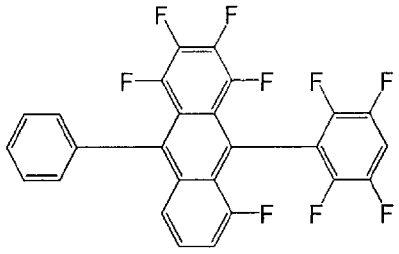

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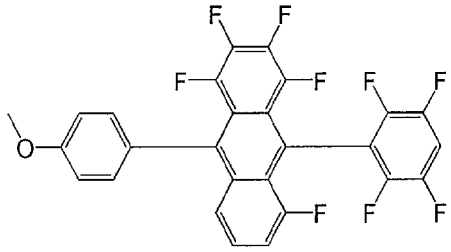

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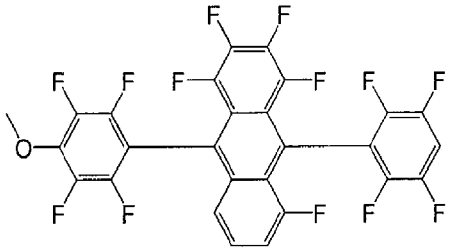

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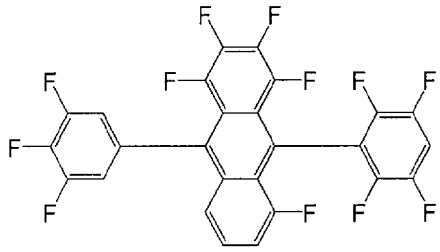

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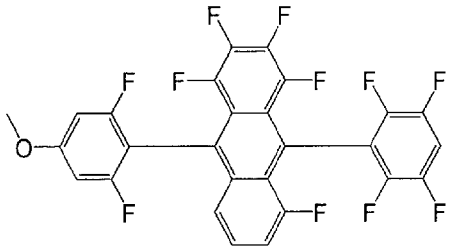

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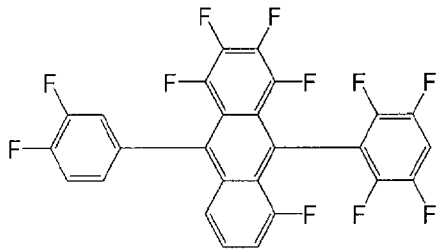

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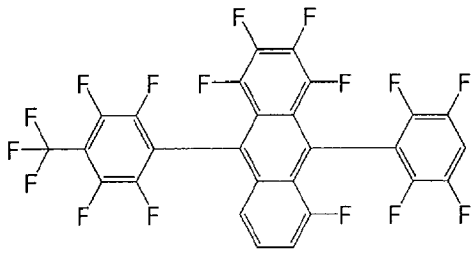

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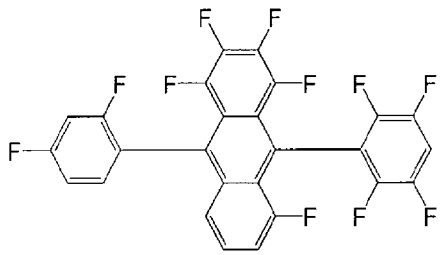

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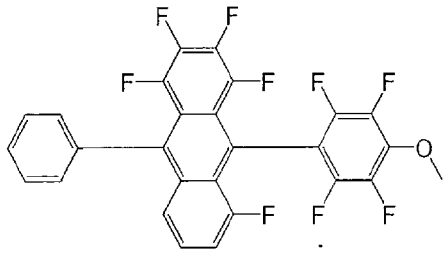

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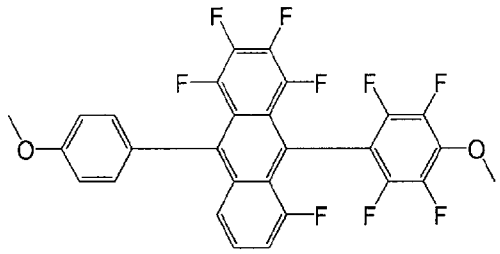

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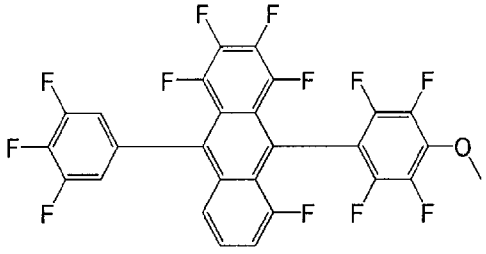

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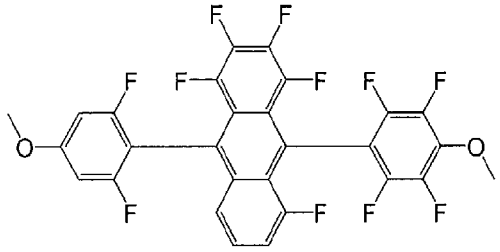

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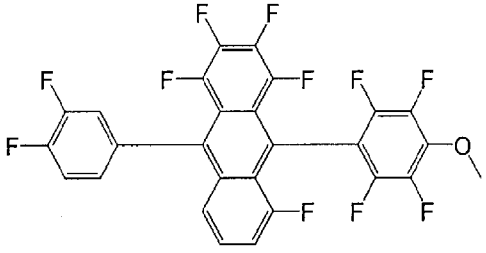

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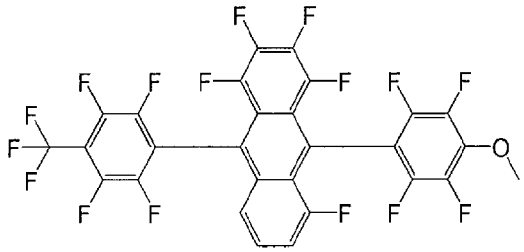

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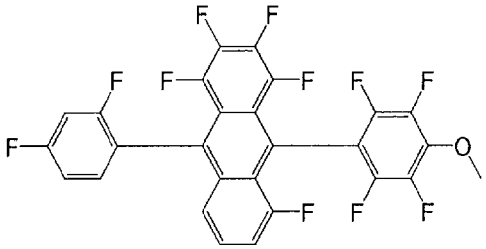

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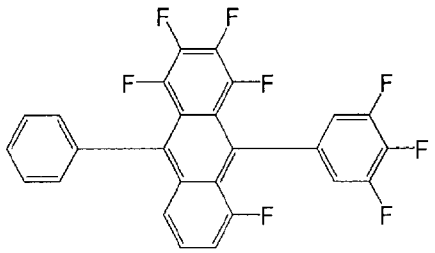

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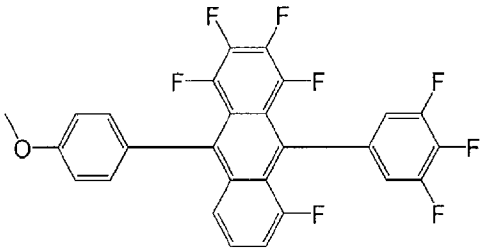

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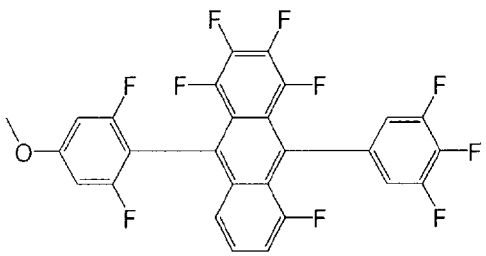

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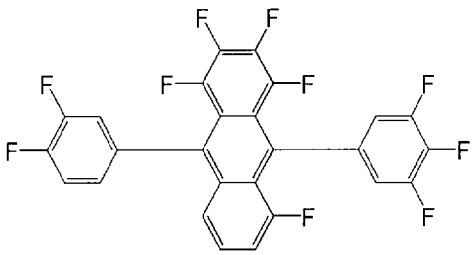

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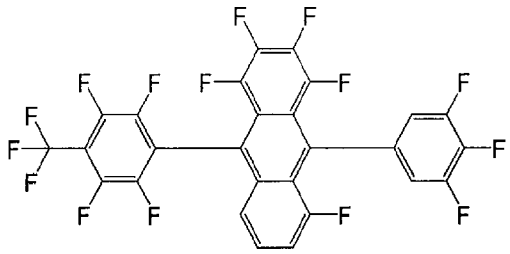

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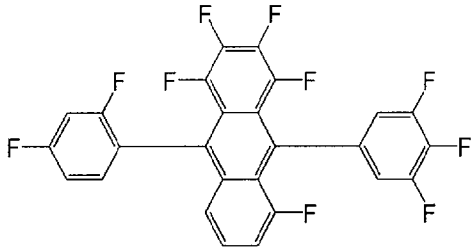

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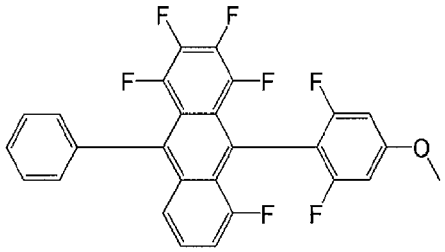

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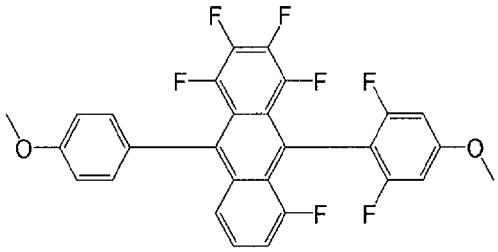

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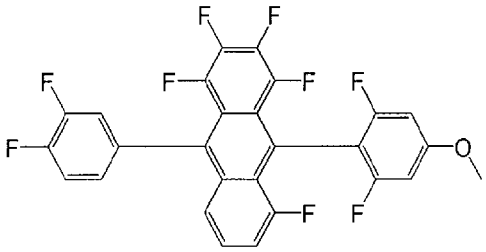

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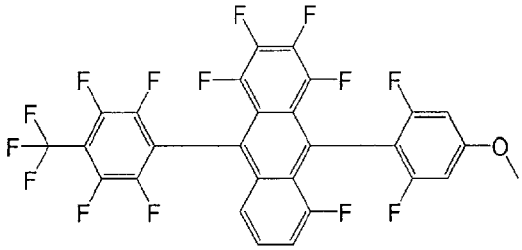

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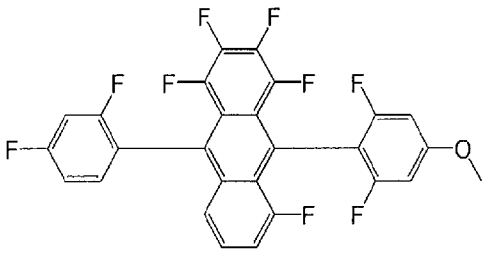

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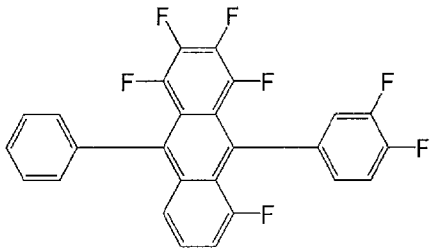

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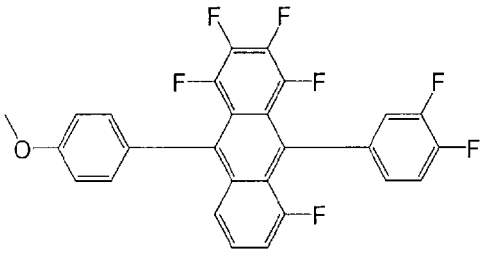

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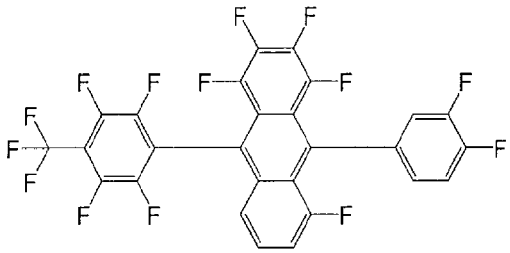

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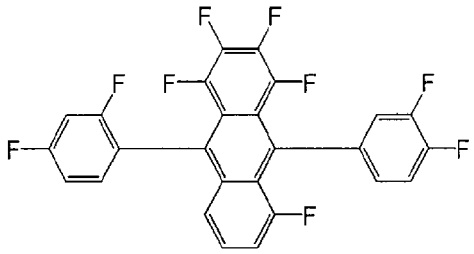

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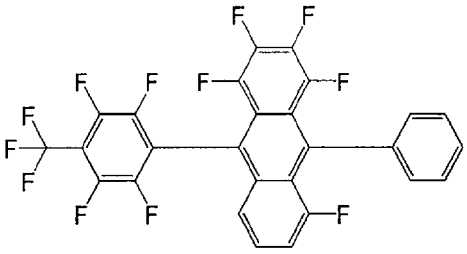

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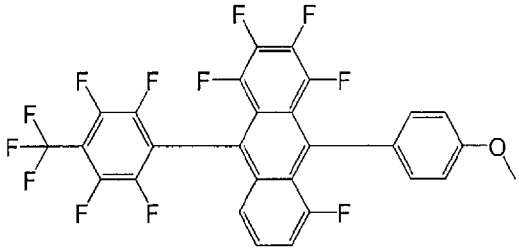

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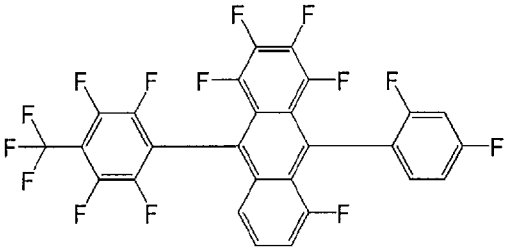

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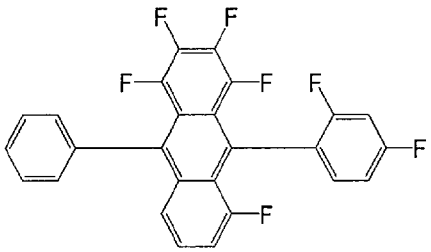

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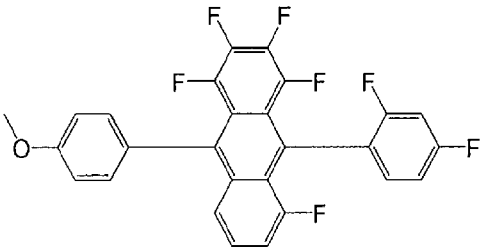

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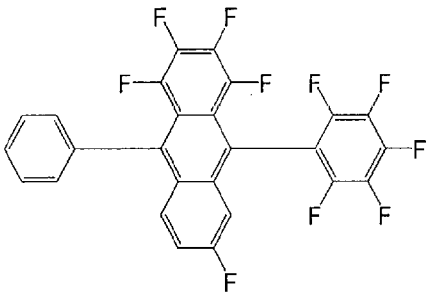

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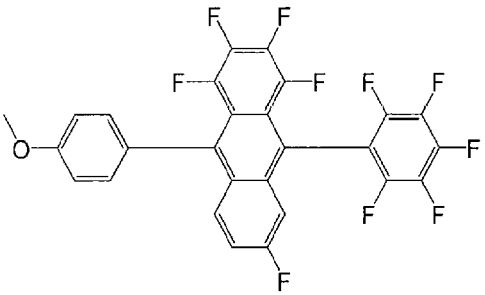

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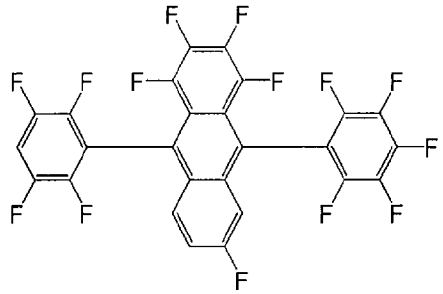

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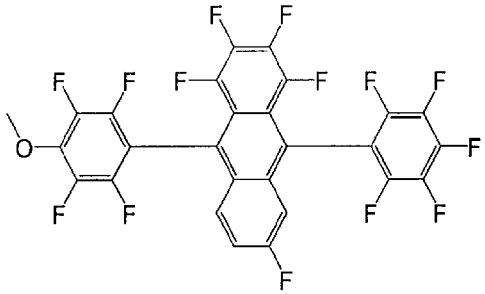

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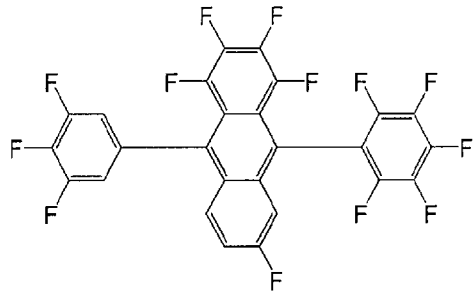

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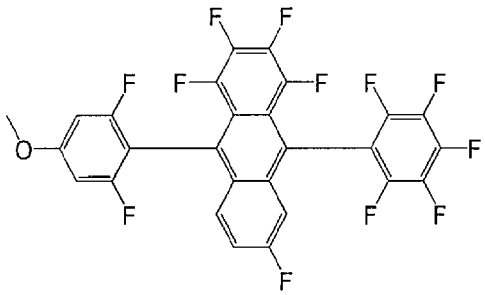

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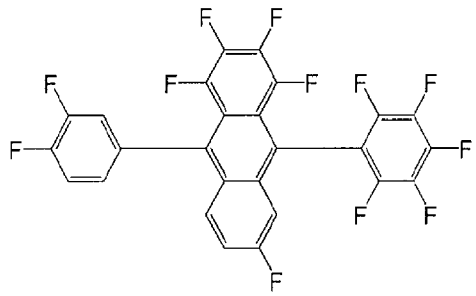

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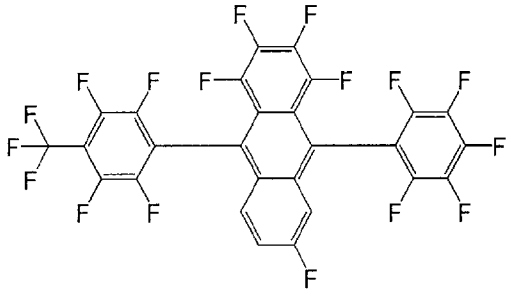

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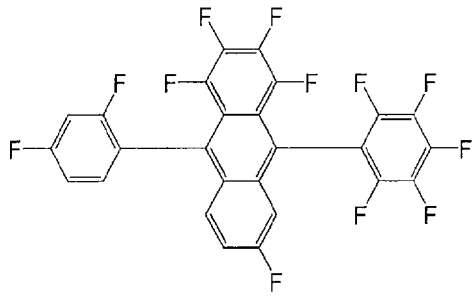

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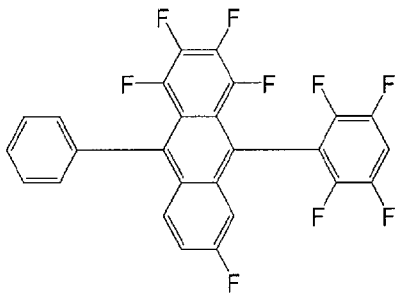

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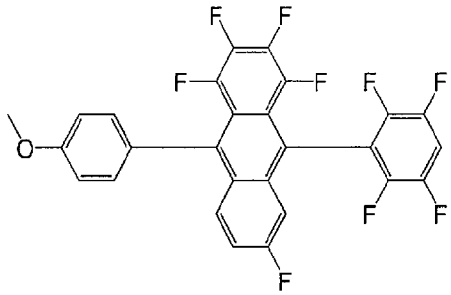

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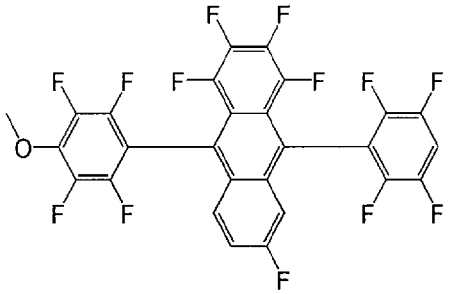

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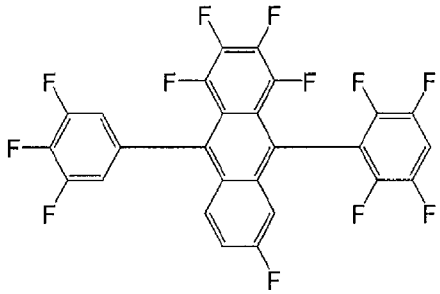

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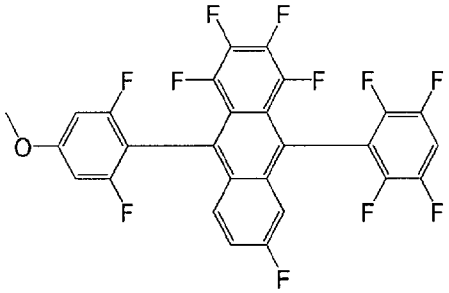

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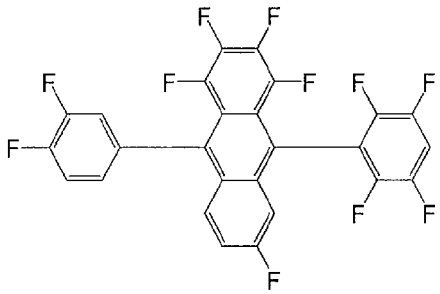

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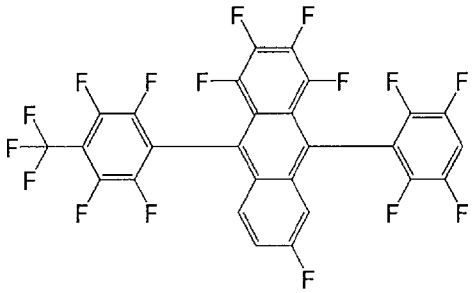

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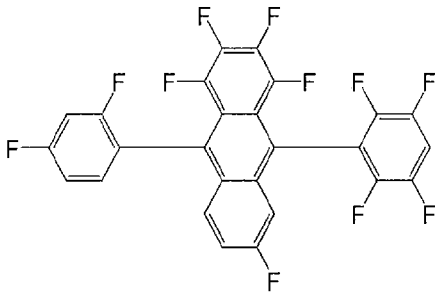

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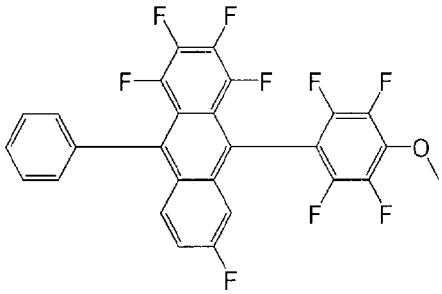

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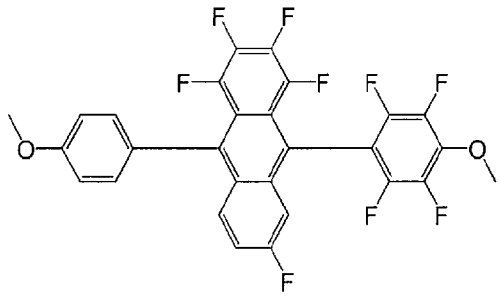

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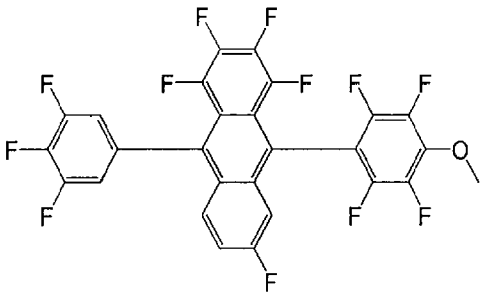

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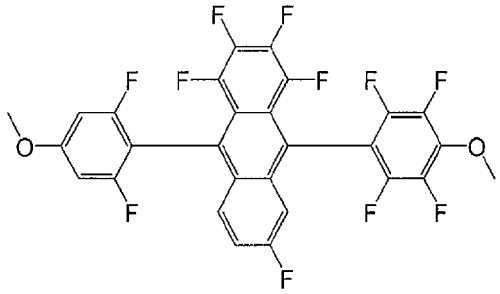

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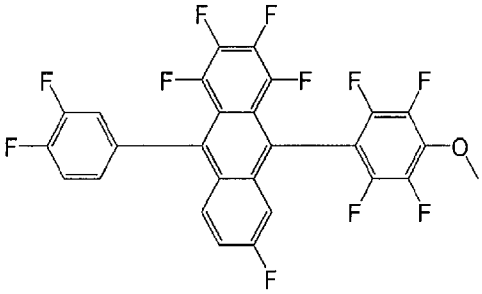

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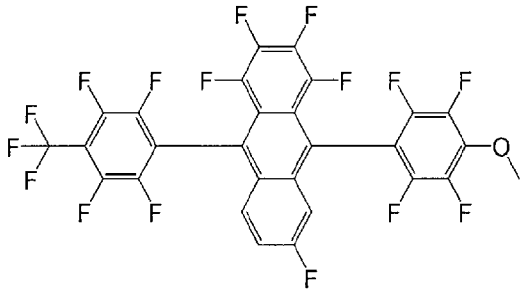

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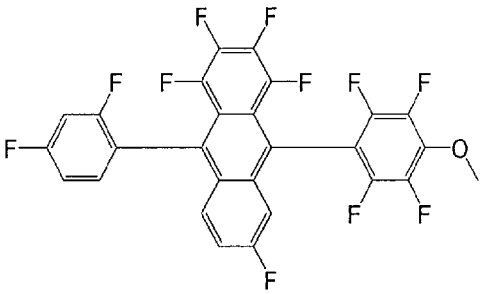

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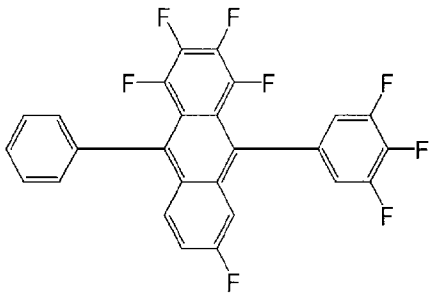

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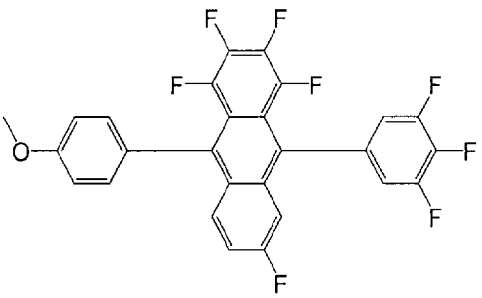

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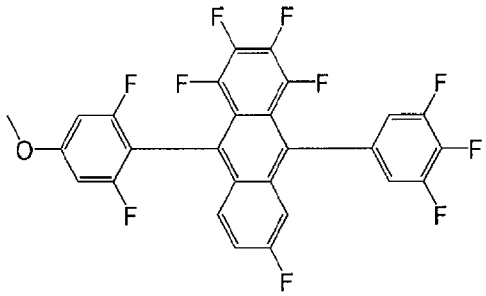

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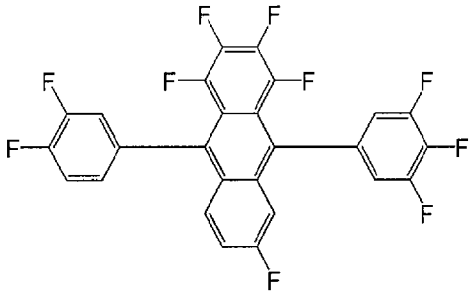

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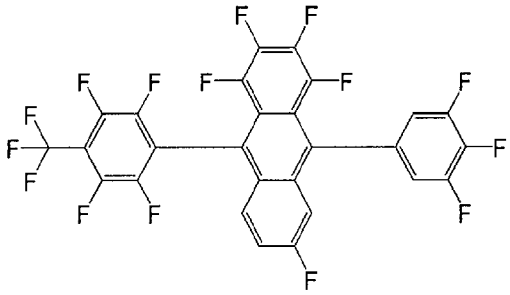

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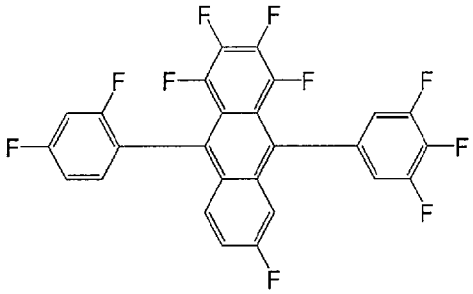

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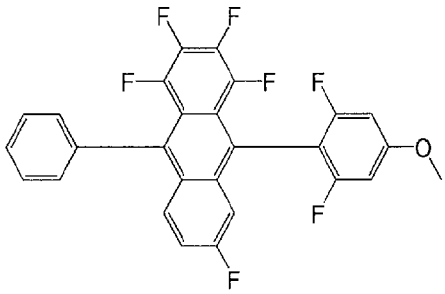

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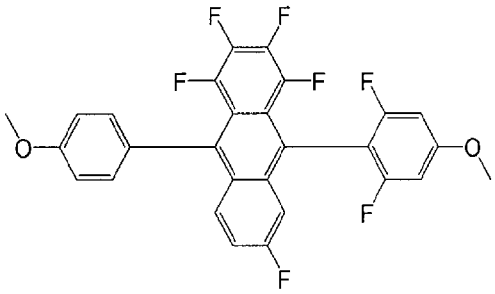

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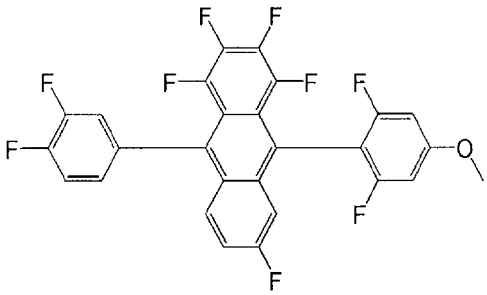

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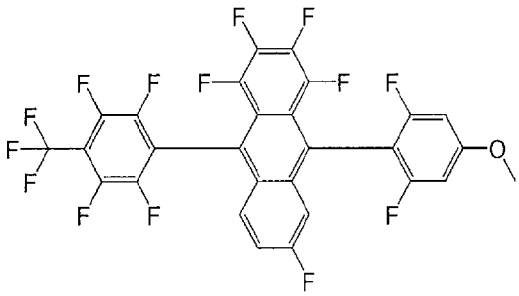

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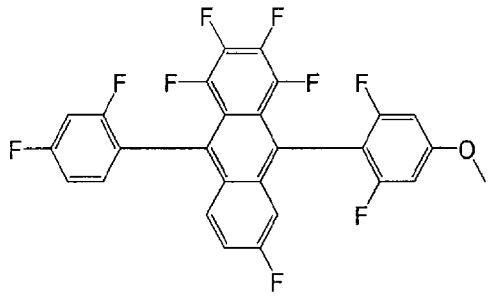

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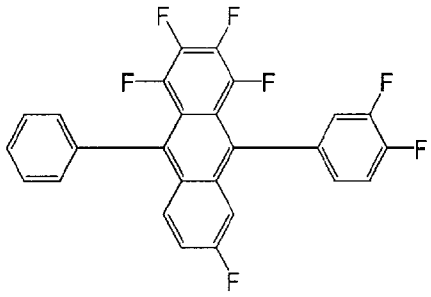

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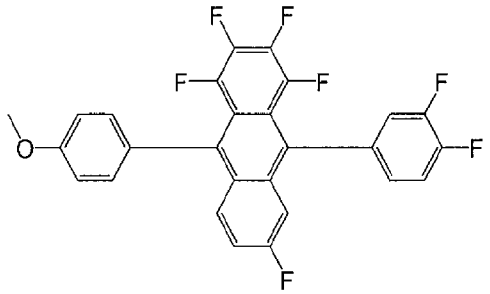

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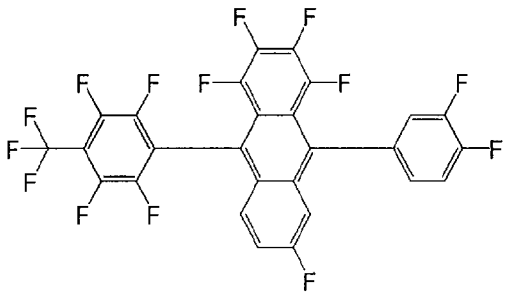

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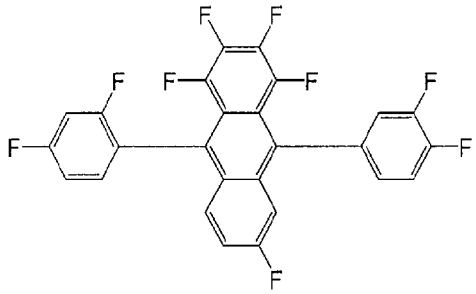

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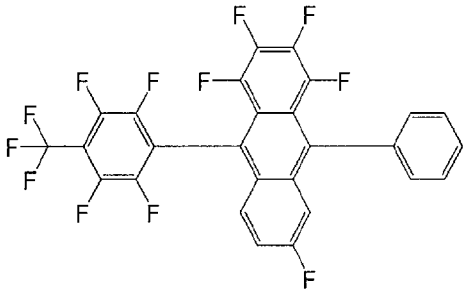

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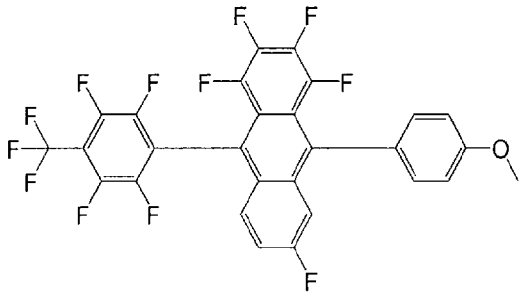

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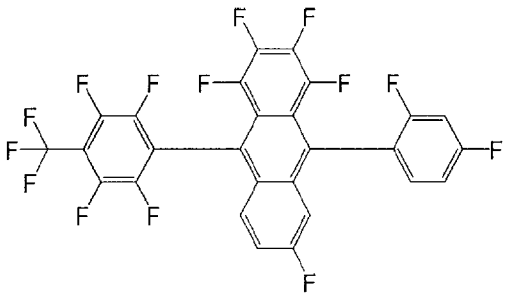

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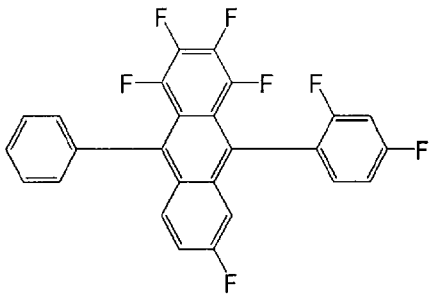

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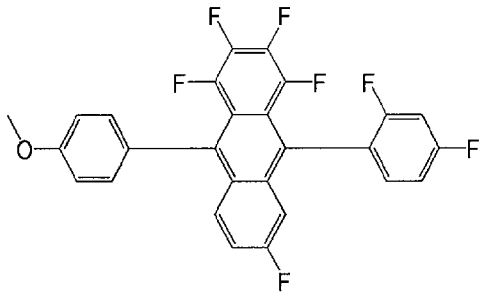

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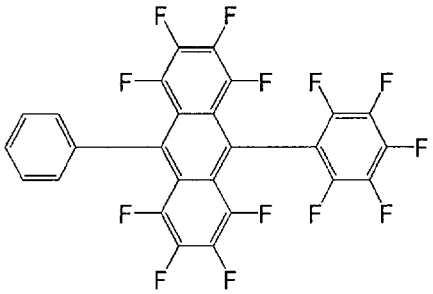

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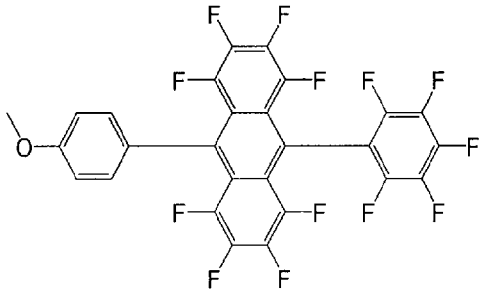

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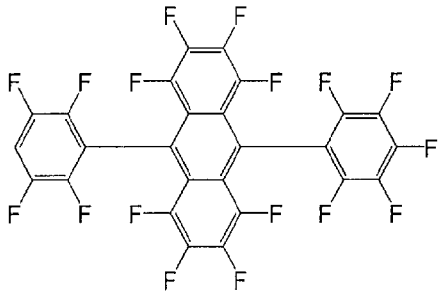

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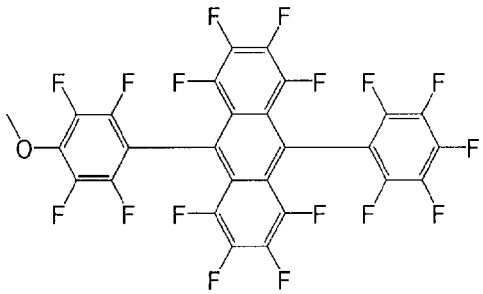

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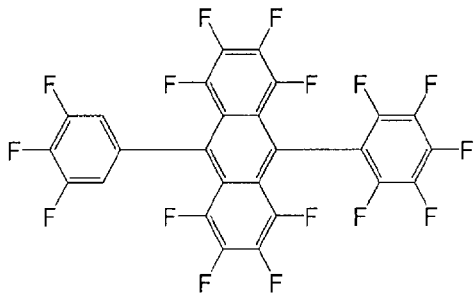

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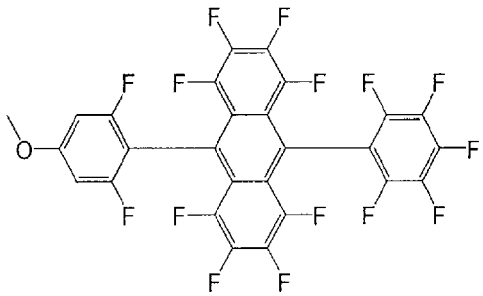

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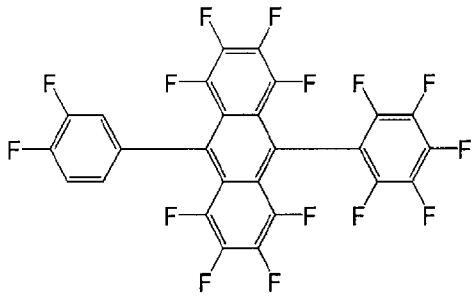

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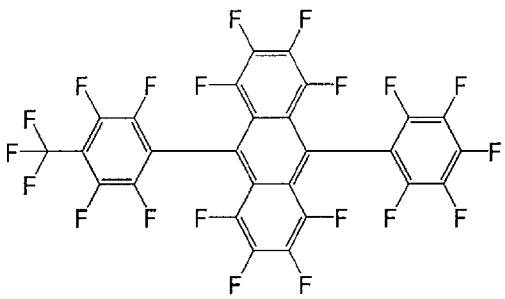

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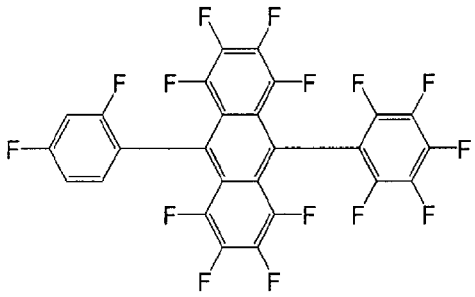

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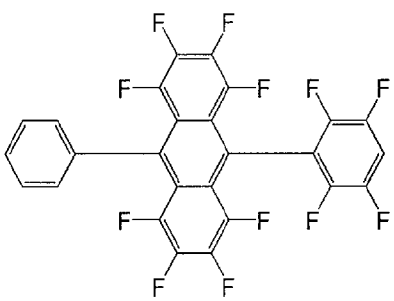

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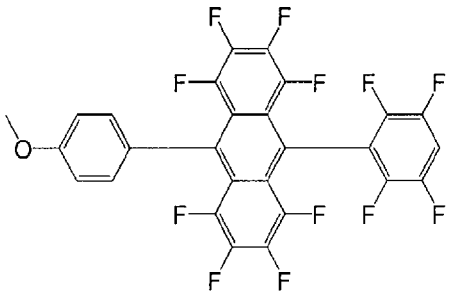

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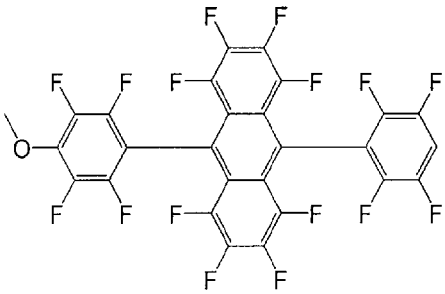

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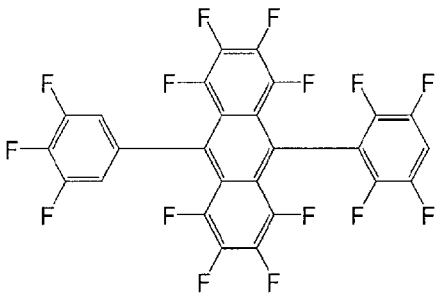

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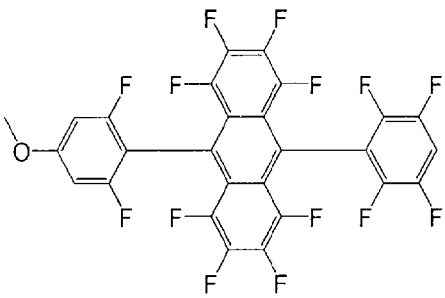

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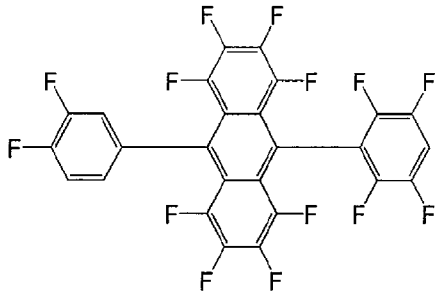
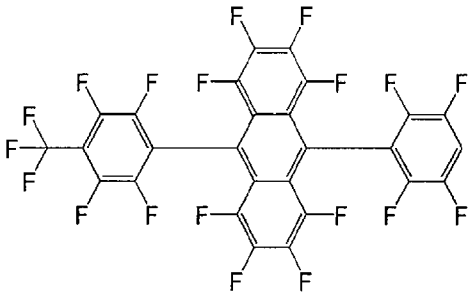


Figure 631



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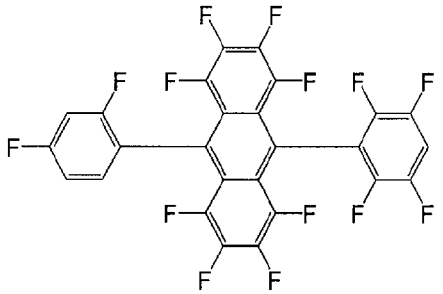

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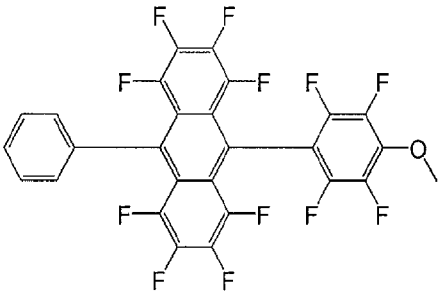

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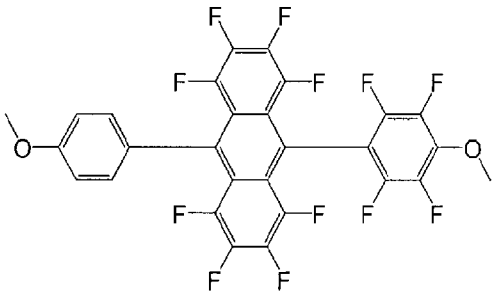

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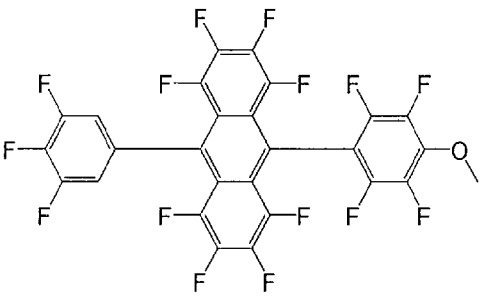

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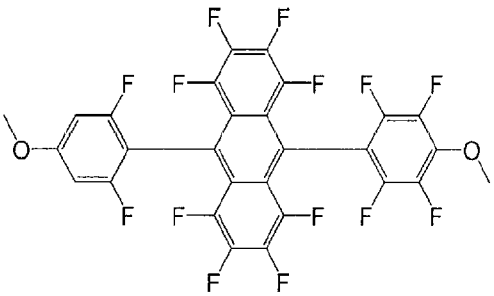

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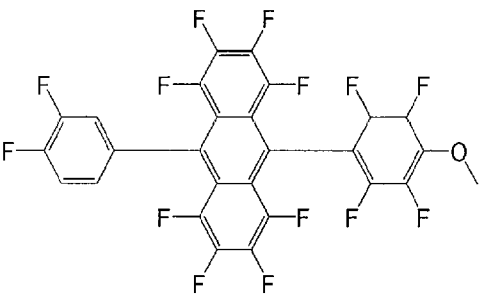

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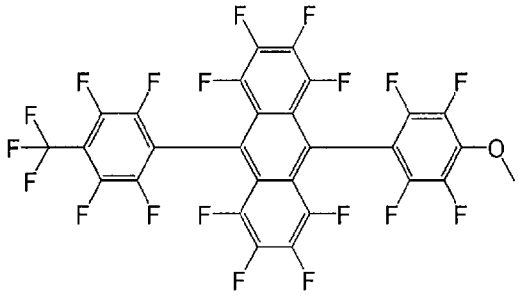

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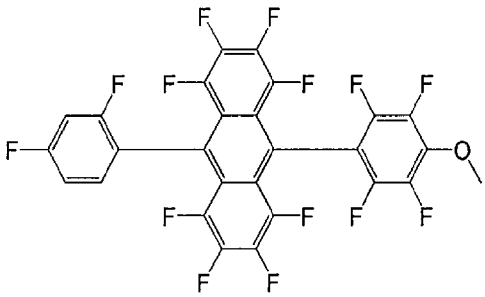
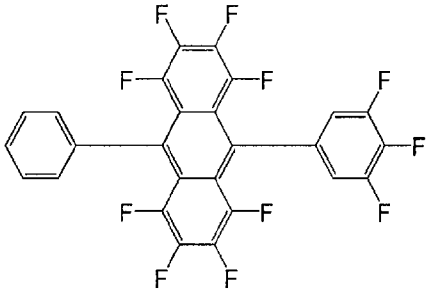


Figure 640



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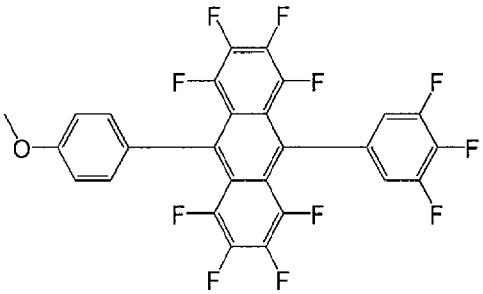

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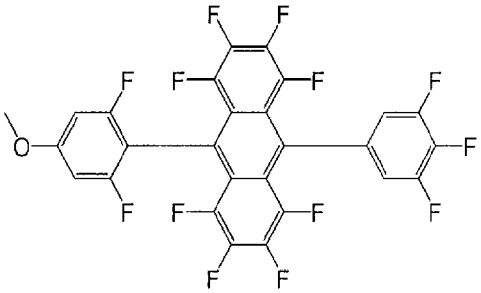

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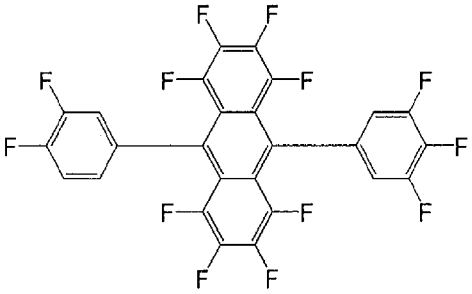

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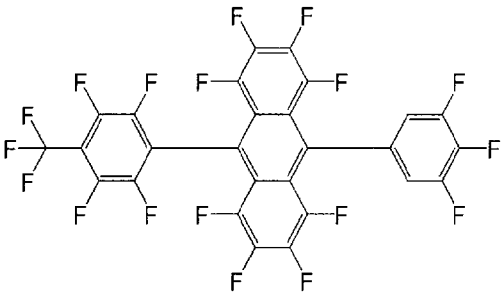

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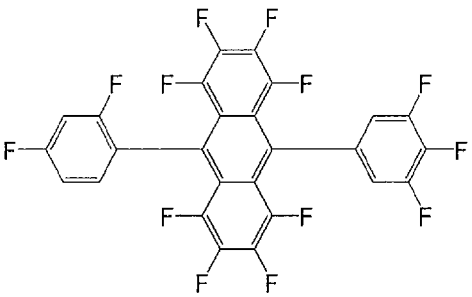

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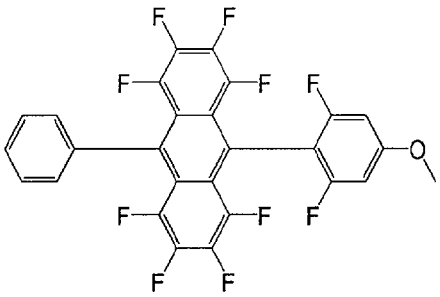
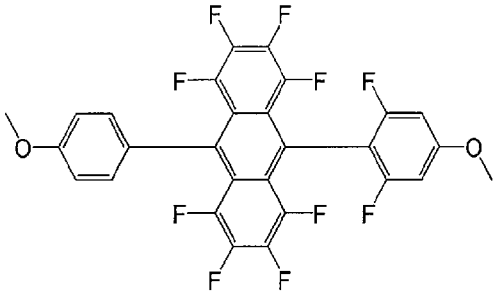


Figure 647



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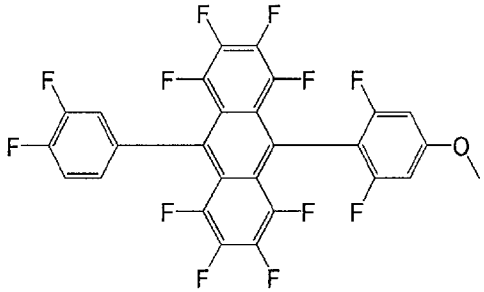

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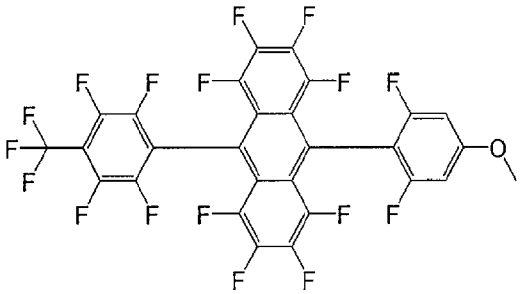
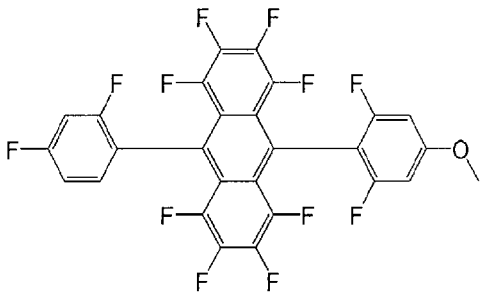


Figure 650



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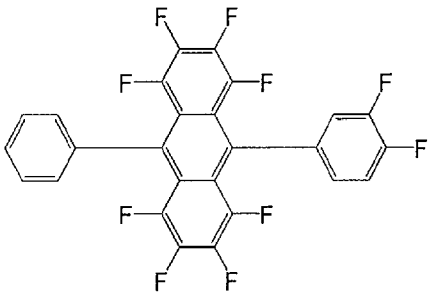

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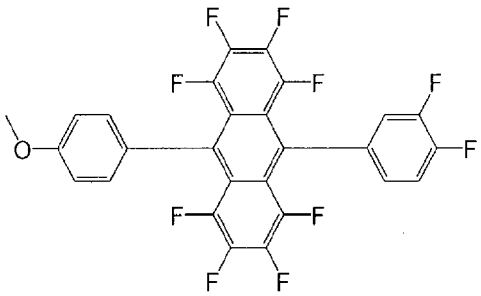

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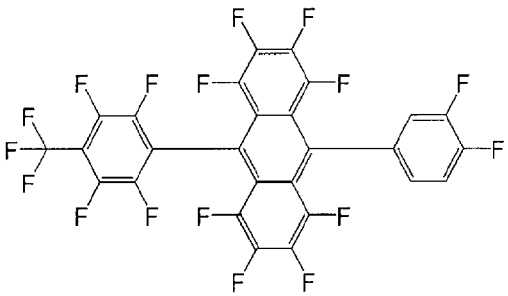
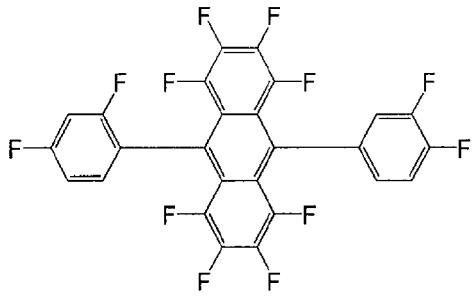


Figure 654



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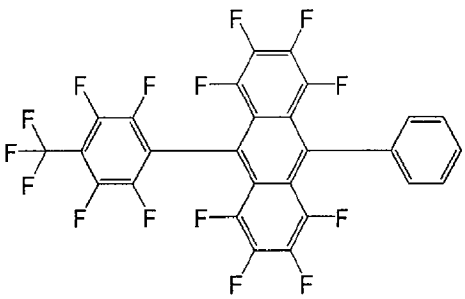


Figure 656

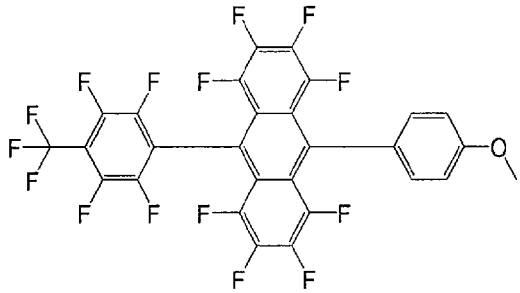
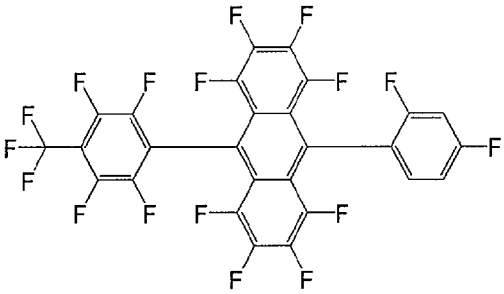


Figure 657



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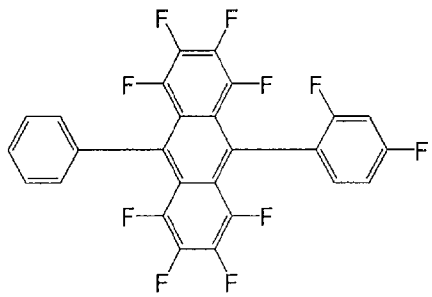


Figure 659

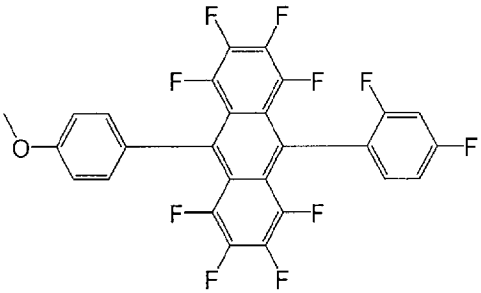
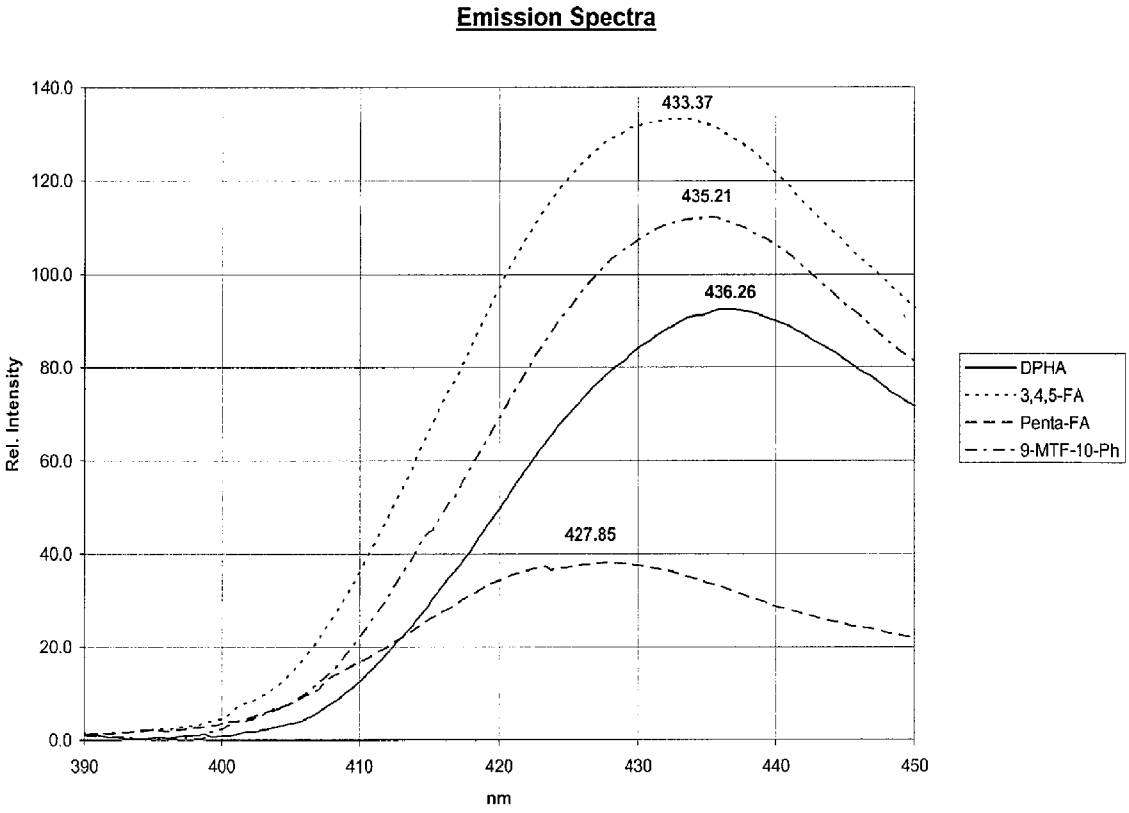


Figure 660

Figure 661



DPHA - 9,10-diphenylanthracene
3,4,5-FA - 9,10-bis(3,4,5-trifluorophenyl)anthracene
Penta-FA - 9,10-bis(2,3,4,5,6-pentafluorophenyl)anthracene
9-MTF-10-Ph – 9-(2,3,5,6-tetrafluoro-4-methoxyphenyl)-10-phenylanthracene

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2010/039800

A. CLASSIFICATION OF SUBJECT MATTER
INV. C09K11/06 C09K11/07

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C09K

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 practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	Formula 5-1 on page 256 Compound VIII'-16 on page 275	3-12
X	EP 1 312 605 A1 (SUMITOMO CHEMICAL CO [JP]) 21 May 2003 (2003-05-21)	1
Y	1,4,5-trifluoro-9,10-diphenylanthracene on paragraphs [0050] and [0052]	3-12
X	US 2008/308776 A1 (BINDRA PERMINDER S [US] ET AL BINDRA PERMINDER S [US] ET AL) 18 December 2008 (2008-12-18)	1,3-12
Y	tables 1,2 claims 1,18,19	2,13-22

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
7 September 2010	28/10/2010

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Saldamli, Saltuk

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2010/039800

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	claims 1,5,6,7,10	2,13-22
X	US 5 597 517 A (CHOPDEKAR VILAS M [US] ET AL) 28 January 1997 (1997-01-28)	1,3-7
Y	claims 1,7,14,16 column 5	2,13-17
X	ZEHM, D., FUDICKAR, W., LINKER, T.: "Molecular Switches Flipped by Oxygen" ANGEW. CHEM. INT. ED., vol. 46, no. 40, 8 October 2007 (2007-10-08), pages 7689-7692, XP002599392 Schemes 2, 3, 5	1
X	TANNACI, J. ET AL: "9,10-Disubstituted Octafluoroanthracene Derivatives via Palladium-Catalyzed Cross-Coupling" J. ORG. CHEM., vol. 73, no. 20, 17 October 2008 (2008-10-17), pages 7895-7900, XP002599393 compounds 2a-2c	1
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