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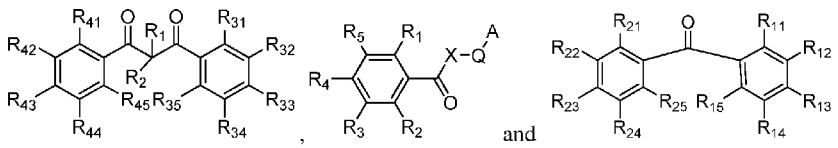
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(54) Title: UV-ABSORBING COMPOUNDS WITH AT LEAST ONE REACTIVE HYDROGEN



(57) Abstract: UV-absorbing compounds are provided that have at least one reactive hydrogen. These compounds have structures: wherein the generic notations have meanings as described herein. Also provided are formulations comprising a UV-absorbing compounds.

UV-ABSORBING COMPOUNDS WITH AT LEAST ONE REACTIVE HYDROGEN

BACKGROUND

Field of the Invention

[0001] The invention provides novel UV radiation absorbing compounds having at least one reactive hydrogen. The invention further provides a wide variety of formulations comprising a UV-absorbing compounds.

Description of Related Art

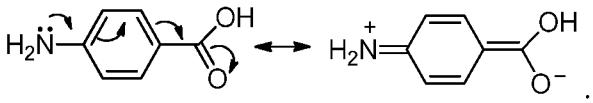
[0002] It is now generally accepted that ultraviolet (UV) radiation can be a serious health hazard. Even a limited exposure to solar radiation can cause short- and long-term skin damage, such as erythema, burns, wrinkles, lentigo ("liver spots"), skin cancers, keratotic lesions, and other cellular changes. There is a greater risk for developing such conditions for those who send prolonged time in the sun, such as for their occupation or during recreation.

[0003] UV radiation is just one portion of the electromagnetic spectrum with wavelengths from about 100 nm and about 400 nm, and is further divided into three subregions. UV-A radiation, from about 320 nm to about 400 nm, has the longest wavelength within the UV spectrum, and consequently is the least energetic. While UV-A rays can induce skin tanning, they are liable to induce adverse changes as well, especially in the case of sensitive skin or of skin which is continually exposed to solar radiation. In particular UV-A rays cause a loss of skin elasticity and the appearance of wrinkles, leading to premature skin aging. UV-B rays have shorter wavelengths, from about 290 nm to about 320 nm, and their higher energy can cause erythema and skin burns which may be harmful. The third subgroup, UV-C has the shortest wavelengths, from about 200 nm to about 290 nm, and the highest energy. The Earth's ozone layer effectively filters much UV-C radiation from reaching the ground. Nonetheless, UV-C rays can be generated from tanning bed devices.

[0004] In addition to harming the skin, UV radiation can injure the hair, resulting in color changes (especially for color-treated hair), embrittlement, and a loss in aesthetics (*e.g.*, shine, manageability).

[0005] UV radiation damage is not limited to the skin and hair, as inanimate objects exposed to solar radiation can experience changes related to color, hardness, and structural integrity, which can contribute to aesthetical and functional deterioration. Thus, there is the very real and demanding need for compositions that protect the skin, hair, and objects from UV rays, especially UV-A and UV-B radiation. Of special interest are compositions that provide broad UV-spectrum protection from both UV-A and UV-B radiation.

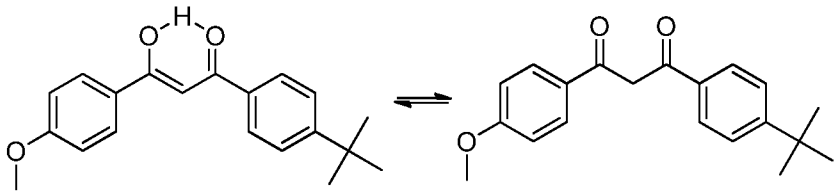
[0006] Broadly speaking, *para*-aminobenzoic acid (PABA) exhibits a common trait shared with many UV absorbers/filters. The molecule possesses both electron withdrawing and electron accepting groups, providing resonance delocalization that coincides with the absorbed energy of UV radiation:



[0007] However, PABA is a highly polar molecule, making it water soluble, and giving it low persistence, meaning that it is not highly retained on the skin after swimming or perspiring. In addition, due to extensive intermolecular bonding, PABA exists as a solid, which may further complicate its formulation. Thus, there exists the need to improve the persistence of UV absorbers, especially those that are water-soluble, and to provide formulation flexibility.

[0008] UV absorbers may exhibit photolability, in which the absorbed energy causes photodegradation and/or photoreactivity, and thus reduce its efficacy. Such photolability may result from irreversible isomerisms (*i.e.*, *keto-enol* tautomerism and *cis-trans* isomerism), photocleavage, and/or photoaddition, and may be formulation sensitive, (*e.g.*, blends of avobenzone and octinoxate). Examples of photolabile UV absorber include, without limitation: avobenzone, PABA derivatives, cinnamates, and dibenzoyl methane derivatives, all of which degrades over time, and reduce UV protection. Hence, there exists a need to stabilize UV absorbers from photodegradative effects.

[0009] Additionally, there exists the need to enhance the efficacy of UV absorbers without increasing their content in the formula, since a maximum addition level frequently is regulated. This efficacy need is especially important for avobenzone, a highly effective UV-A absorber. Avobenzone is subject to keto-enol isomerization due to formulation dependencies (*e.g.*, solvent, other UV absorbers):



[0010] The enol tautomer (left) has its maximum absorbance at 357 nm, which identifies it as a UV-A absorber. Unfortunately, avobenzone is subject to bimolecular reactions (*viz.*, via cleavage mechanisms) that alter the molecule's structure and decrease its effectiveness as an UV absorber. Hence, an effective method is needed for stabilizing labile chromophores like avobenzone in order to enhance their efficacy without increasing their addition level.

[0011] Methods for stabilizing chromophores, and in particular UV absorbers, are known in the prior art. For example, Japanese patent 1971/26,860 describes UV stabilizers having amino, hydroxyl, or isocyanate groups attached to crosslinked polymers, being crosslinked glycidyl methacrylate-divinylbenzene copolymers or crosslinked styrene-maleic anhydride-divinylbenzene copolymers.

[0012] Related to the invention are the following references: European Patents 303,283 and 1,972,323; U.S. Patents 3,001,970; 3,878,229; 3,879,443; 4,256,664; 4,489,057; 4,680,144; 4,868,246; 5,071,898; 5,344,992; 5,427,773; 5,451,394; 5,741,924; 5,808,165; 6,410,795; 7,045,139; and 7,147,866; U.S. Patent Application 2004/0208837; and WO 2007/143209.

[0013] Further related are articles by Kita, *et al.* published in *Angewandte Chemie International Edition,* volume 51 (2012), issue 23, page 572*;* by Song *et al.* published in *Journal of American Chemical Society,* volume 111 (1989), issue 22, page 847; by Bender *et al.*, published in *Tetrahedron*, volume 60 (2004), page 7277;

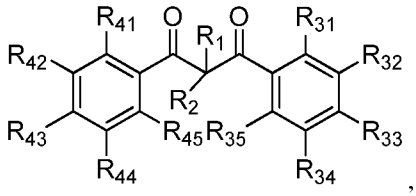
[0014] Also related is a sales specification for 1,3-propanedione, 1-(4-hydroxyphenyl)-3-(4-methylphenyl) (CAS No. 52046-72-7) from

[0015] There is still a need to develop compounds having good UV radiation absorption properties and having one or more reactive hydrogen(s) in the molecule amenable for further functionalization. The invention provides novel UV radiation absorbing compounds having at least one reactive hydrogen atom.

SUMMARY

[0016] The invention provides novel UV radiation absorbing compounds having at least one reactive hydrogen.

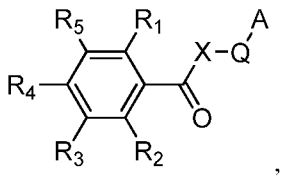
[0017] In one aspect, a UV-absorbing compound has the general formula:



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wherein each $\mathbf{R_1}$ and $\mathbf{R_2}$ may be independently selected from the group consisting of hydrogen and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms; each $\mathbf{R_{31}}$, $\mathbf{R_{32}}$, $\mathbf{R_{33}}$, $\mathbf{R_{34}}$ and $\mathbf{R_{35}}$ may be independently selected from the group consisting of hydrogen, halogen, amino, alkyl amino, hydroxyl, alkoxyl, sulfonyl, carboxyl, and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms with the proviso that at least one of $\mathbf{R_{31}}$, $\mathbf{R_{33}}$, and $\mathbf{R_{35}}$ has a structure –**X**–**Q**–**A**; each $\mathbf{R_{41}}$, $\mathbf{R_{42}}$, $\mathbf{R_{43}}$, $\mathbf{R_{44}}$ and $\mathbf{R_{45}}$ may be independently selected from the group consisting of hydrogen, halogen, amino, alkyl amino, hydroxyl, alkoxyl, sulfonyl, carboxyl, and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms with the proviso that at least one of $\mathbf{R_{41}}$, $\mathbf{R_{42}}$, $\mathbf{R_{43}}$, $\mathbf{R_{44}}$ and $\mathbf{R_{45}}$ may be non-hydrogen; each **X** may be independently selected from the group consisting of O, N$\mathbf{R_1}$, and S; each **Q** may be independently selected from the group consisting of functionalized and unfunctionalized hydrocarbylene optionally having one or more heteroatoms; and each **A** may be independently selected from the group consisting of OH, NH$\mathbf{R_1}$, and SH.

[0018] In a second aspect, a UV-absorbing compound has the general formula:

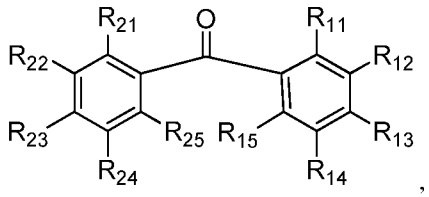


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wherein each $\mathbf{R_1}$, $\mathbf{R_2}$, $\mathbf{R_3}$, $\mathbf{R_4}$ and $\mathbf{R_5}$ may be independently selected from the group consisting of hydrogen, halogen, amino, alkyl amino, hydroxyl, alkoxyl, sulfonyl, carboxyl, and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms

with the proviso that at least one of $\mathbf{R_1}$, $\mathbf{R_2}$, $\mathbf{R_3}$, $\mathbf{R_4}$ and $\mathbf{R_5}$ has a structure $-\overset{R_6}{\underset{|}{N}}-R'_6$; **X** may be selected from the group consisting of O, N$\mathbf{R_7}$, and S; **Q** may be selected from the group consisting of functionalized and unfunctionalized hydrocarbylene optionally having one or more heteroatoms; **A** may be selected from the group consisting of OH, NH$\mathbf{R_7}$, and SH; each $\mathbf{R_6}$ and **R′6** may be the same or different and independently selected from the group consisting of functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms; and each $\mathbf{R_7}$ may be independently selected from the group consisting of hydrogen and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms.

[0019] In a third aspect, a UV-absorbing compound has the general formula:



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wherein each $\mathbf{R_{11}}$, $\mathbf{R_{12}}$, $\mathbf{R_{13}}$, $\mathbf{R_{14}}$ and $\mathbf{R_{15}}$ may be independently selected from the group consisting of hydrogen, halogen, amino, alkyl amino, hydroxyl, alkoxyl, sulfonyl, carboxyl, and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms with the proviso that at least one of $\mathbf{R_{12}}$ and $\mathbf{R_{14}}$ has a structure $-\overset{O}{\underset{O}{S}}-X-Q-A$ and at least two of $\mathbf{R_{11}}$, $\mathbf{R_{13}}$, and $\mathbf{R_{15}}$ may be selected from the group consisting of hydroxyl, alkoxyl, and combinations thereof; each $\mathbf{R_{21}}$, $\mathbf{R_{22}}$, $\mathbf{R_{23}}$, $\mathbf{R_{24}}$ and $\mathbf{R_{25}}$ may be independently selected from the group consisting of hydrogen, halogen, amino, alkyl amino, hydroxyl, alkoxyl, sulfonyl, carboxyl, and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms; each **X** may be independently selected from the group consisting of O and N$\mathbf{R_{16}}$; each **Q** may be independently selected from the group consisting of functionalized and unfunctionalized hydrocarbylene optionally having one or more heteroatoms; each **A** may be independently selected from the group consisting of OH, NH$\mathbf{R_{16}}$, and SH; and each $\mathbf{R_{16}}$ may be independently selected from the group consisting of hydrogen and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms.

[0020] In a fourth aspect, the invention provides a wide variety of formulations comprising a UV-absorbing compounds described herein. Such formulations include, but are not limited to personal care (*e.g.*, hair care, sun care, sunscreen, skin care, color cosmetic, and oral care) formulations, adhesives, coatings, paints, electronics, Household, Industrial and Institutional (HI&I) formulations, inks, membranes, metal working fluids, oilfield formulations, plastics and plasticizers, paper, construction formulations, textiles, industrial products, biocides, pharmaceuticals, food, and agrochemical formulations.

DETAILED DESCRIPTION

[0021] As used herein, the following terms have the meanings set out below.

[0022] The terms "ultraviolet" and "UV" are taken to mean electromagnetic radiation, especially solar electromagnetic radiation, with a wavelength from about 100 nm to about 400 nm, and includes the UV-A, UV-B, and UV-C sub-classifications of such radiation.

[0023] The term "UV-A" means ultraviolet electromagnetic radiation with a wavelength from about 320 nm to about 400 nm, and includes UV-A1 (from about 340 nm to about 400 nm) and UV-A2 (from about 320 nm to about 340 nm).

[0024] The term "UV-B" means ultraviolet electromagnetic radiation with a wavelength from about 290 nm to about 320 nm.

[0025] The term "UV-C" means ultraviolet electromagnetic radiation with a wavelength from about 200 nm to about 290 nm.

[0026] The term "UV-absorber" may be taken to mean a chemical entity that absorbs, scatters, and/or reflects UV radiation.

[0027] The term "each independently selected from the group consisting of" means when a group appears more than once in a structure, that group may be selected independently each time it appears.

[0028] The term "functionalized" refers to replacing one or more hydrogens with one or more non-hydrogen groups, for *e.g.*, alkyl, alkoxyl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, and/or aryl groups. Alkyl, alkenyl and/or alkynyl groups include C_1-C_{60}, more particularly C_1-C_{36}, and most particularly C_1-C_{18} groups. Cycloalkyl groups include cyclopentane, cyclohexane, cycloheptane, and the like. Alkoxy groups include methoxy,

ethoxy, *n*-propoxy, isopropoxy, and the like. Aryl groups include benzenes, naphthalenes (2 rings), anthracenes (3 rings), and the like.

[0029] The term "hydrocarbyl" refers to straight-chain and/or branched-chain groups comprising carbon and hydrogen atoms with optional heteroatom(s). Particularly, the hydrocarbyl group includes C_1-C_{60}, more particularly C_1-C_{36}, and most particularly C_1-C_{18} alkyl and alkenyl groups optionally having one or more hetero atoms. The hydrocarbyl group may be mono-, di- or polyvalent. The divalent hydrocarbyl group may be termed as 'hydrocarbylene'.

[0030] The term "heteroatom" refers to oxygen, nitrogen, sulfur, silicon, and/or phosphorous. The heteroatom may be present as a part of one or more functional groups on the hydrocarbyl chain and/or as a part of the hydrocarbyl chain itself.

[0031] The term "halogen" refers to chloro, bromo, iodo and/or fluoro.

[0032] The term "residue of" refers to a fragment of a reactant that remains after a reaction with another reactant(s). The residue may be mono-, di- or polyvalent.

[0033] The term "lower molecular weight alcohol" refers to any alcohol having from one to 4 carbon atoms, and includes: methanol, ethanol, 1-propanol, 2-propanol, allyl alcohol, propargyl alcohol, 2-aminoethanol, ethylene glycol, methylpropargyl alcohol, 1-butyn-4-ol, 2-butyn-1-ol, 2-buten-1-ol, 2-butanol, 2-methyl-2-propanol, and *t*-butanol. In various aspects of the invention the lower molecular weight alcohol may be methanol, ethanol, 1-propanol, 2-propanol, and *t*-butanol.

[0034] The term "monomer" refers to a small molecule that chemically bonds during polymerization to one or more monomers of the same or different kind to form a polymer.

[0035] The term "polymer" refers to a large molecule (macromolecule) comprising one or more types of monomer residues (repeating units) connected by covalent chemical bonds.

[0036] The terms "personal care formulation" and "cosmetics" refer to such illustrative non-limiting compositions as skin, sun, oil, hair, and preservative compositions, including those to alter the color, condition, or appearance of the skin. Potential personal care formularions include, but are not limited to, compositions for increased flexibility in styling, durable styling, increased humidity resistance for hair, skin, color cosmetics, water-

proof/resistance, wear-resistance, and thermal protecting/enhancing compositions.

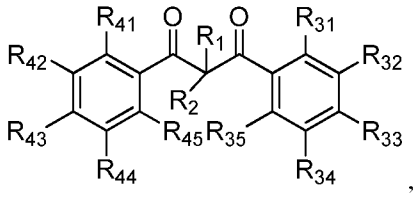
[0037] The term "performance chemicals formulation" refers to any non-personal care formulation. Performance chemicals formulations serve a broad spectrum of arts, and include non-limiting compositions such as: adhesives, agricultural, biocides, coatings, electronics, household-industrial-institutional (HI&I), inks, membranes, metal fluids, oilfield, paper, paints, plastics, printing, construction, and wood-care formulations.

[0038] The term "oilfield formulation" refers to a composition that may be used in the exploration, extraction, recovery, or completion of any hydrocarbon-based fuel. Non-limiting examples of oilfield formulations include anti-agglomerants, emulsifiers, de-emulsifiers, gas hydrate inhibitors, kinetic hydrate inhibitors, shale swelling inhibitors, drilling fluids, drilling muds, friction reducers, rheology modifier, fracturing fluids, and/or scale inhibitors.

[0039] The term "coating formulation" refers to any composition suitable for application in one or more layers onto a substrate in order to provide one or more desired functions, including, but not limited to protecting, smoothing, strengthening, decorating, color enhancing/altering, substrate preparing and/or texturizing. The substrate for a coating formulation may include, without limitation, paper, paper board, wood, inorganic substrate, woven and non-woven textiles, metal, leather, powder, plastic, polymer, glass, cement, ceramic, traffic, tile, rubber, sealant, cable, concrete, plasterboard, adhesives, fillers, primers, inks, fertilizers, pharmaceuticals, structural materials, molding, printing, inks, and the like. Examples of coating formulations include, without limitation, the following: paints, primers, stains, sealers, varnishes/polyurethanes, adhesives, waterproofers, wood hardeners. Coating formulations may be applied by brush, dauber, roll, strip/sheet, and/or trowel, or may be atomized and applied as a spray, mist, or droplet.

[0040] The term "paint formulation" refers to a non-limiting type of a coating formulation. Paints may be water based or non-water based (*i.e.*, solvent based). Paint formulations may be designed for any number of substrates, including wood, siding, dry wall, plaster, plastics, masonry, brick, tile, particle board, glass, stucco, concrete, and the like. Non-limiting examples of paints include exterior paints, interior paints, architectural paints, and automotive paints.

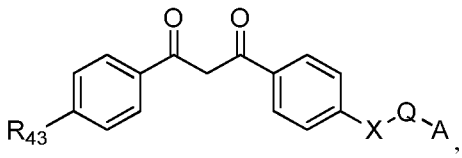
[0041] In a first aspect, the invention provides a UV-absorbing compound having the general formula:



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wherein each $\mathbf{R_1}$ and $\mathbf{R_2}$ may be independently selected from the group consisting of hydrogen and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms; each $\mathbf{R_{31}}$, $\mathbf{R_{32}}$, $\mathbf{R_{33}}$, $\mathbf{R_{34}}$ and $\mathbf{R_{35}}$ may be independently selected from the group consisting of hydrogen, halogen, amino, alkyl amino, hydroxyl, alkoxyl, sulfonyl, carboxyl, and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms with the proviso that at least one of $\mathbf{R_{31}}$, $\mathbf{R_{33}}$, and $\mathbf{R_{35}}$ has a structure **–X–Q–A**; each $\mathbf{R_{41}}$, $\mathbf{R_{42}}$, $\mathbf{R_{43}}$, $\mathbf{R_{44}}$ and $\mathbf{R_{45}}$ may be independently selected from the group consisting of hydrogen, halogen, amino, alkyl amino, hydroxyl, alkoxyl, sulfonyl, carboxyl, and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms with the proviso that at least one of $\mathbf{R_{41}}$, $\mathbf{R_{42}}$, $\mathbf{R_{43}}$, $\mathbf{R_{44}}$ and $\mathbf{R_{45}}$ may be non-hydrogen; each **X** may be independently selected from the group consisting of O, N$\mathbf{R_1}$, and S; each **Q** may be independently selected from the group consisting of functionalized and unfunctionalized hydrocarbylene optionally having one or more heteroatoms; and each **A** may be independently selected from the group consisting of OH, NH$\mathbf{R_1}$, and SH. Particularly, $\mathbf{R_{33}}$ has a structure **–X–Q–A.**

[0042] In a particular embodiment, the invention provides a UV-absorbing compound having the general formula:



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wherein **X** may be selected from the group consisting of O, N$\mathbf{R_1}$, and S; **Q** may be selected from the group consisting of functionalized and unfunctionalized hydrocarbylene optionally having one or more heteroatoms; **A** may be selected from the group consisting of OH, NH$\mathbf{R_1}$, and SH; each $\mathbf{R_1}$ may be independently selected from the group consisting of hydrogen and functionalized and unfunctionalized alkyl; and $\mathbf{R_{43}}$ may be a functionalized or unfunctionalized alkyl.

[0043] In a particular embodiment, **Q** may be C_1-C_{60} alkylene. Particularly, **Q** may be a residue of a compound selected from the group consisting of diols, diamines, thio alcohols, amino alcohols, polyols, polyether polyols, polyacetal polyethers, polyalkylene polyamines, polyetheramines, polyalkylene imines, polysaccharides, and combinations thereof. More particularly, **Q** may be a residue of a diol, an amino alcohol, or a diamine.

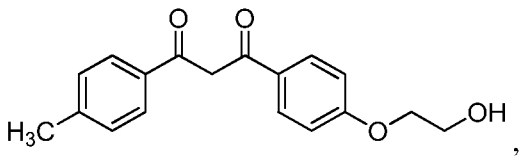
[0044] Non-limiting examples of diols include ethylene glycol, propylene glycol, diethylene glycol, triethylene glycol, tetraethylene glycol, dipropylene glycol, 2-butyl-2-ethyl-1,3-propanediol, 2,2-dimethyl-1,3-propanediol, 1,1-bis(hydroxymethyl)cyclopropane, 1,2-butanediol, 2,3-butanediol, 1,4-butanediol, 3-methyl-1,3-butanediol, 1,2-cyclopentanediol, 1,3-cyclopentanediol, 1,4-pentanediol, 1,5-pentanediol, 1,5-pentanediol, 2,4-pentanediol, 3-methyl-1,5-pentanediol, 1,2-cyclohexanediol, 1,3-cyclohexanediol, 1,4-cyclohexanediol, 1,2-hexanediol, 1,5-hexanediol, 1,6-hexanediol, 2,5-hexanediol, 1,8-octanediol, and 3,6-dithiaoctane-1,8-diol.

[0045] Non-limiting examples of amino alcohols include ethanol amine, propanol amine, 2-(methylamino)ethanol, 1-amino-2-propanol, 2-(ethylamino)ethanol, 2-amino-2-methyl-1-propanol, 4-amino-1-butanol, 4-amino-2-butanol, 2-(2-aminoethoxy)ethanol, 2-aminocyclopentanol, 2-(isopropylamino)ethanol, 2-amino-3-methyl-1-butanol, 5-amino-1-pentanol, 2-amino-1-pentanol, 1-amino-1-cyclopentanemethanol, 2-aminocyclohexanol, 4-aminocyclohexanol, 6-amino-1-hexanol, 2-amino-1-hexanol, 2-(aminomethyl)cyclohexanol, 5-amino-2,2-dimethylpentanol, 2-amino-1-phenylethanol, 4-chlorophenylalaninol, 2-benzylaminoethanol, 6-amino-1-hexanol, 8-amino-1-octanol, and 3-amino-1-adamantanol.

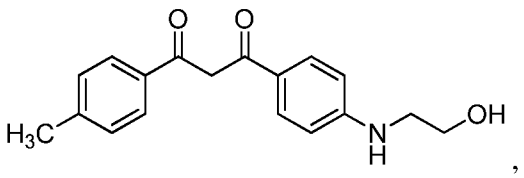
[0046] Non-limiting examples of diamines include ethylene diamine, diphenylethylenediamine, 1,3-diaminopropane, diaminocyclopropane, 1,4-diaminobutane, 1,5-diaminopentane, diaminocyclopentane, hexamethylenediamine, and diaminocyclohexane.

[0047] In a particular embodiment, $\mathbf{R_{43}}$ may be C_1-C_{18} alkyl. Even more particularly, $\mathbf{R_{43}}$ may be methyl.

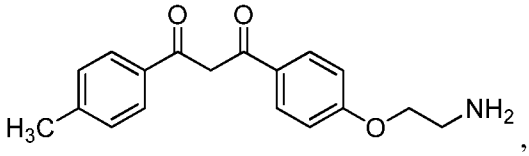
[0048] Non-limiting examples of UV-absorbing compounds according to the first aspect of the invention include:



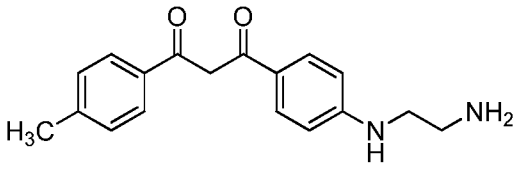
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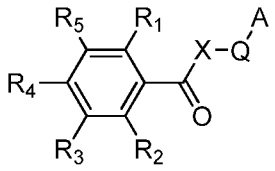
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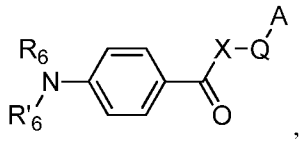
[0049] In a second aspect, the invention provides a UV-absorbing compound having the general formula:



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wherein each $\mathbf{R_1}$, $\mathbf{R_2}$, $\mathbf{R_3}$, $\mathbf{R_4}$ and $\mathbf{R_5}$ may be independently selected from the group consisting of hydrogen, halogen, amino, alkyl amino, hydroxyl, alkoxyl, sulfonyl, carboxyl, and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms with the proviso that at least one of $\mathbf{R_1}$, $\mathbf{R_2}$, $\mathbf{R_3}$, $\mathbf{R_4}$ and $\mathbf{R_5}$ has a structure $-\overset{R_6}{\underset{|}{N}}-R'_6$; **X** may be selected from the group consisting of O, N$\mathbf{R_7}$, and S; **Q** may be selected from the group consisting of functionalized and unfunctionalized hydrocarbylene optionally having one or more heteroatoms; **A** may be selected from the group consisting of OH, NH$\mathbf{R_7}$, and SH; each $\mathbf{R_6}$ and $\mathbf{R'_6}$ may be the same or different and independently selected from the group consisting of functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms; and each $\mathbf{R_7}$ may be independently selected from the group consisting of hydrogen and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms. Particularly, $\mathbf{R_4}$ may be dialkylamino. More particularly, $\mathbf{R_4}$ may be dimethylamino.

[0050] In a particular embodiment, the invention provides a UV-absorbing compound having the general formula:



wherein **X** may be selected from the group consisting of O, N**R**$_7$, and S; **Q** may be selected from the group consisting of functionalized and unfunctionalized hydrocarbylene optionally having one or more heteroatoms; **A** may be selected from the group consisting of OH, NH**R**$_7$, and SH; **R**$_6$ and **R′**$_6$ may be the same or different and may be selected from the group consisting of functionalized and unfunctionalized alkyl; and each **R**$_7$ may be independently selected from the group consisting of hydrogen and functionalized and unfunctionalized alkyl optionally having one or more heteroatoms.

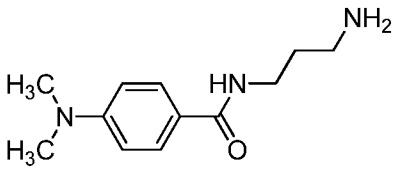
[0051] In a particular embodiment, **Q** may be C_1-C_{60} alkylene. Particularly, **Q** may be a residue of a compound selected from the group consisting of diols, diamines, thio alcohols, amino alcohols, polyols, polyether polyols, polyacetal polyethers, polyalkylene polyamines, polyetheramines, polyalkylene imines, polysaccharides, and combinations thereof. More particularly, **Q** may be a residue of a diol, an amino alcohol, or a diamine.

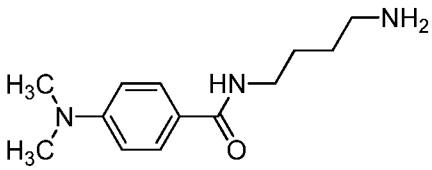
[0052] Non-limiting examples of diols include ethylene glycol, propylene glycol, diethylene glycol, triethylene glycol, tetraethylene glycol, dipropylene glycol, 2-butyl-2-ethyl-1,3-propanediol, 2,2-dimethyl-1,3-propanediol, 1,1-bis(hydroxymethyl)cyclopropane, 1,2-butanediol, 2,3-butanediol, 1,4-butanediol, 3-methyl-1,3-butanediol, 1,2-cyclopentanediol, 1,3-cyclopentanediol, 1,4-pentanediol, 1,5-pentanediol, 1,5-pentanediol, 2,4-pentanediol, 3-methyl-1,5-pentanediol, 1,2-cyclohexanediol, 1,3-cyclohexanediol, 1,4-cyclohexanediol, 1,2-hexanediol, 1,5-hexanediol, 1,6-hexanediol, 2,5-hexanediol, 1,8-octanediol, and 3,6-dithiaoctane-1,8-diol.

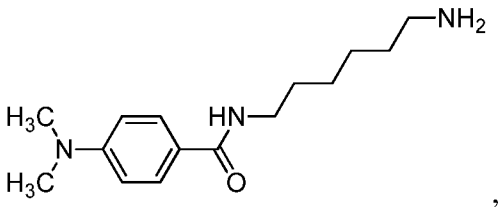
[0053] Non-limiting examples of amino alcohols include ethanol amine, propanol amine, 2-(methylamino)ethanol, 1-amino-2-propanol, 2-(ethylamino)ethanol, 2-amino-2-methyl-1-propanol, 4-amino-1-butanol, 4-amino-2-butanol, 2-(2-aminoethoxy)ethanol, 2-aminocyclopentanol, 2-(isopropylamino)ethanol, 2-amino-3-methyl-1-butanol, 5-amino-1-pentanol, 2-amino-1-pentanol, 1-amino-1-cyclopentanemethanol, 2-aminocyclohexanol, 4-aminocyclohexanol, 6-amino-1-hexanol, 2-amino-1-hexanol, 2-(aminomethyl)cyclohexanol, 5-amino-2,2-dimethylpentanol, 2-amino-1-phenylethanol, 4-chlorophenylalaninol, 2-benzylaminoethanol, 6-amino-1-hexanol, 8-amino-1-octanol, and 3-amino-1-adamantanol.

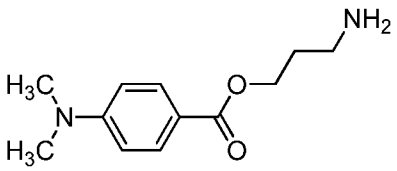
[0054] Non-limiting examples of diamines include ethylene diamine, diphenylethylenediamine, 1,3-diaminopropane, diaminocyclopropane, 1,4-diaminobutane, 1,5-diaminopentane, diaminocyclopentane, hexamethylenediamine, and diaminocyclohexane.

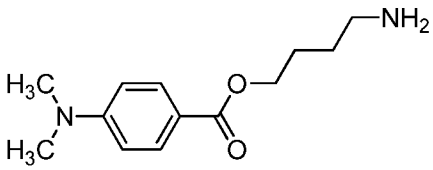
[0055] Non-limiting examples of UV-absorbing compounds according to the second aspect of the invention include:

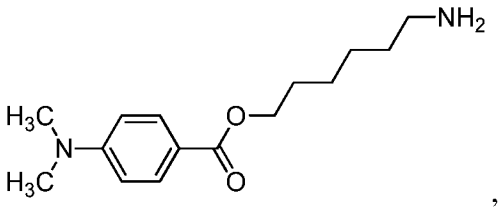

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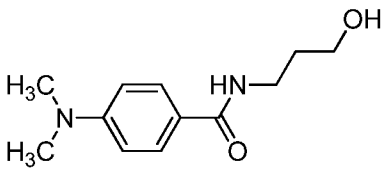

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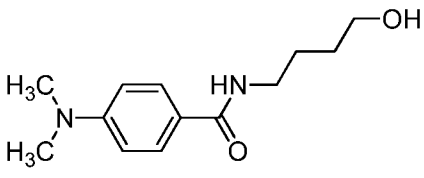

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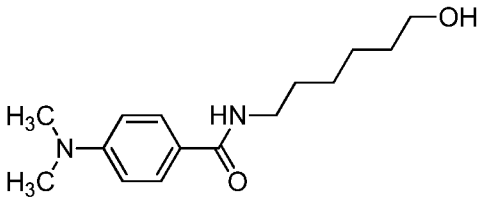

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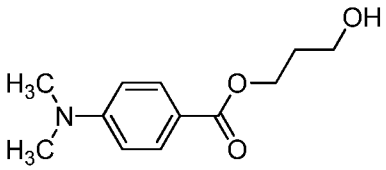

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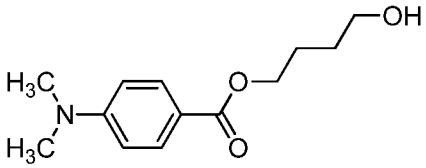

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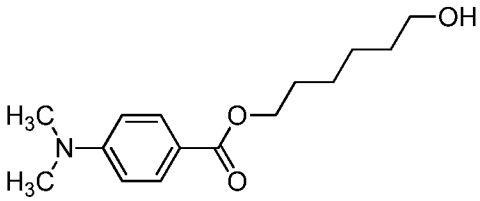

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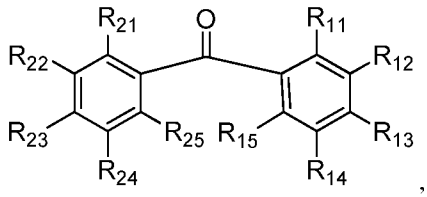

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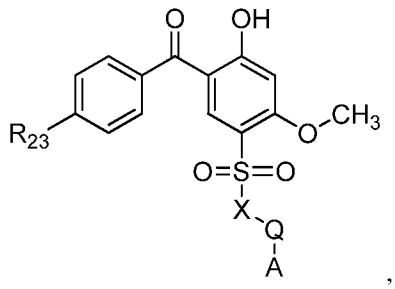
[0056] In a third aspect, the invention provides a UV-absorbing compound having the general formula:



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wherein each $\mathbf{R_{11}}$, $\mathbf{R_{12}}$, $\mathbf{R_{13}}$, $\mathbf{R_{14}}$ and $\mathbf{R_{15}}$ may be independently selected from the group consisting of hydrogen, halogen, amino, alkyl amino, hydroxyl, alkoxyl, sulfonyl, carboxyl, and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms with the proviso that at least one of $\mathbf{R_{12}}$ and $\mathbf{R_{14}}$ has a structure $-\overset{O}{\overset{\|}{S}}(=O)-X-Q-A$ and at least two of $\mathbf{R_{11}}$, $\mathbf{R_{13}}$, and $\mathbf{R_{15}}$ may be selected from the group consisting of hydroxyl, alkoxyl, and combinations thereof; each $\mathbf{R_{21}}$, $\mathbf{R_{22}}$, $\mathbf{R_{23}}$, $\mathbf{R_{24}}$ and $\mathbf{R_{25}}$ may be independently selected from the group consisting of hydrogen, halogen, amino, alkyl amino, hydroxyl, alkoxyl, sulfonyl, carboxyl, and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms; each **X** may be independently selected from the group consisting of O and $N\mathbf{R_{16}}$; each **Q** may be independently selected from the group consisting of functionalized and unfunctionalized hydrocarbylene optionally having one or more heteroatoms; each **A** may be independently selected from the group consisting of OH, $NH\mathbf{R_{16}}$, and SH; and each $\mathbf{R_{16}}$ may be independently selected from the group consisting of hydrogen and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms. Particularly, $\mathbf{R_{14}}$ has a structure $-\overset{O}{\overset{\|}{S}}(=O)-X-Q-A$, $\mathbf{R_{13}}$ may be alkoxy and $\mathbf{R_{11}}$ may be hydroxy. More particularly, $\mathbf{R_{13}}$ may be methoxy.

[0057] In a particular embodiment, the invention provides a UV-absorbing compound having the general formula:



wherein **X** may be selected from the group consisting of O and N$\mathbf{R_{16}}$; **Q** may be selected from the group consisting of functionalized and unfunctionalized hydrocarbylene optionally having one or more heteroatoms; **A** may be selected from the group consisting of OH, NH$\mathbf{R_{16}}$, and SH; $\mathbf{R_{23}}$ may be selected from the group consisting of hydrogen and functionalized and unfunctionalized alkyl; and each $\mathbf{R_{16}}$ may be independently selected from the group consisting of hydrogen and functionalized and unfunctionalized alkyl.

[0058] In a particular embodiment, **Q** may be C_1-C_{60} alkylene. Particularly, **Q** may be a residue of a compound selected from the group consisting of diols, diamines, thio alcohols, amino alcohols, polyols, polyether polyols, polyacetal polyethers, polyalkylene polyamines, polyetheramines, polyalkylene imines, polysaccharides, and combinations thereof. More particularly, **Q** may be a residue of a diol, an amino alcohol, or a diamine.

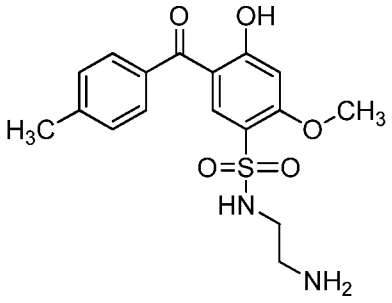
[0059] Non-limiting examples of diols include ethylene glycol, propylene glycol, diethylene glycol, triethylene glycol, tetraethylene glycol, dipropylene glycol, 2-butyl-2-ethyl-1,3-propanediol, 2,2-dimethyl-1,3-propanediol, 1,1-bis(hydroxymethyl)cyclopropane, 1,2-butanediol, 2,3-butanediol, 1,4-butanediol, 3-methyl-1,3-butanediol, 1,2-cyclopentanediol, 1,3-cyclopentanediol, 1,4-pentanediol, 1,5-pentanediol, 1,5-pentanediol, 2,4-pentanediol, 3-methyl-1,5-pentanediol, 1,2-cyclohexanediol, 1,3-cyclohexanediol, 1,4-cyclohexanediol, 1,2-hexanediol, 1,5-hexanediol, 1,6-hexanediol, 2,5-hexanediol, 1,8-octanediol, and 3,6-dithiaoctane-1,8-diol.

[0060] Non-limiting examples of amino alcohols include ethanol amine, propanol amine, 2-(methylamino)ethanol, 1-amino-2-propanol, 2-(ethylamino)ethanol, 2-amino-2-methyl-1-propanol, 4-amino-1-butanol, 4-amino-2-butanol, 2-(2-aminoethoxy)ethanol, 2-aminocyclopentanol, 2-(isopropylamino)ethanol, 2-amino-3-methyl-1-butanol, 5-amino-1-pentanol, 2-amino-1-pentanol, 1-amino-1-cyclopentanemethanol, 2-aminocyclohexanol, 4-aminocyclohexanol, 6-amino-1-hexanol, 2-amino-1-hexanol, 2-(aminomethyl)cyclohexanol,

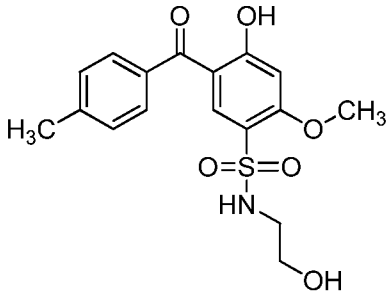
5-amino-2,2-dimethylpentanol, 2-amino-1-phenylethanol, 4-chlorophenylalaninol, 2-benzylaminoethanol, 6-amino-1-hexanol, 8-amino-1-octanol, and 3-amino-1-adamantanol.

[0061] Non-limiting examples of diamines include ethylene diamine, diphenylethylenediamine, 1,3-diaminopropane, diaminocyclopropane, 1,4-diaminobutane, 1,5-diaminopentane, diaminocyclopentane, hexamethylenediamine, and diaminocyclohexane.

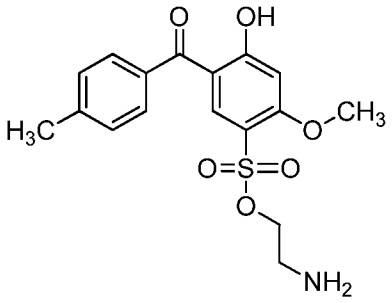
[0062] Non-limiting examples of UV-absorbing compounds according to the third aspect of the invention include:



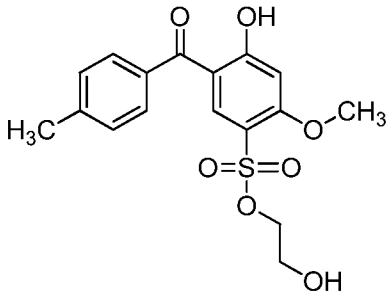
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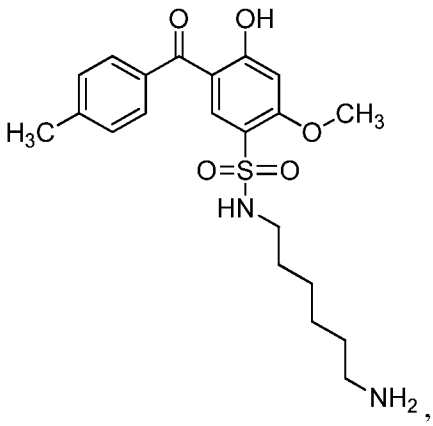
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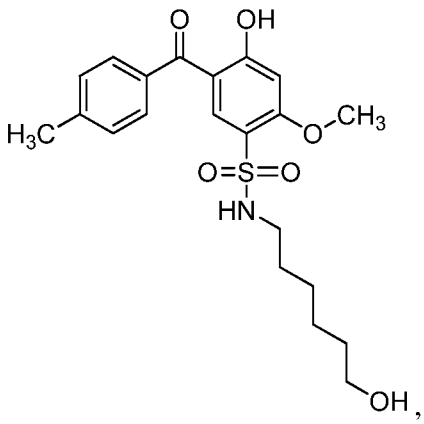
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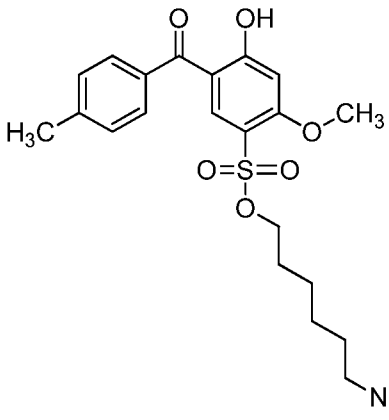
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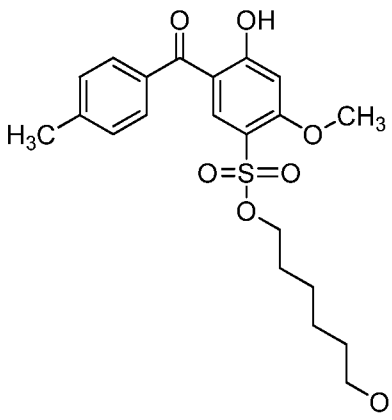
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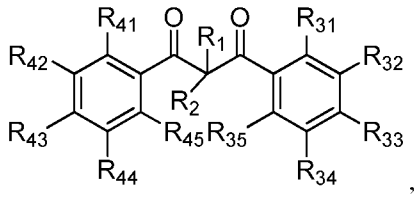


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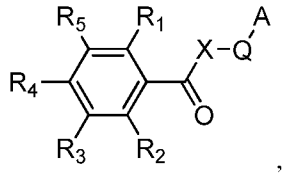
[0063] In a fourth aspect, the invention provides formulations comprising UV-absorbing compound having the general formula:



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wherein $\mathbf{R_1}$, $\mathbf{R_2}$, $\mathbf{R_{31}}$, $\mathbf{R_{32}}$, $\mathbf{R_{33}}$, $\mathbf{R_{34}}$, $\mathbf{R_{35}}$, $\mathbf{R_{41}}$, $\mathbf{R_{42}}$, $\mathbf{R_{43}}$, $\mathbf{R_{44}}$, and $\mathbf{R_{45}}$ are defined above.

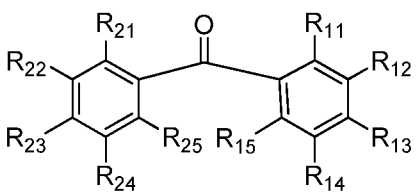
[0064] In a fifth aspect, the invention provides formulations comprising UV-absorbing compound having the general formula:



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wherein $\mathbf{R_1}$, $\mathbf{R_2}$, $\mathbf{R_3}$, $\mathbf{R_4}$, $\mathbf{R_5}$, **X**, **Q**, and **A** are defined above.

[0065] In a sixth aspect, the invention provides formulations comprising UV-absorbing compound having the general formula:



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wherein each $\mathbf{R_{11}}$, $\mathbf{R_{12}}$, $\mathbf{R_{13}}$, $\mathbf{R_{14}}$, $\mathbf{R_{15}}$, $\mathbf{R_{21}}$, $\mathbf{R_{22}}$, $\mathbf{R_{23}}$, $\mathbf{R_{24}}$, and $\mathbf{R_{25}}$ are defined above.

[0066] The compounds described herein may be used alone or in combination with other ingredient(s) in various formulations and product forms. Such formulations include, but are not limited to personal care formulations, adhesives, coatings, paints, electronics, Household, Industrial and Institutional (HI&I) compositions, inks, paper, polish, printing, membranes, metal working fluids, oilfield formulations, construction formulations, plastics and plasticizers, textiles, industrial formulations, printing, lubricants, biocides, preservative, pharmaceuticals, food, agrochemical, and wood-care formulations.

[0067] The term "personal care formulation" refers to a composition intended for use on or in the human body. Non-limiting, but specific types of personal care formulations include hair care compositions (encompassing styling and non-styling compositions), sun care compositions (encompassing after-sun compositions), skin care compositions, and oral care compositions. Non-limiting examples of personal care formulations include a skin lotion, skin crème, skin ointment, skin salve, anti-aging crème, moisturizer, deodorant, tanning agent, sun block, sunscreen, foundation, concealer, eyebrow pencil, eye shadow, eye liner, mascara, rouge, finishing powder, lipstick, lip gloss, nail polish, make-up remover, nail polish remover, shampoo, rinse-off conditioner, leave-on conditioner, hair styling gel, hair mousse, hair spray, styling aide, hair color, and hair color remover.

[0068] Non-limiting applications of the hair care compositions include: hair styling, hair setting, hair sculpting, hair curling, hair holding, hair waving, hair fixing, hair maintaining, hair shaping, hair straightening, hair volumizing, hair relaxing, shampooing, hair conditioning, hair cleansing, promoting hair style durability, imparting humidity resistance to hair and hair styles, enhancing hair shine, repairing split ends of hair, enhancing hair manageability such as lightness, smoothness, softness, disentangling and/or suppleness of hair, modulating hair stylability, protecting hair from thermal damage, hair dyeing, hair coloring, hair bleaching, oxidation dyeing of hair, limiting hair color bleeding, protecting hair color, hair treating (*e.g.*, anti-dandruff), anti-hair fall, and protecting hair from UV radiation.

[0069] The hair care compositions of the invention may be particularly used in hair styling. More particularly, the hair care compositions may be used to improve the hair stiffness, curl retention, and/or hair conditioning.

[0070] The hair care compositions may further comprise one or more additional ingredients. Particularly, the additional ingredients may be selected from the group consisting of: skin care or hair care agents, hair styling agents, hair fixative agents, film formers, structurants, gelling agents, surfactants, thickeners, preservatives, viscosity modifiers, electrolytes, pH adjusting agents, perfumes, dyes, organosilicon compounds, anti-dandruff agents, anti-foaming agents, anti-frizz agents, penetrants, vitamins, conditioning agents, chelating agents, antimicrobial agents, preservatives, UV absorbers, sunscreens, natural extracts, propellants, carriers, diluents, solvents, pharmaceutical actives, lubricants, combing aids, plasticizers, solubilizers, neutralizing agents, vapor pressure suppressants, bleaching agents, hydrating agents, moisturizers, cosmetic adjuvants and/or additives, protectants, and mixtures thereof.

[0071] The formulations according to the invention may further comprise one or more UV actives that is/are different from a UV-absorbing compounds described herein.

[0072] Non-limiting examples of such UV actives include 2,4-bis-(2,4-dihydroxyphenyl)-6-(4-methoxyphenyl)-s-triazine, aminobenzoic acid; 2-aminobenzophenone; amyl dimethyl PABA; bemotrizinol; benzophenone-3; benzophenone-4; benzophenone-9; 2-(2H-benzotriazole-2-yl)-4,6-di-tert-pentylphenol; 2-(2H-benzotriazole-2-yl)-4-methylphenol; 2-(2H-benzotriazole-2-yl)-4,6-bis(1-methyl-1-phenylethyl)phenol; bis-benzoxazoyl phenyl ethylhexyl amino triazine; 3-benzylidene camphor sulfonic acid; CAS number 152261-33-1; *N*,*N*′-bisformyl-*N*,*N*′-bis-(2,2,6,6-tetramethyl-4-piperidinyl)-hexamethylendiamine; bisoctrizole; 2-[(p-(tert-butylamido)-anilino]-4,6,-bis[(p-(2′-ethylhexyl-1′-oxycarbonyl)-anilino]-1,3,5-triazine; 6-tert-butyl-2-(5-chloro-2H-benzotriazole-2-yl)-4-methylphenol; 2,4-di-tert-butyl-6-(5-chloro-2H-benzotriazole-2-yl)-phenol; camphor benzalkonium methosulfate; diethanolamine p-methoxycinnamate; diethylaminohydroxybenzoylhexylbenzoate; diethylhexyl butamido triazone; digalloyl trioleate; dioxybenzone; disodium phenyl dibenzimidazole tetrasulfonate; drometrizole trisiloxane; ecamsule; ensulizole; ethyl 4-bis(hydroxypropyl) aminobenzoate; ethylhexyl p-methoxycinnamate; 2-ethylhexyl salicylate; ethylhexyl triazone; beta-2-glucopyranoxypropylhydroxybenzophenone; glyceryl aminobenzoate; homomenthyl salicylate; [2-hydroxy-4-(octyloxy)phenyl](phenyl)methanone; 2-[bis(2-hydroxyethyl)amino] ethyl salicylate; (E)-3-(4-hydroxy-3-methoxyphenyl)prop-2-enoic acid; lawsone with dihydroxyacetone; meradimate; methoxycinnamido propyl hydroxy sultaine menthyl

anthranilate; meradimate; methyl-2-aminobenzoate; oxybenzone; 2-phenylbenzimidazole-5-sulfonic acid (and its potassium, sodium and triethanolamine salts); sulisobenzone; bis-(2,2,6,6-tetramethyl-4-piperidyl)-sebacate; sterically hindered oligomeric amine, triethanolamine salicylate, and combinations thereof.

[0073] Non-limiting applications of the sun care formulations include: protecting skin and/or hair from UV radiation (including any or all of UV-A, UV-B and/or UV-C radiation), sun screening, skin anti-irritating, skin repairing, skin wrinkle masking, skin nourishing, skin moisturizing, skin relaxing, skin refreshing, skin cooling, skin soothing, skin tanning, skin tan prolonging, sun-less skin tanning, skin glowing, skin micro-glittering, skin shimmering, and skin anti-tanning.

[0074] Non-limiting applications of the skin care formulations include: protecting skin from UV radiation (including any or all of UV-A, UV-B and/or UV-C radiation), skin cleansing, face cleansing, body cleansing, insect repelling, antiperspirant, exfoliating skin, rejuvenating skin, influencing cell turnover, deodorant, astringent, imparting water resistance or water proofness to skin, decreasing and/or minimizing the appearance of skin wrinkles, decreasing and/or minimizing the appearance of skin blemishes (such as lentigo, skin discolorations, pimples, and/or acne), changing skin color (including skin lightening, skin brightening, skin color darkening, and color cosmetics for the face, cheeks, lips, eyelids, and/or eye lashes), skin iridescing, skin glossing, curling of eye lashes, eye lining, eye shadowing, mascara, removing facial and/or body hair, skin tightening, skin tanning, skin bronzing, skin blushing, prolonging skin tan, sun-less skin tanning, anti-tanning, skin anti-bacterial, skin anti-oxidant, skin anti-photoaging, skin anti-seborrheic, cell exchange and/or cell respiration activating of skin, skin conditioning, skin detoxifying, skin emollient, skin moisturizing, film forming on skin, skin healing-cicatrizing, skin immune-protecting, skin plumping, glossing, shading, plumping, and/or coloring of lips, skin revitalizing, skin energizing, skin re-sculpting, skin nourishing, skin smoothing, skin slimming, skin anti-irritating, and skin sanitizing.

[0075] Non-limiting applications of the oral care formulations include: tooth and/or mouth cleansing, providing denture adhesion, delivering and/or retaining actives to oral cavity, mouth washing, mouth refreshing, mouth rinsing, mouth gargling, providing oral hygiene, preventing, reducing, controlling, and/or removing tooth stain, preventing and/or controlling tooth decay, preventing and/or controlling tartar, tooth flossing, tooth whitening and/or bleaching, mouth treating, and tooth filling.

[0076] Non-limiting applications of the pharmaceutical and/or food formulations include: providing anti-tack, binder, coating, disintegrating, dispersing, encapsulating, filling, film forming, lubricating, and solubilizing. Additional insight into how the compounds described herein find application in this art area may be found in the following publications by Ashland Specialty Ingredients: *Health and nutrition product guide–Performance enhancing products* (08/2008), *Plasdone™ povidones product overview* (04/2010), *Plasdone™ K-12 and K-17 povidones–Solubilizers for liquid softgel fill formulations* (09/2010), *Plasdone™ K-29/32 povidone–High efficiency binder for wet granulation* (04/2010), *Plasdone™ S-630 copovidone–Product Overview* (04/2010), *Polyplasdone™ Ultra and Ultra-10 crospovidones–Product overview* (09/2010), *Polyplasdone™ superdisintegrants–Product overview* (07/2010), *Polyplasdone™ crospovidone–Superdisintegrants for orally disintegrating and chewable tablets* (07/2010), *Polyplasdone™ crospovidone–Nonionic superdisintegrant for improved dissolution of cationic drugs* (07/2009), *Polyplasdone™ crospovidone–The solution for poorly soluble drugs* (07/2009), *Polyplasdone™ crospovidone–Novel pelletization aid for extrusion spheronization* (07/2010), *PVP-Iodine povidone iodine antiseptic agent* (03/2004), and *Pharmaceutical technical bulletin–PVP-Iodine for prophylaxis and treatment of bovine mastitis* (12/2003). Each publication is hereby incorporated in its entirety by reference.

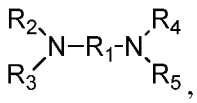
[0077] Any range in composition pH may be used. In embodiments wherein the formulation may be applied to keratinous material, the pH may range from about 2 to 12. The pH may be adjusted to a desired value by means of adding one or more acidifying or alkalinizing agents that are well-known in the state of the art. For example, the composition can contain at least one alkalizing or acidifying agent in amounts from about 0.01% to about 30% based on the total weight of the composition.

[0078] Non-limiting examples of acidifying or acidic pH adjusting agents include organic acids, such as citric acid, acetic acid, carboxylic acids, α-hydroxyacids, β-hydroxyacids, α,β-hydroxyacids, ω-hydroxyacids, salicylic acid, tartaric acid, lactic acid, glycolic acid, natural fruit acids, and combinations thereof. In addition, inorganic acids, for example hydrochloric acid, nitric acid, sulfuric acid, sulfamic acid, phosphoric acid, and combinations thereof can be utilized.

[0079] Non-limiting examples of alkalizing or alkaline pH adjusting agents include ammonia, alkali metal hydroxides (such as sodium hydroxide and potassium hydroxide),

ammonium hydroxide, alkanolamines (such as mono-, di- and triethanolamine), diisopropylamine, dodecylamine, diisopropanolamine, aminomethyl propanol, cocamine, oleamine, morpholine, triamylamine, triethylamine, tromethamine (2-amino-2-hydroxymethyl)-1,3-propanediol), and tetrakis(hydroxypropyl)ethylenediamine, hydroxyalkylamines and ethoxylated and/or propoxylated ethylenediamines, alkali metal salts of inorganic acids, such as sodium borate (borax), sodium phosphate, sodium pyrophosphate, and the like, and mixtures thereof.

[0080] Non-limiting examples of alkalizing agent can be chosen from ammonia, alkali carbonates, alkanolamines, like mono-, di- and triethanolamines, as well as their derivatives, sodium or potassium hydroxides and compounds of the following formula:



wherein R_1 may be a propylene residue that may be optionally substituted with an hydroxyl group or a C1-C4 alkyl radical; R_2, R_3, R_4 and R_5 are identical or different and represent a hydrogen atom, a C1-C4 alkyl radical or C1-C4 hydroxyalkyl radical.

[0081] The composition also may comprise one or more buffers. Suitable buffering agents include but are not limited to alkali or alkali earth carbonates, phosphates, bicarbonates, citrates, borates, acetates, acid anhydrides, succinates and the like, such as sodium phosphate, citrate, borate, acetate, bicarbonate, and carbonate. The personal care compositions may be formulated in any of the product forms known to a person of ordinary skill in the art. Non-limiting product forms are described below.

Product Forms

[0082] Non-limiting hair care product forms include: shampoos, conditioners, aerosols, mousses, sprays, mists, gels, waxes, creams, lotions, glues, pomades, spritzes, solutions, oils, liquids, solids, W/O emulsions, O/W emulsions, suspensions, multiple emulsions, microemulsions, microencapsulated products, sticks, balms, tonics, pastes, reconstitutable products, nanoemulsions, solid lipid nanoparticles, liposomes, cubosomes, neosomes, putties, lacquers, serums, perms, volumizers, packs, flakes, 2-in-1 shampoo/conditioner products, and 3-in-1 shampoo/conditioner/styling products.

[0083] The formulations according to the invention may also take the form of after-shampoo compositions, to be rinsed off or not, for permanents, straightening, waving, dyeing, or bleaching, or the form of rinse compositions to be applied before or after dyeing, bleaching, permanents, straightening, relaxing, waving or even between the two stages of a permanent or straightening process.

[0084] Non-limiting sun care product forms include: solutions, liquids, creams, powders, lotions, gels, pastes, waxes, aerosols, sprays, mists, roll-ons, sticks, milks, emulsions, and wipes.

[0085] Non-limiting skin care product forms include: solutions, oils, lotions, creams, ointments, liquids, gels, solids, W/O emulsions, O/W emulsions, milks, suspensions, microemulsions, dispersions, microencapsulated products, sticks, balms, tonics, pastes, mists, reconstitutable products, peels, soaps, aerosols, mousses, waxes, glues, pomades, spritzes, putties, lacquers, serums, perms, powders, pencils, flakes, blush, highlighters, bronzers, concealers, and 2-way cake products.

[0086] The compositions of the invention may also take the form of skin-washing compositions, and particularly in the form of solutions or gels for the bath or shower, or of make-up removal products.

[0087] The six skin care product categories that follow next may be considered a subset of the skin and sun care products:

[0088] (1) Eye care

[0089] Non-limiting eye care product forms include: mascaras, eye liners, eye shadows, curlers of eye lashes, eyebrow pencils, and eye pencils.

[0090] (2) Lip care

[0091] Non-limiting lip care product forms include: lipsticks, lip balms, lip pencils, lip glosses, lip sprays, transparent lip bases, tinted lip moisturizers, and multi-functional color sticks that can also be used for cheeks and eyes.

[0092] (3) Nail care

[0093] Non-limiting nail care product forms include: nail polishes, nail varnishes, enamels, nail varnish removers, home-manicure products such as cuticle softeners and nail strengtheners, and artificial nails.

[0094] (4) Face care

[0095] Non-limiting face care product forms include: creams, lotions, solutions, oils, liquids, peels, scrubs, emulsions, suspensions, microemulsions, microencapsulated product, pastes, reconstitutable product, aerosols, mousses, gels, waxes, glues, pomades, spritzes, facial wet-wipes, putties, lacquers, serums, perms, powders, blush, highlighters, bronzers, masks, and concealers.

[0096] (5) Body care

[0097] Non-limiting body care product forms include: foams, peels, masks, gels, sticks, aerosols, lotions, salts, oils, balls, liquids, powders, peels, pearls, bar soaps, liquid soaps, body washes, cleansers, scrubs, creams, flakes, other bath and shower products, shaving products, waxing products, and sanitizers.

[0098] (6) Foot care

[0099] Non-limiting foot care product forms include: mousses, creams, lotions, powders, liquids, sprays, aerosols, gels, flakes, and scrubs.

[00100] Non-limiting oral care product forms include: toothpastes, adhesives, gums, gels, powders, creams, solutions, lotions, liquids, dispersions, suspensions, emulsions, tablets, capsules, rinses, flosses, aerosols, strips, films, pads, bandages, microencapsulated products, syrups, and lozenges.

[00101] Also contemplated are personal care compositions comprising polymer(s) described herein complexed with iodine. These compositions may be used in treating skin conditions, non-limiting examples of which include dermatitis, wounds, bacterial infections, burns, rashes, and herpes. These complexed compositions may be staining, substantially non-staining, or essentially non-staining.

[00102] Examples of related personal care compositions are disclosed in U.S. patents 5,599,800; 5,650,166; 5,916,549; and 6,812,192; U.S. patent application 2009/0317432; EP

556,660; 661,037; 661,038; 662,315; 676,194; 796,077; 970,682; 976383; 1,415,654; and 2,067,467; and WO 2005/032506; each of which is hereby incorporated in its entirety by reference.

[00103] It is also contemplated that the personal care compositions may be used in products for male and/or female personal grooming and/or toiletry such as: sanitary napkins, baby diapers, adult diapers, feminine products, products for incontinence, and other related products.

[00104] An array of additional personal care compositions, methods, and uses are contemplated. Disclosure of these compositions may be found in the following brochures by Ashland Specialty Ingredients, each of which is hereby incorporated in its entirety by reference: *Plasdone™ K-29/32, Advanced non-oxidative, non-abrasive teeth whitening in toothpastes, mouthwashes, and oral rinses* (2010), *Polymers for oral care, product and applications guide* (2002), *A formulation guide for excellent hair styling gels and lotions* (4/2003), *PVP (polyvinylpyrrolidone)* (no date provided), and *Textile chemicals, solutions for the most challenging product environment* (no date provided).

[00105] Also contemplated are additional personal care compositions that may comprise the polymers described herein. Disclosures on such compositions may be found in the publications listed below, each of which is hereby incorporated in its entirety by reference: (1) Prototype Formulations - Personal Care Products (2009) from Xiameter, Dow Corning. (2) Sun care formulations under the category "Refreshing Sun", "Younger Sun", "Sun for Men", and "Sunny Glow" from Dow Corning. (3) Cosmetic Nanotechnology, Polymers and Colloids in Cosmetics, 2007, ACS Symposium Series. (4) Review Paper: Lipid nanoparticles (SLN, NLC) in cosmetic and pharmaceutical dermal products, International Journal of Pharmaceutics, Volume 366, 2009.

Optional: Additional composition ingredients

[00106] It is also contemplated that the personal care compositions optionally may contain one or more additional ingredients.

[00107] Further, it is contemplated that the composition ingredients may be formulated in a single container, or the ingredients may be formulated in-part in two or more distinct

containers of the same or different type, the contents of which may require mixing prior to use.

[00108] Furthermore, it also is contemplated that the compositions may be prepared in the form of concentrates that may be diluted by a suitable substance(s) prior to use. The concentrate may, in turn, be present in any of the forms as described under 'Product Forms' for the personal care compositions of the invention.

[00109] A non-limiting list of classes of additional ingredients that may optionally be present in different types of personal care compositions is provided below: conditioning agents, antimicrobials, protectives (for example, antiradical agents), abrasives, UV absorbers, emulsifiers (including, but not limited to ethoxylated fatty acids, ethoxylated glyceryl esters, ethoxylated oils, ethoxylated sorbitan esters, fatty esters, PEG esters, polyglycerol esters), antiperspirants (including, but not limited to aluminium chlorohydrates, aluminium zirconium chlorhydrates), antioxidants, vitamins and/or provitamins, botanicals, fixatives, oxidizing agents, reducing agents, dyes, cleansing agents, anionic, cationic, nonionic, and/or amphoteric surfactants, thickeners and/or gelling agents, perfumes, flavors, and/or fragrances, pearlizing agents, stabilizers, pH adjusters, filters, antimicrobial agents, preservatives and/or disinfectants, associative polymers, oils of vegetable, mineral, and/or synthetic origin, polyols, silicones, colorants, bleaching agents, highlighting agents, propellants (including, but not limited to dimethyl ether, hydrofluorocarbon 152A, *n*-butane, *iso*-butane, *n*-propane, *iso*-pentane, compressed air, liquified nitrogen, nitrous oxide, liquified carbon dioxide, and combinations thereof), styling polymers, benefit agents, skin lighteners (including, but not limited to arbutin and kojic acids), tanning agents (including, but not limited to dihydroxyacetone), solvents and/or cosolvents, diluents, essential oils, sequestrants and/or chelators, carriers, and natural extracts and/or natural products.

[00110] The amount of each ingredient in the composition varies depending on the type of composition, the function and/or physicochemical property of the ingredient, and the amount of other co-ingredients. The precise amount of each ingredient may be easily determined by any person skilled in the related arts.

[00111] It may be desirable to include one or more ingredients described in the prior art disclosures IPCOM000186541D, IPCOM000128968D, and IPCOM000109682D on

www.ip.com, the contents of each of these disclosures are hereby incorporated in their entirety by reference.

[00112] Further reference to formulary co-ingredients and product forms include the disclosures in US 2010/0183532, paragraphs [0096]—[0162], and WO 2010/105050, paragraphs [0053]—[0069], the contents of which are hereby incorporated in their entirety by reference.

[00113] Non-limiting examples of structurants that may be used in the hair care compositions according to the invention include dextrin palmitate, trihydroxystearin, hydroxy stearic acid, hydrophilic or hydrophobic silica, hydrophobically modified clay selected from the group consisting of stearalkonium hectorite, quaternium-18 bentonite, quaternium-18 hectorite, disteardimonium hectorite, derivatives thereof, and mixtures thereof.

[00114] The hair care compositions of the invention may additionally comprise one or more hair styling agents, hair fixative agents, and/or film formers.

[00115] Particularly useful as styling agents are hair styling polymers. The hair styling polymers may be cationic, anionic, amphoteric or nonionic in nature. The polymers may be synthetic or naturally derived. Non-limiting examples of hair styling polymers include the following polymer products available for sale from Ashland Specialty Ingredients: (1) Cationic styling polymers with hair conditioning benefits – Styleze™ W Polymer, Styleze™ CC-10 (pseudo cationic), Gafquat™ 755 NP, and Gafquat™ 440; (2) Styling polymers with excellent high humidity curl retention – Styleze™ 2000, Allianz™ LT 120, Styleze™ W Polymer, and Advantage™ LCA; (3) Non-ionic styling polymers with broad ingredient compatibility – Polyvinylpyrrolidones such as PVP K-30, PVP K-60 and PVP K-90, Vinylpyrrolidone/vinyl acetate copolymers such as PVP/VA (E, I or W) 735, PVP/VA (E or W) 635, PVP/VA (E or I) 535, PVP/VA (E or I) 335 and PVP/VA S-630, and poly(vinylpyrrolidone/dimethylaminoethylmethacrylate) polymers such as Copolymer 845/937. Additional details on the aforementioned polymers and methods of use, or formulations thereof, may be found in a publication from Ashland Specialty Ingredients titled *"A Formulation Guide for Excellent Hair Styling Gels and Lotions"* (2002) that is hereby incorporated in its entirety by reference.

[00116] A non-limiting example of hair fixative agent that may be used in hair care compositions according to the invention includes a hair fixative polymer available for sale

from Ashland Specialty Ingredients, AquaStyle™ 300 (INCI name Polyquaternium-69). A related publication from Ashland Specialty Ingredients titled *"Aquastyle™ 300, A Fixative Polymer with Enhanced Styling Benefits"* (2007) is hereby incorporated in its entirety by reference.

[00117] Non-limiting examples of film formers that may be used in hair care compositions according to the invention include film forming polymers available for sale from Ashland Specialty Ingredients such as (1) Aquaflex™ FX 64, (2) AquaCat™ clear cationic solution, (3) Aqualon™ carboxymethylcellulose, (4) Klucel™ hydroxypropylcellulose, and (5) Primaflo™ HP22 polymer solution.

[00118] Further details on hair styling agents, hair fixative agents, and/or film formers may be found in U.S. patents 7,871,600, 7,205,271, 7,122,175, 7,041,281, 6,998,114, 6,749,836, 6,689,346, 6,599,999, 6,562,325, 6,413,505, 6,387,351, 6,228,352, 5,643,581, 5,922,312, 5,897,870, 5,879,669, 5,709,850, 5,753,216 and 5,632,977 each of which is hereby incorporated in its entirety by reference.

[00119] Non-limiting examples of anti-frizz agents that may be used in hair care compositions according to the invention include anti-frizz polymers available for sale from Ashland Specialty Ingredients such as AquaStyle™ 300 and Styleze™ XT3. Information on related anti-frizz agents may be found in U.S. patents 7,914,773, 7,785,575, and U.S. published application 2010/00093584, the disclosures of each of which is hereby incorporated in its entirety by reference.

[00120] One or more plasticizers or coalescing agents may be added to modify the film forming characteristics of hair care compositions according to the invention. Non-limiting examples of plasticizers include glycols, adipic esters, phthalate esters, isobutyrate esters, terephthalate esters, epoxidized butyl esters or fatty acids, epoxidized vegetable oils, glycerine, di-2-ethylhexyladipate or dioctyladipate (DOA), di-2-ethylhexyl phthalate or dioctyl phthalate (DOP), di-2-ethylhexyl terephthalate (DOTP), dicyclohexyl phthalate, diisononyl adipate, diisononylphthalate, *n*-butyl benzyl phthalate, 1,3-butylene glycol/adipic acid polyester, dialkyl adipate, dialkyl phthalate derivatives where the alkyl group is a C_1 -C_{12} alkyl group, di-*n*-hexylazelate, diphenylphthalate, tricresol phosphate, benzyl benzoate, dibutyl phosphate, tributyl phosphate, tributoxyethyl phosphate, triphenyl phosphate, butyl acetyl ricinoleate, glycerol acetyl ricinoleate, dibutyl phthalate, diethyl phthalate, dioctyl

phthalate, dimethoxyethyl phthalate, diisobutyl phthalate, diamyl phthalate, dibutyl glycolate, butyl stearate, triethyl citrate, tributyl citrate, tributyl acetyl citrate, 2-hexyltriethylacetyl citrate, dibutyl tartarate, camphor, epoxidized butyl esters of linseed oil fatty acids, epoxidized linseed oil, epoxidized soya oil, propylene glycol adipate, 2,2,4-trimethyl-1,3-pentanediol diisobutyrate (TXIB), methyl abietate, cumyl acetate, dibutoxyethyl adipate, di-*n*-hexylazalate, glyceryl-tri-benzerate, tri-*n*-butylcitrate, dioctyl fumarate, triisonyl trimellitate, dioctyl isophthalate, butyl oleate, chlorinated paraffin, tricresolphosphate, dibutyl sebacate, dimethicone copolyol (Dow Corning 190), PEG-6 capric/caprylic glyceride (SOFTIGEN 767), DIACETIN, LAURAMIDE DEA (MONAMID 716), phenyl trimethicone (ABIL AV 20-1000), propylene glycol, dipropylene glycol, as well as polymeric plasticizers, and mixtures thereof. Non-limiting examples of coalescing solvents include acetone, methyl acetate, and di- or tri-propylene glycol methyl ethers, and mixtures thereof. Further examples of plasticizers may be found in U.S. patents 5,753,216 and 5,676,935, the disclosures of each of which are hereby incorporated in its entirety by reference.

[00121] Non-limiting examples of propellants that may be used in hair care compositions of the invention include trichlorofluoromethane, chlorodifluoromethane, 1,1-difluoroethane, dichlorotetrafluoroethane, monochlorodifluoromethane, trichlorotrifluoroethane, dimethyl ether, C_1 -C_4 hydrocarbons such as methane, ethane, propane, *n*-butane, and isobutane, water-soluble gases such as, dimethyl ether, carbon dioxide, and/or nitrous oxide, and insoluble, compressed gases such as nitrogen, helium, and fully-fluorinated oxetanes and oxepanes, and mixtures thereof.

[00122] Non-limiting examples of penetrants that may be used in hair care compositions of the invention include lanolin compounds, protein hydrolysates, protein derivatives, and mixtures thereof.

[00123] Non-limiting examples of anti-foaming agents that may be used in hair care compositions of the invention include carrier oils, silicone oils, silicone foam inhibitors, hydrophobic silica, hydrophobic fat derivatives, waxes, water-insoluble polymers, amphiphilic components, emulsifiers, coupling agents, and mixtures thereof.

[00124] Any known conditioning agent may be used in the personal care compositions of the invention. An extensive discussion on conditioning agents may be found in the book *Conditioning Agents for Skin and Hair*, *Cosmetic Science and Technology Series*, Volume

21, 1999, Marcel Dekker Publishers. The contents of the book are hereby incorporated in its entirety by reference.

[00125] Conditioning agents may be chosen from synthetic oils, mineral oils, vegetable oils, fluorinated or perfluorinated oils, natural or synthetic waxes, silicones, cationic polymers, proteins and hydrolyzed proteins, cationic surfactants, ceramide type compounds, fatty amines, fatty acids and their derivatives, as well as mixtures of these different types of compounds.

[00126] Non-limiting examples of suitable synthetic oils include: polyolefins, *e.g.,* poly-α-olefins, such as polybutenes, polyisobutenes, polydecenes, and blends thereof. The polyolefins may be hydrogenated.

[00127] Non-limiting examples of suitable mineral oils include hexadecane and oil of paraffin.

[00128] Non-limiting examples of suitable animal and vegetable oils include: sunflower oil, corn oil, soy oil, avocado oil, jojoba oil, squash oil, raisin seed oil, sesame seed oil, walnut oil, fish oil, glycerol tricaprocaprylate, purcellin oil, liquid jojoba, and blends thereof. Also suitable are natural oils such as oils of eucalyptus, lavender, vetiver, litsea cubeba, lemon, sandalwood, rosemary, chamomile, savory, nutmeg, cinnamon, hyssop, caraway, orange, geranium, cade, bergamot, and blends thereof.

[00129] The conditioning agent may be a fluorinated or a perfluorinated oil. The fluoridated oils may also be fluorocarbons such as fluoramines, *e.g.*, perfluorotributylamine, fluoridated hydrocarbons such as perfluorodecahydronaphthalene, fluoroesters, fluoroethers, and blends thereof.

[00130] Non-limiting examples of suitable natural and synthetic waxes include: carnauba wax, candelila wax, alfa wax, paraffin wax, ozokerite wax, vegetable waxes such as olive wax, rice wax, hydrogenated jojoba wax, absolute flower waxes such as black currant flower wax, animal waxes such as bees wax, modified bees wax (cerabellina), marine waxes and polyolefin waxes such as polyethylene wax, and blends thereof.

[00131] The conditioning agent may be any silicone known by those skilled in the art. Silicones include polyorganosiloxanes that are insoluble in the composition. The silicones

may be present in the form of oils, waxes, resins, or gums. They may be volatile or non-volatile.

[00132] Non-limiting examples of suitable silicones include: polyalkyl siloxanes, polyaryl siloxanes, polyalkyl aryl siloxanes, silicone gums and resins, polyorgano siloxanes modified by organofunctional groups, and blends thereof.

[00133] Suitable polyalkyl siloxanes include polydimethyl siloxanes with terminal trimethyl silyl groups or terminal dimethyl silanol groups (dimethiconol) and polyalkyl (C1-C20) siloxanes. Suitable polyalkyl aryl siloxanes include polydimethyl methyl phenyl siloxanes and polydimethyl diphenyl siloxanes. The siloxanes can have a linear or branched structure.

[00134] Suitable silicone gums include polydiorganosiloxanes, such as those having a number-average molecular weight between 200,000 Da and 1,000,000 Da used alone or mixed with a solvent.

[00135] Non-limiting examples of suitable silicone gums include: polymethyl siloxane, polydimethyl siloxane/methyl vinyl siloxane gums, polydimethyl siloxane/diphenyl siloxane, polydimethyl siloxane/phenyl methyl siloxane, polydimethyl siloxane/diphenyl siloxane/methyl vinyl siloxane, and blends thereof.

[00136] Non-limiting examples of suitable silicone resins include silicones with a dimethyl/trimethyl siloxane structure and resins of the trimethyl siloxysilicate type.

[00137] The organo-modified silicones suitable for use in the invention include silicones such as those previously defined and containing one or more organofunctional groups attached by means of a hydrocarbon radical, and grafted silicone polymers. The organo-modified silicones may be one from the amino functional silicone family.

[00138] The silicones may be used in the form of emulsions, nano-emulsions, or micro-emulsions.

[00139] The cationic polymers that may be used as conditioning agents according to the invention generally have a molecular weight (average number) from about 500 Da to about 5,000,000 Da, and particularly from about 1,000 Da to about 3,000,000 Da. The expression "cationic polymer" as used herein indicates any polymer having at least one cationic group.

[00140] The cationic polymers may be chosen from among polymers containing primary, secondary, tertiary amine, and/or quaternary ammonium groups that may form part of the main polymer backbone and/or side chain(s).

[00141] Non-limiting examples of suitable cationic polymers include polyamines, polyaminoamides, and quaternary polyammonium classes of polymers, such as:

[00142] (1) homopolymers and copolymers derived from acrylic or methacrylic esters or amides. The copolymers may contain one or more units derived from acrylamides, methacrylamides, diacetone acrylamides, acrylic or methacrylic acids or their esters, vinyllactams such as vinyl pyrrolidone or vinyl caprolactam, and vinyl esters. Non-limiting, specific examples include: copolymers of acrylamide and dimethyl amino ethyl methacrylate quaternized with dimethyl sulfate or with an alkyl halide; copolymers of acrylamide and methacryloyl oxyethyl trimethyl ammonium chloride; the copolymer of acrylamide and methacryloyl oxyethyl trimethyl ammonium methosulfate; copolymers of vinyl pyrrolidone and dialkylaminoalkyl acrylate or methacrylate, optionally quaternized, such as the products sold under the name Gafquat™ by Ashland Specialty Ingredients; terpolymers of dimethyl amino ethyl methacrylate, vinyl caprolactam, and vinyl pyrrolidone such as the product sold under the name Gaffix™ VC 713 by Ashland Specialty Ingredients; the vinyl pyrrolidone/methacrylamidopropyl dimethylamine copolymer, marketed under the name Styleze™ CC 10 by Ashland Specialty Ingredients; and the vinyl pyrrolidone/quaternized dimethyl amino propyl methacrylamide copolymers such as the product sold under the name Gafquat™ HS 100 by Ashland Specialty Ingredients (Wayne, NJ).

[00143] (2) derivatives of cellulose ethers containing quaternary ammonium groups, such as hydroxy ethyl cellulose quaternary ammonium that has reacted with an epoxide substituted by a trimethyl ammonium group.

[00144] (3) derivatives of cationic cellulose such as cellulose copolymers or derivatives of cellulose grafted with a hydrosoluble quaternary ammonium monomer, as described in U.S. patent 4,131,576, such as hydroxy alkyl cellulose, and hydroxymethyl-, hydroxyethyl- or hydroxypropyl- cellulose grafted with a salt of methacryloyl ethyl trimethyl ammonium, methacrylamidopropyl trimethyl ammonium, or dimethyl diallyl ammonium.

[00145] (4) cationic polysaccharides such as described in U.S. patents 3,589,578 and 4,031,307, guar gums containing cationic trialkyl ammonium groups, and guar gums modified by a salt, *e.g.*, chloride of 2,3-epoxy propyl trimethyl ammonium.

[00146] (5) polymers composed of piperazinyl units and alkylene or hydroxy alkylene divalent radicals with straight or branched chains, possibly interrupted by atoms of oxygen, sulfur, nitrogen, or by aromatic or heterocyclic cycles, as well as the products of the oxidation and/or quaternization of such polymers.

[00147] (6) water-soluble polyamino amides prepared by polycondensation of an acid compound with a polyamine. These polyamino amides may be reticulated.

[00148] (7) derivatives of polyamino amides resulting from the condensation of polyalkylene polyamines with polycarboxylic acids followed by alkylation by bi-functional agents.

[00149] (8) polymers obtained by reaction of a polyalkylene polyamine containing two primary amine groups and at least one secondary amine group with a dioxycarboxylic acid chosen from among diglycolic acid and saturated dicarboxylic aliphatic acids having 3 to 8 atoms of carbon. Such polymers include those described in U.S. patents 3,227,615 and 2,961,347.

[00150] (9) cyclopolymers of alkyl diallyl amine or dialkyl diallyl ammonium such as the homopolymer of dimethyl diallyl ammonium chloride and copolymers of diallyl dimethyl ammonium chloride and acrylamide.

[00151] (10) quaternary diammonium polymers such as hexadimethrine chloride.

[00152] (11) quaternary polyammonium polymers, including, for example, Mirapol® A 15, Mirapol® AD1, Mirapol® AZ1, and Mirapol® 175 products sold by Miranol.

[00153] (12) quaternary polymers of vinyl pyrrolidone and vinyl imidazole such as the products sold under the names Luviquat® FC 905, FC 550, and FC 370 by BASF Corporation.

[00154] (13) quaternary polyamines.

[00155] (14) reticulated polymers known in the art.

[00156] Other cationic polymers that may be used include cationic proteins or hydrolyzed cationic proteins, polyalkyleneimines such as polyethyleneimines, polymers containing vinyl pyridine or vinyl pyridinium units, condensates of polyamines and epichlorhydrins, quaternary polyurethanes, and derivatives of chitin.

[00157] The conditioning agent may comprise a protein or hydrolyzed cationic or non-cationic protein. Non-limiting examples of suitable compounds include: hydrolyzed collagens having triethyl ammonium groups, hydrolyzed collagens having trimethyl ammonium and trimethyl stearyl ammonium chloride groups, hydrolyzed animal proteins having trimethyl benzyl ammonium groups (benzyltrimonium hydrolyzed animal protein), hydrolyzed proteins having groups of quaternary ammonium on the polypeptide chain, including at least one C1-C18 alkyl, and blends thereof.

[00158] Non-limiting examples of suitable hydrolyzed cationic proteins include: Croquat® L, in which the quaternary ammonium groups include a C12 alkyl group, Croquat® M, in which the quaternary ammonium groups include C10-C18 alkyl groups, Croquat® S in which the quaternary ammonium groups include a C18 alkyl group, Crotein® Q in which the quaternary ammonium groups include at least one C1-C18 alkyl group, and blends thereof. These products are sold by Croda.

[00159] The conditioning agent may also comprise quaternized vegetable protein(s) such as wheat, corn, or soy proteins, non-limiting examples of which include: cocodimonium hydrolyzed wheat protein, laurdimonium hydrolyzed wheat protein, steardimonium hydrolyzed wheat protein, 2-*N*-stearoyl amino-octadecane-1,3-diol, 2-*N*-behenoyl amino-octadecane-1,3-diol, 2-*N*-[2-hydroxy-palmitoyl]-amino-octadecane-1,3-diol, 2-*N*-stearoyl amino-octadecane-1,3,4-triol, *N*-stearoyl phytosphingosine, 2-*N*-palmitoyl amino-hexadecane-1,3-diol, bis-(*N*-hydroxy ethyl *N*-cetyl) malonamide, *N*-(2-hydroxy ethyl)-*N*-(3-cetoxyl-2-hydroxy propyl) amide of cetylic acid, *N*-docosanoyl *N*-methyl-D-glucamine, and blends thereof.

[00160] The conditioning agent may also comprise a cationic surfactant such as a salt of a primary, secondary, or tertiary fatty amine, optionally polyoxyalkylenated, a quaternary ammonium salt, a derivative of imadazoline, or an amine oxide. Conditioning agents may also be selected from the group consisting of: mono-, di-, and tri- alkyl amines, and quaternary ammonium compounds with a counterion such as a chloride, a methosulfate, a

tosylate, etc. Non-limiting examples of suitable amines include: cetrimonium chloride, dicetyldimonium chloride, behentrimonium methosulfate, and blends thereof.

[00161] The conditioning agent may comprise a fatty amine. Non-limiting examples of suitable fatty amines include: dodecyl amines, cetyl amines, stearyl amines such as stearamidopropyl dimethylamine, and blends thereof.

[00162] The conditioning agent may comprise a fatty acid or derivative(s) thereof. Non-limiting examples of suitable fatty acids include: myristic acid, palmitic acid, stearic acid, behenic acid, oleic acid, linoleic acid, isostearic acid, and blends thereof. The derivatives of fatty acids include carboxylic ester acids including mono-, di-, tri- and tetra- carboxylic acids esters, amides, anhydrides, esteramides, imides, and mixtures of these functional groups.

[00163] Also suitable as conditioning agents are the following commercial products:

[00164] (1) Aquacat™ Clear Cationic Solution (INCI Name: guar hydroxypropyltrimonium Chloride), *N*-Hance™ SP-100 (INCI Name: acrylamidopropyl trimonium chloride/acrylamide copolymer), and *N*-Hance™ cationic guar (INCI Name: guar hydroxypropyltrimonium chloride) from Ashland Specialty Ingredients

[00165] (2) Salcare® from BASF Corp.

[00166] (3) Softcat™ Polymers from The Dow Chemical Company.

[00167] (4) Jaguar® C500, Polycare® Boost, Mackconditioner™ Brite, and Mackine® 301 from Rhodia.

[00168] (5) Stepanquat® ML, Stepanquat® GA-90, Ninol®, and Ammonyx® from Stepan Company.

[00169] (6) Conditioneze™ 7 and Conditioneze™ NT-20 from Ashland Specialty Ingredients (Wayne, NJ).

[00170] Of course, mixtures of two or more conditioning agents may be used.

[00171] The conditioning agent(s) may be present in an amount from about 0.001% to about 20%, particularly from about 0.01% to about 10%, and even more particularly from about 0.1% to about 3% by weight of the composition.

[00172] Personal care compositions may optionally comprise antimicrobial agent(s).

[00173] Non-limiting examples of suitable water insoluble, non-cationic antimicrobial agents include: halogenated diphenyl ethers, phenolic compounds including phenol and its homologs, mono and poly-alkyl and aromatic halophenols, resorcinol and its derivatives, bisphenolic compounds and halogenated salicylanilides, benzoic esters, halogenated carbanilides, and blends thereof.

[00174] Non-limiting examples of suitable water soluble antimicrobial agents include: quaternary ammonium salts, bis-biquanide salts, triclosan monophosphate, and blends thereof.

[00175] The quaternary ammonium agents include those in which one or two of the substituents on the quaternary nitrogen has a carbon chain length (typically alkyl group) from about 8 to about 20, typically from about 10 to about 18 carbon atoms, while the remaining substituents (typically alkyl or benzyl group) have a lower number of carbon atoms, such as from about 1 to about 7 carbon atoms, typically methyl or ethyl groups.

[00176] Non-limiting examples of suitable quaternary ammonium antibacterial agents include: Dodecyl trimethyl ammonium bromide, tetradecylpyridinium chloride, domiphen bromide, *N*-tetradecyl-4-ethyl pyridinium chloride, dodecyl dimethyl(2-phenoxyethyl)ammonium bromide, benzyl dimethylstearyl ammonium chloride, cetyl pyridinium chloride, quaternized 5-amino-1,3-bis(2-ethyl-hexyl)-5-methyl hexahydropyrimidine, benzalkonium chloride, benzethonium chloride, methyl benzethonium chloride, and blends thereof.

[00177] Other antimicrobial compounds are bis[4-(R-amino)-1-pyridinium]alkanes as disclosed in U.S. patent 4,206,215. Other antimicrobials such as copper salts, zinc salts and/or stannous salts may also be included. Also useful are enzymes, including endoglycosidase, papain, dextranase, mutanase, and blends thereof. Such antimicrobial agents are disclosed in U.S. patents 2,946,725 and 4,051,234. The antimicrobial agents may also comprise chlorhexidine, triclosan, and flavor oils such as thymol. Triclosan and other agents are disclosed in U.S. patents 5,015,466 and 4,894,220.

[00178] In particular embodiments, one or more preservatives may be included.

[00179] Non-limiting examples of suitable preservatives include: benzoic acid, sorbic acid, dehydroacetic acid, diazolidinyl ureas, imidazolidinyl ureas, salicylic acid, piroctone olamine, DMDM hydantoin, IPBC (iodopropynyl butylcarbamate), triclosan, bronopol, formaldehyde, isothiazolinones, nitrates/nitrites, parabens, phenoxyethanol, potassium sorbate, sodium benzoate, sulphites, sulphur dioxide, and blends thereof.

[00180] In particular embodiments, preservative boosters/solvents may be incorporated, non-limiting examples of which include: caprylyl glycol, hexylene glycol, pentylene glycol, ethylhexylglycerin, caprylhydroxamic acid, caprylohydroxamic acid, glyceryl caprylate, and blends thereof.

[00181] Polysaccharides, such as gum Arabic, may be included as well.

[00182] Personal care compositions may comprise liquid or liquid-like carrier(s) that help to distribute, disperse, and/or dissolve the ingredients.

[00183] Non-limiting examples of suitable liquid carriers include: water, alcohols, oils, esters, and blends thereof.

[00184] The compositions of the invention may also be in the form of aqueous or hydro-alcoholic solutions.

[00185] The physiological and cosmetically acceptable medium may consist exclusively of water, a cosmetically acceptable solvent, or a blend of water and a cosmetically acceptable solvent, such as a lower alcohol composed of C1 to C4, such as ethanol, isopropanol, t-butanol, *n*-butanol, alkylene glycols such as propylene glycol, and glycol ethers.

[00186] In one of the embodiment, the compositions of the invention may be anhydrous.

[00187] Personal care formulations may comprise antioxidant(s) and/or antiradical protecting agent(s).

[00188] Non-limiting examples of suitable antioxidants and/or antiradical protecting agents include: BHA (*tert*-butyl-4-hydroxy anisole), BHT (2,6-di-*tert*-butyl-*p*-cresol), TBHQ (*tert*-butyl hydroquinone), polyphenols such as proanthocyanodic oligomers, flavonoids, hindered amines such as tetra amino piperidine, erythorbic acid, polyamines such as spermine, cysteine, glutathione, superoxide dismutase, lactoferrin, and blends thereof.

[00189] Personal care compositions may comprise vitamin(s), provitamin(s), and/or mineral(s).

[00190] Non-limiting examples of suitable vitamins include: ascorbic acid (vitamin C), vitamin E, vitamin E acetate, vitamin E phosphate, B vitamins such as B3 and B5, niacin, vitamin A, derivatives thereof, and blends thereof.

[00191] Non-limiting examples of suitable provitamins include: panthenol, retinol, and blends thereof.

[00192] Non-limiting examples of suitable minerals include: talc, clay, calcium carbonate, silica, kaolin, mica, and blends thereof. Further examples of minerals that may be used in the personal care compositions may be found in a brochure titled *Minerals for Personal Care* from Imerys Performance Minerals, the disclosure of which is hereby incorporated in its entirety by reference.

[00193] Personal care formulations may comprise one or more surfactants. Surfactants serve in solubilizing, dispersing, emulsifying and/or reducing the interfacial tension. Surfactants may be chosen from anionic, nonionic, amphoteric, zwitterionic, or cationic surfactants, or blends thereof.

[00194] Anionic surfactants useful herein include the water-soluble salts of alkyl sulfates having from 8 to 20 carbon atoms in the alkyl radical (*e.g.*, sodium alkyl sulfate) and the water-soluble salts of sulfonated monoglycerides of fatty acids having from 8 to 20 carbon atoms. Sodium lauryl sulfate (SLS) and sodium coconut monoglyceride sulfonates are non-limiting examples of anionic surfactants of this type.

[00195] Non-limiting examples of suitable anionic surfactants include: sarcosinates, taurates, isethionates, sodium lauryl sulfoacetate, sodium laureth carboxylate, and sodium dodecyl benzenesulfonate. Also suitable are alkali metal or ammonium salts of surfactants such as the sodium and potassium salts of the following: lauroyl sarcosinate, myristoyl sarcosinate, palmitoyl sarcosinate, stearoyl sarcosinate, and oleoyl sarcosinate.

[00196] Non-limiting examples of suitable cationic surfactants include: derivatives of aliphatic quaternary ammonium compounds having at least one long alkyl chain containing from about 8 to about 18 carbon atoms, such as, lauryl trimethylammonium chloride, cetyl

pyridinium chloride, cetyl trimethylammonium bromide, di-isobutylphenoxyethyl-dimethylbenzylammonium chloride, coconut alkyltrimethylammonium nitrite, cetyl pyridinium fluoride, and blends thereof. Further suitable are quaternary ammonium fluorides having detergent properties such as compounds described in U.S. patent 3,535,421. Certain cationic surfactants may act as germicides in the compositions disclosed herein.

[00197] Nonionic surfactants useful herein include compounds produced by the condensation of alkylene oxide groups (hydrophilic in nature) with an organic hydrophobic compound which may be aliphatic or alkylaromatic in nature.

[00198] Non-limiting examples of suitable nonionic surfactants include: poloxamers (sold under the trade name Pluronic® by BASF Corporation), polyethylene oxide condensates of alkyl phenols, products derived from the condensation of ethylene oxide with the reaction product of propylene oxide and ethylene diamine, ethylene oxide condensates of aliphatic alcohols, long chain tertiary amine oxides, long chain tertiary phosphine oxides, long chain dialkyl sulfoxides, and blends thereof.

[00199] Non-limiting examples of suitable zwitterionic surfactants include betaines and derivatives of aliphatic quaternary ammonium compounds in which the aliphatic radicals can be straight chain or branched, and which contain an anionic water-solubilizing group, *e.g.*, carboxy, sulfonate, sulfate, phosphate, or phosphonate.

[00200] Non-limiting examples of suitable betaines include: decyl betaine or 2-(*N*-decyl-*N*,*N*-dimethylammonio)acetate, coco betaine or 2-(*N*-coc-*N*,*N*-dimethyl ammonio)acetate, myristyl betaine, palmityl betaine, lauryl betaine, cetyl betaine, stearyl betaine, and blends thereof. The amidobetaines are exemplified by cocoamidoethyl betaine, cocoamidopropyl betaine, lauramidopropyl betaine, and the like. The betaines of choice include cocoamidopropyl betaines such as lauramidopropyl betaine. Suitable betaine surfactants are disclosed in U.S. patent 5,180,577.

[00201] Other surfactants such as fluorinated surfactants may also be incorporated within the compositions of the invention.

[00202] Also suitable as surfactants are the following commercial products:

[00203] (1) Alkanolamides, under the trade names Amidex™ and Schercomid™; amido-amines, under the trade names Katemul™ and Schercodine™; amine oxides, under the trade names Chemoxide™ and Schercamox™; amphoterics, under the trade names Chembetaine™, Schercotaine™ and Schercoteric™; imidazolines, under the trade name Schercozoline™; pearlizing agents, under the trade name Quickpearl™; performance concentrates, under the trade names Sulfochem™ and Chemoryl™; soaps (potassium cocoate and potassium soyate); specialty ethoxylates, under the trade name Chemonic™; specialty quats under the trade names Quatrex™ and Schercoquat™; sulfates, under the trade name Sulfochem™; and sulfosuccinates, under the trade name Chemccinate™ from Lubrizol.

[00204] (2) Avaniel, Cremaphore®, Jordapan®, and Pluracare® from BASF Corp.

[00205] (3) Miracare® SLB, Mackam® Bab, Mackanate® Ultra SI, Miranol® Ultra, and Miracare® Plaisant from Rhodia.

[00206] (4) Stepan® Pearl 2, Stepan® Pearl 4, Stepan® Pearl Series, Neobee® M-20, Stepan® PTC, Amphosol® 2CSF, Steol®, Stepan-Mild® GCC, Stepan® SLL-FB, Stepanol® AM, Stepanol® PB, Alpha-Step® BSS-45, Bio-Terge® 804, Stepan-Mild® L3, Stepan® SLL-FB, Stepan® SSL-CG, and Stepanol® CFAS-70 from Stepan Company.

[00207] Also suitable as surfactants are those described in the book *Surfactants in Personal Care Products and Decorative Cosmetics*, Third Edition, 2006, CRC Press. The disclosure is incorporated hereby in its entirety by reference.

[00208] Personal care compositions may be also be formulated as detergent compositions, such as shampoos, bath gels, and bubble baths. Such compositions comprise water as a liquid carrier. The surfactant or surfactants that form the washing base may be chosen alone or in blends, from known anionic, amphoteric, zwitterionic and/or non-ionic surfactants. The quantity and quality of the washing base must be sufficient to impart a satisfactory foaming and/or detergent value to the final composition. The washing base may be present in an amount from about 4% to about 50% by weight, particularly from about 6% to about 35% by weight, and more particularly from about 8% to about 25% by weight of the final composition.

[00209] Personal care compositions may comprise one or more thickener(s) and/or viscosifier(s).

[00210] Non-limiting examples of suitable thickeners and/or viscosifiers include: Acetamide MEA; acrylamide/ethalkonium chloride acrylate copolymer; acrylamide/ethyltrimonium chloride acrylate/ethalkonium chloride acrylate copolymer; acrylamides copolymer; acrylamide/sodium acrylate copolymer; acrylamide/sodium acryloyldimethyltaurate copolymer; acrylates/acetoacetoxyethyl methacrylate copolymer; acrylates/beheneth-25 methacrylate copolymer; acrylates/C10-C30 alkyl acrylate crosspolymer; acrylates/ceteth-20 itaconate copolymer; acrylates/ceteth-20 methacrylate copolymer; acrylates/laureth-25 methacrylate copolymer; acrylates/palmeth-25 acrylate copolymer; acrylates/palmeth-25 itaconate copolymer; acrylates/steareth-50 acrylate copolymer; acrylates/steareth-20 itaconate copolymer; acrylates/steareth-20 methacrylate copolymer; acrylates/stearyl methacrylate copolymer; acrylates/vinyl isodecanoate crosspolymer; acrylic acid/acrylonitrogens copolymer; adipic acid/methyl DEA crosspolymer; agar; agarose; alcaligenes polysaccharides; algin; alginic acid; almondamide DEA; almondamidopropyl betaine; aluminum/magnesium hydroxide stearate; ammonium acrylates/acrylonitrogens copolymer; ammonium acrylates copolymer; ammonium acryloyldimethyltaurate/vinyl formamide copolymer; ammonium acryloyldimethyltaurate/VP copolymer; ammonium alginate; ammonium chloride; ammonium polyacryloyldimethyl taurate; ammonium sulfate; amylopectin; apricotamide DEA; apricotamidopropyl betaine; arachidyl alcohol; arachidyl glycol; arachis hypogaea (peanut) flour; ascorbyl methylsilanol pectinate; astragalus gummifer gum; attapulgite; avena sativa (oat) kernel flour; avocadamide DEA; avocadamidopropyl betaine; azelamide MEA; babassuamide DEA; babassuamide MEA; babassuamidopropyl betaine; behenamide DEA; behenamide MEA; behenamidopropyl betaine; behenyl betaine; bentonite; butoxy chitosan; caesalpinia spinosa gum; calcium alginate; calcium carboxymethyl cellulose; calcium carrageenan; calcium chloride; calcium potassium carbomer; calcium starch octenylsuccinate; C20-40 alkyl stearate; canolamidopropyl betaine; capramide DEA; capryl/capramidopropyl betaine; carbomer; carboxybutyl chitosan; carboxymethyl cellulose acetate butyrate; carboxymethyl chitin; carboxymethyl chitosan; carboxymethyl dextran; carboxymethyl hydroxyethylcellulose; carboxymethyl hydroxypropyl guar; carnitine; cellulose acetate propionate carboxylate; cellulose gum; ceratonia siliqua gum; cetearyl alcohol; cetyl alcohol; cetyl babassuate; cetyl betaine; cetyl glycol; cetyl hydroxyethylcellulose; chimyl alcohol; cholesterol/HDI/pullulan copolymer; cholesteryl hexyl dicarbamate pullulan; citrus aurantium dulcis (orange) peel extract; cocamide DEA; cocamide MEA; cocamide MIPA; cocamidoethyl betaine; cocamidopropyl betaine; cocamidopropyl hydroxysultaine; coco-

betaine; coco-hydroxysultaine; coconut alcohol; coco/oleamidopropyl betaine; coco-Sultaine; cocoyl sarcosinamide DEA; cornamide/cocamide DEA; cornamide DEA; croscarmellose; crosslinked bacillus/glucose/sodium glutamate ferment; cyamopsis tetragonoloba (guar) gum; decyl alcohol; decyl betaine; dehydroxanthan gum; dextrin; dibenzylidene sorbitol; diethanolaminooleamide DEA; diglycol/CHDM/isophthalates/SIP copolymer; dihydroabietyl behenate; dihydrogenated tallow benzylmonium hectorite; dihydroxyaluminum aminoacetate; dimethicone/PEG-10 crosspolymer; dimethicone/PEG-15 crosspolymer; dimethicone propyl PG-betaine; dimethylacrylamide/acrylic acid/polystyrene ethyl methacrylate copolymer; dimethylacrylamide/sodium acryloyldimethyltaurate crosspolymer; distearеth-100 IPDI; DMAPA acrylates/acrylic acid/acrylonitrogens copolymer; erucamidopropyl hydroxysultaine; ethylene/sodium acrylate copolymer; gelatin; gellan gum; glyceryl alginate; glycine soja (soybean) flour; guar hydroxypropyltrimonium chloride; hectorite; hyaluronic acid; hydrated silica; hydrogenated potato starch; hydrogenated tallow; hydrogenated tallowamide DEA; hydrogenated tallow betaine; hydroxybutyl methylcellulose; hydroxyethyl acrylate/sodium acryloyldimethyl taurate copolymer; hydroxyethylcellulose; hydroxyethyl chitosan; hydroxyethyl ethylcellulose; hydroxyethyl stearamide-MIPA; hydroxylauryl/hydroxymyristyl betaine; hydroxypropylcellulose; hydroxypropyl chitosan; hydroxypropyl ethylenediamine carbomer; hydroxypropyl guar; hydroxypropyl methylcellulose; hydroxypropyl methylcellulose stearoxy ether; hydroxypropyl starch; hydroxypropyl starch phosphate; hydroxypropyl xanthan gum; hydroxystearamide MEA; isobutylene/sodium maleate copolymer; isostearamide DEA; isostearamide MEA; isostearamide mIPA; isostearamidopropyl betaine; lactamide MEA; lanolinamide DEA; lauramide DEA; lauramide MEA; lauramide MIPA; lauramide/myristamide DEA; lauramidopropyl betaine; lauramidopropyl hydroxysultaine; laurimino bispropanediol; lauryl alcohol; lauryl betaine; lauryl hydroxysultaine; lauryl/myristyl glycol hydroxypropyl ether; lauryl sultaine; lecithinamide DEA; linoleamide DEA; linoleamide MEA; linoleamide MIPA; lithium magnesium silicate; lithium magnesium sodium silicate; macrocystis pyrifera (kelp); magnesium alginate; magnesium/aluminum/hydroxide/carbonate; magnesium aluminum silicate; magnesium silicate; magnesium trisilicate; methoxy PEG-22/dodecyl glycol copolymer; methylcellulose; methyl ethylcellulose; methyl hydroxyethylcellulose; microcrystalline cellulose; milkamidopropyl betaine; minkamide DEA; minkamidopropyl betaine; MIPA-myristate; montmorillonite; Moroccan lava clay; myristamide DEA; myristamide MEA; myristamide MIPA; myristamidopropyl betaine; myristamidopropyl hydroxysultaine; myristyl alcohol; myristyl betaine; natto gum; nonoxynyl

hydroxyethylcellulose; oatamide MEA; oatamidopropyl betaine; octacosanyl glycol isostearate; octadecene/MA copolymer; oleamide DEA; oleamide MEA; oleamide MIPA; oleamidopropyl betaine; oleamidopropyl hydroxysultaine; oleyl betaine; olivamide DEA; olivamidopropyl betaine; oliveamide MEA; palmamide DEA; palmamide MEA; palmamide MIPA; palmamidopropyl betaine; palmitamide DEA; palmitamide MEA; palmitamidopropyl betaine; palm kernel alcohol; palm kernelamide DEA; palm kernelamide MEA; palm kernelamide MIPA; palm kernelamidopropyl betaine; peanutamide MEA; peanutamide MIPA; pectin; PEG-800; PEG-crosspolymer; PEG-150/decyl alcohol/SMDI copolymer; PEG-175 diisostearate; PEG-190 distearate; PEG-15 glyceryl tristearate; PEG-140 glyceryl tristearate; PEG-240/HDI copolymer bis-decyltetradeceth-20 ether; PEG-100/IPDI copolymer; PEG-180/laureth-50/^{TM}MG copolymer; PEG-10/lauryl dimethicone crosspolymer; PEG-15/lauryl dimethicone crosspolymer; PEG-2M; PEG-5M; PEG-7M; PEG-9M; PEG-14M; PEG-20M; PEG-23M; PEG-25M; PEG-45M; PEG-65M; PEG-90M; PEG-115M; PEG-160M; PEG-180M; PEG-120 methyl glucose trioleate; PEG-180/octoxynol-40/^{TM}MG copolymer; PEG-150 pentaerythrityl tetrastearate; PEG-4 rapeseedamide; PEG-150/stearyl alcohol/SMDI copolymer; phaseolus angularis seed powder; polianthes tuberosa extract; polyacrylate-3; polyacrylic acid; polycyclopentadiene; polyether-1; polyethylene/isopropyl maleate/MA copolyol; polyglyceryl-3 disiloxane dimethicone; polyglyceryl-3 polydimethylsiloxyethyl dimethicone; polymethacrylic acid; polyquaternium-52; polyvinyl alcohol; potassium alginate; potassium aluminum polyacrylate; potassium carbomer; potassium carrageenan; potassium chloride; potassium palmate; potassium polyacrylate; potassium sulfate; potato starch modified; PPG-2 cocamide; PPG-1 hydroxyethyl caprylamide; PPG-2 hydroxyethyl cocamide; PPG-2 hydroxyethyl coco/isostearamide; PPG-3 hydroxyethyl soyamide; PPG-14 laureth-60 hexyl dicarbamate; PPG-14 laureth-60 isophoryl dicarbamate; PPG-14 palmeth-60 hexyl dicarbamate; propylene glycol alginate; PVP/decene copolymer; PVP montmorillonite; pyrus cydonia seed; pyrus malus (apple) fiber; rhizobian gum; ricebranamide DEA; ricinoleamide DEA; ricinoleamide MEA; ricinoleamide MIPA; ricinoleamidopropyl betaine; ricinoleic acid/adipic acid/AEEA copolymer; rosa multiflora flower wax; sclerotium gum; sesamide DEA; sesamidopropyl betaine; sodium acrylate/acryloyldimethyl taurate copolymer; sodium acrylates/acrolein copolymer; sodium acrylates/acrylonitrogens copolymer; sodium acrylates copolymer; sodium acrylates crosspolymer; sodium acrylate/sodium acrylamidomethylpropane sulfonate copolymer; sodium acrylates/vinyl isodecanoate crosspolymer; sodium acrylate/vinyl alcohol copolymer; sodium carbomer; sodium carboxymethyl chitin; sodium carboxymethyl dextran;

sodium carboxymethyl beta-glucan; sodium carboxymethyl starch; sodium carrageenan; sodium cellulose sulfate; sodium chloride; sodium cyclodextrin sulfate; sodium hydroxypropyl starch phosphate; sodium isooctylene/MA copolymer; sodium magnesium fluorosilicate; sodium oleate; sodium palmitate; sodium palm kernelate; sodium polyacrylate; sodium polyacrylate starch; sodium polyacryloyldimethyl taurate; sodium polygamma-glutamate; sodium polymethacrylate; sodium polystyrene sulfonate; sodium silicoaluminate; sodium starch octenylsuccinate; sodium stearate; sodium stearoxy PG-hydroxyethylcellulose sulfonate; sodium styrene/acrylates copolymer; sodium sulfate; sodium tallowate; sodium tauride acrylates/acrylic acid/acrylonitrogens copolymer; sodium tocopheryl phosphate; solanum tuberosum (potato) starch; soyamide DEA; soyamidopropyl betaine; starch/acrylates/acrylamide copolymer; starch hydroxypropyltrimonium chloride; stearamide AMP; stearamide DEA; stearamide DEA-distearate; stearamide DIBA-stearate; stearamide MEA; stearamide MEA-stearate; stearamide MIPA; stearamidopropyl betaine; steareth-60 cetyl ether; steareth-100/PEG-136/HDI copolymer; stearyl alcohol; stearyl betaine; sterculia urens gum; synthetic fluorphlogopite; tallamide DEA; tallow alcohol; tallowamide DEA; tallowamide MEA; tallowamidopropyl betaine; tallowamidopropyl hydroxysultaine; tallowamine oxide; tallow betaine; tallow dihydroxyethyl betaine; tamarindus indica seed gum; tapioca starch; TEA-alginate; TEA-carbomer; TEA-hydrochloride; trideceth-2 carboxamide MEA; tridecyl alcohol; triethylene glycol dibenzoate; trimethyl pentanol hydroxyethyl ether; triticum vulgare (wheat) germ powder; triticum vulgare (wheat) kernel flour; triticum vulgare (wheat) starch; tromethamine acrylates/acrylonitrogens copolymer; tromethamine magnesium aluminum silicate; undecyl alcohol; undecylenamide DEA; undecylenamide MEA; undecylenamidopropyl betaine; welan gum; wheat germamide DEA; wheat germamidopropyl betaine; xanthan gum; yeast beta-glucan; yeast polysaccharides; zea mays (corn) starch; and blends thereof.

[00211] Also suitable as thickeners and/or viscosifiers are the following commercial products:

[00212] (1) Aqualon™ carboxymethylcellulose, Benecel™ methylcellulose and hydroxypropyl methylcellulose, Blanose™ sodium carboxymethylcellulose, Klucel™ hydroxypropylcellulose, Natrosol™ hydroxyethylcellulose, Natrosol™ Plus and PolySurf™ cetyl modified hydroxyethylcellulose, *N*-Hance™ cationic guar, *N*-Hance™ HP Series

hydroxypropyl guar, *N*-Hance™ SP-100 conditioning polymer, and Supercol™ guar gum from Ashland Specialty Ingredients

[00213] (2) Carbopol® Polymers, Fixate™ PLUS Polymer, Glucamate™ Thickeners, Amidex™ Surfactants, Chembetaine™ Surfactants, Chemoxide™ Surfactants, Chemonic™ Surfactants, Chemccinate™ Surfactants, Amidex™ BC-24 Surfactant, Chemoryl™ LB-30 Surfactant, Novethix™ L-10 Polymer, Ceralan™ Lanolin Product, Pemulen™ TR-1 Polymeric Emulsifier, Pemulen™ TR-2 Polymeric Emulsifier, Hydramol™ PGPD Ester, Schercodine™ M Amido-Amine, Schercodine™ P Amido-Amine, Schercomid™ Diethanolamides from The Lubrizol Corporation.

[00214] (3) Salcare® and Luvigel® from BASF Corporation.

[00215] (4) Aculyn™ 22, Aculyn™ 28, Aculyn™ 33, Aculyn™ 38, and Aculyn™ 44 from The Dow Chemical Company.

[00216] (5) Ammonyx® C and Stepan-Mild® GCC from Stepan Company.

[00217] (6) Stabileze™, Rapithix™ A-60, Rapithix™ A-100, Ultrathix™ P-100, Lubrajel™ and FlexiThix™ from Ashland Specialty Ingredients (Wayne, NJ).

[00218] Also suitable as a thickener/rheology modifier are lightly- to moderately-crosslinked polyvinylpyrrolidones. Disclosures of these polymers are provided in the following publications, each of which is hereby incorporated in its entirety by reference: U.S. patent 5,073,614; 5,312,619; 5,139,770; 5,716,634; 5,470,884; 5,759,524; 5,997,887; 6,024,942; as well as international application PCT/US10/26973, PCT/US10/26976, PCT/US10/26940, PCT/US11/32993, and PCT/US11/34515.

[00219] Personal care compositions may comprise natural extracts and/or natural products. Extensive details on natural products that can be used in personal care compositions is provided in book chapter "Chemistry of Cosmetics, Comprehensive Natural Products II" in *Chemistry and Biology*; volume 3, 2010.

Oral care composition ingredients

[00220] Oral care compositions may optionally contain one or more additional ingredients. Non-limiting examples of suitable ingredients include: carriers, dentifrices, cleaning agents,

breath freshening actives, pain relievers, anesthetics, anti-inflammatory agents, antimicrobial agents, antibacterial agents, anti-calculus agents, anti-plaque agents, gums, thickeners, gelling agents, surfactants, flavors, warming or tingling agents, tooth bleaching agents, whiteners, stain removers, stain preventers, abrasives, adhesives, colors, emollients, emulsifiers, preservatives, solvents, binders, stimulants, depressants, diet aids, smoking cessation aides, vitamins, minerals, throat-soothing agents, spices, herbs, herbal extracts, alkaloids (such as caffeine and nicotine), and humectants.

[00221] The choice of a carrier to be used is basically determined by the way the composition is to be introduced into the oral cavity. Carrier materials for toothpaste, tooth gel or the like include abrasive materials, sudsing agents, binders, humectants, flavoring and sweetening agents, as disclosed in *e.g.*, U.S. patent 3,988,433. Carrier materials for biphasic dentifrice formulations are disclosed in U.S. patents 5,213,790; 5,145,666; 5,281,410; 4,849,213; and 4,528,180. Mouthwash, rinse or mouth spray carrier materials typically include water, flavoring and sweetening agents, etc., as disclosed in, *e.g.*, U.S. patent 3,988,433. Lozenge carrier materials typically include a candy base; chewing gum carrier materials include a gum base, flavoring and sweetening agents, as in, *e.g.*, U.S. patent 4,083,955. Sachet carrier materials typically include a sachet bag, flavoring and sweetening agents. For sub-gingival gels used for delivery of actives into the periodontal pockets or around the periodontal pockets, a "sub-gingival gel carrier" is chosen as disclosed in, *e.g.*, U.S. patents 5,198,220 and 5,242,910. The selection of a carrier will depend on secondary considerations like taste, cost, and shelf stability, and other factors.

[00222] Oral care compositions may comprise one or more dental abrasives. Dental abrasives useful in the compositions include many different materials. The material selected must be one which is compatible within the composition of interest and does not excessively abrade dentin.

[00223] Non-limiting examples of suitable abrasives include: silicas including gels and precipitates, insoluble sodium polymetaphosphate, hydrated alumina, calcium carbonate, dicalcium orthophosphate dihydrate, calcium pyrophosphate, tricalcium phosphate, calcium polymetaphosphate, resinous abrasive materials such as particulate condensation products of urea and formaldehyde, and blends thereof.

[00224] Another class of abrasives is the particulate thermo-setting polymerized resins as described in U.S. patent 3,070,510.

[00225] Non-limiting examples of suitable resins include: melamines, phenolics, ureas, melamine-ureas, melamine-formaldehydes, urea-formaldehyde, melamine-urea-formaldehydes, cross-linked epoxides, cross-linked polyesters, and blends thereof.

[00226] Silica dental abrasives of various types may be employed because of their unique benefits of exceptional dental cleaning and polishing performance without unduly abrading tooth enamel or dentine. The silica abrasive polishing materials herein, as well as other abrasives, generally have an average particle size ranging from about 0.1 to about 30 microns, and particularly from about 5 to about 15 microns. The abrasive can be precipitated silica or silica gels such as the silica xerogels described in U.S. patent 3,538,230, and U.S. patent 3,862,307.

[00227] Non-limiting examples of suitable silica abrasives include: silica xerogels marketed under the trade name "Syloid" by the W.R. Grace & Company, Davison Chemical Division and precipitated silica materials such as those marketed by the J.M. Huber Corporation under the trade name, Zeodent®, particularly the silicas carrying the designation Zeodent® 119, Zeodent® 118, Zeodent® 109 and Zeodent® 129. The types of silica dental abrasives useful in the toothpastes of the invention are described in more detail in U.S. patents 4,340,583; 5,603,920; 5,589,160; 5,658,553; 5,651,958; and 6,740,311. Each of these disclosures is hereby incorporated in its entirety by reference.

[00228] Mixtures of abrasives can be used such as mixtures of the various grades of Zeodent® silica abrasives listed above.

[00229] The total amount of abrasive(s) in the oral care compositions typically range from about 6% to about 70% by weight; toothpastes may contain from about 10% to about 50% of abrasives by weight of the composition. Dental solution, mouth spray, mouthwash and non-abrasive gel compositions typically contain little or no abrasives.

[00230] Oral care compositions may comprise polymeric mineral surface active agent(s) (PMSAs). PMSAs include any agent which will have a strong affinity for the tooth surface, deposit a polymer layer or coating on the tooth surface and produce the desired surface modification effects. The "mineral" descriptor is intended to convey that the surface activity

or substantivity of the polymer is toward mineral surfaces such as calcium phosphate minerals or teeth.

[00231] Non-limiting examples of suitable PMSAs include: polyelectrolytes such as condensed phosphorylated polymers; polyphosphonates; copolymers of phosphate- or phosphonate-containing monomers or polymers with other monomers such as ethylenically unsaturated monomers and amino acids or with other polymers such as proteins, polypeptides, polysaccharides, poly(acrylate), poly(acrylamide), poly(methacrylate), poly(ethacrylate), poly(hydroxyalkylmethacrylate), poly(vinyl alcohol), poly(maleic anhydride), poly(maleate) poly(amide), poly(ethylene amine), poly(ethylene glycol), poly(propylene glycol), poly(vinyl acetate), poly(vinyl benzyl chloride), polycarboxylates, carboxy-substituted polymers, and blends thereof. Also suitable as polymeric mineral surface active agents are the carboxy-substituted alcohol polymers described in U.S. patents 5,292,501; 5,213,789, 5,093,170; 5,009,882; and 4,939,284; and the diphosphonate-derivatized polymers in U.S. patent 5,011,913; the synthetic anionic polymers including polyacrylates and copolymers of maleic anhydride or acid and methyl vinyl ether (*e.g.*, Gantrez^{TM}), as described, for example, in U.S. patent 4,627,977. Another example of a polymeric mineral surface active agent is a diphosphonate modified polyacrylic acid.

[00232] Polymers with activity must have sufficient surface binding propensity to desorb pellicle proteins and remain affixed to enamel surfaces. For tooth surfaces, polymers with end or side chain phosphate or phosphonate functions may be used, although other polymers with mineral binding activity may prove effective depending upon adsorption affinity.

[00233] PMSAs are useful in the compositions because of their stain prevention benefit. It is believed the PMSAs provide a stain prevention benefit because of their reactivity or substantivity to mineral surfaces, resulting in desorption of portions of undesirable adsorbed pellicle proteins, in particular those associated with binding color bodies that stain teeth, calculus development and attraction of undesirable microbial species. The retention of these PMSAs on teeth can also prevent stains from accruing due to disruption of binding sites of color bodies on tooth surfaces.

[00234] The ability of PMSA to bind stain promoting ingredients of oral care products such as stannous ions and cationic antimicrobials is also believed to be helpful. The PMSA will also provide tooth surface conditioning effects which produce desirable effects on surface

thermodynamic properties and surface film properties, which impart improved clean feel aesthetics both during and most importantly, following rinsing or brushing. Many of these polymeric agents are also known or expected to provide tartar control benefits when applied in oral compositions, hence providing improvement in both the appearance of teeth and their tactile impression to consumers. The desired surface effects may include: 1) creating a hydrophilic tooth surface immediately after treatment; and 2) maintaining surface conditioning effects and control of pellicle film for extended periods following product use, including post brushing or rinsing and throughout more extended periods. The effect of creating an increased hydrophilic surface can be measured in terms of a relative decrease in water contact angles. The hydrophilic surface, importantly, is maintained on the tooth surface for an extended period after using the product.

[00235] Oral care compositions may comprise additional anticalculus agent(s), such as a pyrophosphate salt as a source of pyrophosphate ion.

[00236] Non-limiting examples of suitable pyrophosphate salts include: dialkali metal pyrophosphate salts, tetraalkali metal pyrophosphate salts, and mixtures thereof. Particularly, disodium dihydrogen pyrophosphate ($Na_2H_2P_2O_7$), tetrasodium pyrophosphate ($Na_4P_2O_7$), and tetrapotassium pyrophosphate ($K_4P_2O_7$) in their unhydrated as well as hydrated forms may find utility.

[00237] In compositions of the invention, the pyrophosphate salt may be present in one of three ways: predominately dissolved, predominately undissolved, or a mixture of dissolved and undissolved pyrophosphate.

[00238] Compositions comprising predominately dissolved pyrophosphate refer to compositions where at least one pyrophosphate ion source is in an amount sufficient to provide at least about 1.0% free pyrophosphate ions. The amount of free pyrophosphate ions may be from about 1% to about 15%, particularly from about 1.5% to about 10%, and more particularly from about 2% to about 6%. Free pyrophosphate ions may be present in a variety of protonated states depending on the pH of the composition.

[00239] Compositions comprising predominately undissolved pyrophosphate refer to compositions containing no more than about 20% of the total pyrophosphate salt dissolved in the composition, particularly less than about 10% of the total pyrophosphate dissolved in the composition. Tetrasodium pyrophosphate salt may be one such pyrophosphate salt in these

compositions. Tetrasodium pyrophosphate may be the anhydrous salt form or the decahydrate form, or any other species stable in solid form in the oral care compositions. The salt is in its solid particle form, which may be its crystalline and/or amorphous state, with the particle size of the salt being small enough to be aesthetically acceptable and readily soluble during use. The amount of pyrophosphate salt useful in making these compositions is any tartar control effective amount, generally from about 1.5% to about 15%, particularly from about 2% to about 10%, and more particularly from about 3% to about 8% by weight of the oral care composition.

[00240] The pyrophosphate salts are described in more detail in *Kirk-Othmer Encyclopedia of Chemical Technology*, third edition, volume 17, Wiley-Interscience Publishers (1982).

[00241] Oral care compositions may comprise peroxide compounds.

[00242] Non-limiting examples of suitable peroxide compounds include: hydrogen peroxide and organic peroxides including urea peroxide, carbamide peroxide, glyceryl peroxide, benzoyl peroxide, derivatives thereof, and blends thereof.

[00243] Typically, the peroxide compound can be employed in amounts so that at least about 1% by weight of the composition comprises peroxide. The peroxide compound may comprise from about 2% to about 30% by weight of the composition. More particularly, the peroxide comprises from about 3% to about 15% by weight of the composition. A typical peroxide concentration in the composition is generally from about 2% to about 7% by weight for home use products, and from about 15% to about 20% by weight for dental professional use.

[00244] Thickening or gelling agents used in dentifrice compositions may include nonionic polyoxyethylene polyoxypropylene block copolymers. Illustrative of polyoxyethylene polyoxypropylene block copolymers useful in the practice include block copolymers having the formula $HO(C_2H_4O)_b(C_3H_6O_6)_a(C_2H_4O)_bH$ wherein a is an integer such that the hydrophobic base represented by $(C_3H_6O_6)$ has a molecular weight of about 2,750 Da to 4000 Da, b is an integer such that the hydrophilic portion (moiety) represented by (C_2H_4O) constitutes from about 70% to about 80% by weight of the copolymer. Block copolymers of this composition are available commercially under the trademark Pluronic® F type.

[00245] Pluronic® F127 has a molecular weight of 4,000 Da and contains 70% of the hydrophilic polyoxyethylene moiety.

[00246] Also suitable as a thickening agent is lightly- to moderately-crosslinked PVP, described in international application PCT/US11/30642.

[00247] The thickening agents may be present in an amount from about 15% to about 50% by weight, particularly from about 25% to about 45% by weight of the composition.

[00248] Surfactants may also be included in the oral care compositions of the invention, where they may serve in solubilizing, dispersing, emulsifying and/or reducing the surface tension of the teeth in order to increase the contact between the tooth and the peroxide. The compositions may also comprise surfactants, also commonly referred to as sudsing agents. Suitable surfactants are those which are reasonably stable and foam throughout a wide pH range. Surfactants may be chosen from anionic, nonionic, amphoteric, zwitterionic, or cationic surfactants, or blends thereof.

[00249] Anionic surfactants useful herein include the water-soluble salts of alkyl sulfates having from 8 to 20 carbon atoms in the alkyl radical (*e.g.*, sodium alkyl sulfate) and the water-soluble salts of sulfonated monoglycerides of fatty acids having from 8 to 20 carbon atoms. Sodium lauryl sulfate (SLS) and sodium coconut monoglyceride sulfonates are non-limiting examples of anionic surfactants of this type. Many suitable anionic surfactants are disclosed in U.S. patent 3,959,458. The compositions may comprise an anionic surfactant in an amount from about 0.025% to about 9% by weight, particularly from about 0.05% to about 5% by weight, and more particularly from about 0.1% to about 1% by weight of the composition.

[00250] Non-limiting examples of suitable anionic surfactants include: sarcosinates, taurates, isethionates, sodium lauryl sulfoacetate, sodium laureth carboxylate, and sodium dodecyl benzenesulfonate. Also suitable are alkali metal or ammonium salts of surfactants such as the sodium and potassium salts of the following: lauroyl sarcosinate, myristoyl sarcosinate, palmitoyl sarcosinate, stearoyl sarcosinate, and oleoyl sarcosinate. The sarcosinate surfactant may be present in the compositions from about 0.1% to about 2.5%, particularly from about 0.5% to about 2.0% by weight of the total composition.

[00251] Non-limiting examples of suitable cationic surfactants include: derivatives of aliphatic quaternary ammonium compounds having at least one long alkyl chain containing from about 8 to about 18 carbon atoms such as lauryl trimethylammonium chloride, cetyl pyridinium chloride, cetyl trimethylammonium bromide, di-isobutylphenoxyethyl-dimethylbenzylammonium chloride, coconut alkyltrimethylammonium nitrite, cetyl pyridinium fluoride, and blends thereof. Also suitable are the quaternary ammonium fluorides described in U.S. patent 3,535,421, where the quaternary ammonium fluorides have detergent properties. Certain cationic surfactants can also act as germicides in the compositions disclosed herein.

[00252] Nonionic surfactants that may be used in the compositions of the invention include compounds produced by the condensation of alkylene oxide groups (hydrophilic in nature) with an organic hydrophobic compound which may be aliphatic or alkylaromatic in nature.

[00253] Non-limiting examples of suitable nonionic surfactants include: poloxamers (sold under the trade name Pluronic® by BASF Corporation), polyethylene oxide condensates of alkyl phenols, products derived from the condensation of ethylene oxide with the reaction product of propylene oxide and ethylene diamine, ethylene oxide condensates of aliphatic alcohols, long chain tertiary amine oxides, long chain tertiary phosphine oxides, long chain dialkyl sulfoxides and blends thereof.

[00254] Non-limiting examples of suitable zwitterionic surfactants include betaines and derivatives of aliphatic quaternary ammonium compounds in which the aliphatic radicals can be straight chain or branched, and which contain an anionic water-solubilizing group, *e.g.*, carboxy, sulfonate, sulfate, phosphate, or phosphonate.

[00255] Non-limiting examples of suitable betaines include: decyl betaine or 2-(*N*-decyl-*N,N*-dimethylammonio)acetate, coco betaine or 2-(*N*-coc-*N,N*-dimethyl ammonio)acetate, myristyl betaine, palmityl betaine, lauryl betaine, cetyl betaine, stearyl betaine, and blends thereof. The amidobetaines are exemplified by cocoamidoethyl betaine, cocoamidopropyl betaine, lauramidopropyl betaine, and the like. The betaines of choice include cocoamidopropyl betaines such as lauramidopropyl betaine. Suitable betaine surfactants are disclosed in U.S. patent 5,180,577.

[00256] Other surfactants such as fluorinated surfactants may also be incorporated within the compositions of the invention.

[00257] Oral care compositions may comprise flavor(s).

[00258] Non-limiting examples of suitable flavors include: methyl salicylate, ethyl salicylate, methyl cinnamate, ethyl cinnamate, butyl cinnamate, ethyl butyrate, ethyl acetate, methyl anthranilate, iso-amyl acetate, iso-armyl butyrate, allyl caproate, eugenol, eucalyptol, thymol, cinnamic alcohol, cinnamic aldehyde, octanol, octanal, decanol, decanal, phenylethyl alcohol, benzyl alcohol, benzaldehyde, α-terpineol, linalool, limonene, citral, vanillin, ethyl vanillin, propenyl guaethol, maltol, ethyl maltol, heliotropin, anethole, dihydroanethole, carvone, oxanone, menthone, β-damascenone, ionone, gamma decalactone, gamma nonalactone, gamma undecalactone, 4-hydroxy-2,5-dimethyl-3(2H)-furanone, and blends thereof.

[00259] Generally suitable flavoring agents are those containing structural features and functional groups that are less prone to oxidation by peroxide. These include derivatives of flavor chemicals that are saturated or contain stable aromatic rings or ester groups.

[00260] Also suitable are flavor chemicals that may undergo some oxidation or degradation without resulting in a significant change in the flavor character or profile. The flavor chemicals, including menthol, may be provided as single or purified chemicals rather than supplied in the composition by addition of natural oils or extracts such as peppermint, spearmint, or wintergreen oils as these sources may contain other components that are relatively unstable and may degrade in the presence of peroxide. Flavoring agents are generally used in the compositions at levels of from about 0.001% to about 5% by weight of the composition.

[00261] The flavor system may typically include sweetening agent(s). Sweeteners include compounds of natural and artificial origin.

[00262] Non-limiting examples of suitable water-soluble natural sweeteners include: monosaccharides, disaccharides and polysaccharides, such as xylose, ribose, glucose (dextrose), mannose, galactose, fructose (levulose), sucrose (sugar), maltose, invert sugar (a mixture of fructose and glucose derived from sucrose), partially hydrolyzed starch, corn syrup solids, dihydrochalcones, monellin, steviosides, glycyrrhizin, and blends thereof.

[00263] Non-limiting examples of suitable water-soluble artificial sweeteners include: soluble saccharin salts, i.e., sodium or calcium saccharin salts, cyclamate salts, the sodium,

ammonium or calcium salt of 3,4-dihydro-6-methyl-1,2,3-oxathiazine-4-one-2,2-dioxide, the potassium salt of 3,4-dihydro-6-methyl-1,2,3-oxathiazine-4-one-2,2-dioxide (acesulfame-K), the free acid form of saccharin, and the like. Other suitable sweeteners include dipeptide based sweeteners, such as L-aspartic acid derived sweeteners, such as L-aspartyl-L-phenylalanine methyl ester (aspartame) and materials described in U.S. patent 3,492,131, L-α-aspartyl-*N*-(2,2,4,4-tetramethyl-3-thietanyl)-D-alaninamide hydrate, methyl esters of L-aspartyl-L-phenylglycerin and L-aspartyl-L-2,5,dihydrophenyl-glycine, L-aspartyl-2,5-dihydro-L-phenylalanine, L-aspartyl-L-(1-cyclohexyen)-alanine, derivatives thereof, and blends thereof. Water-soluble sweeteners derived from naturally occurring water-soluble sweeteners, such as a chlorinated derivative of ordinary sugar (sucrose), known, for example, under the product description of sucralose as well as protein based sweeteners such as thaumatoccous danielli (Thaumatin I and II) may be used. The compositions may contain sweetener(s) in an amount from about 0.1% to about 10% by weight, in particular from about 0.1% to about 1% by weight of the composition.

[00264] In addition, the flavor system may include salivating agents, warming agents, and numbing agents. These agents are present in the compositions in an amount from about 0.001% to about 10% by weight, particularly from about 0.1% to about 1% by weight of the composition.

[00265] A non-limiting example of suitable salivating agent includes Jambus® manufactured by Takasago. Non-limiting examples of suitable warming agents include capsicum and nicotinate esters such as benzyl nicotinate. Non-limiting examples of suitable numbing agents include benzocaine, lidocaine, clove bud oil, ethanol, and blends thereof.

[00266] Oral care compositions may comprise chelating agent(s).

[00267] The chelating agents may include metal solubilizing agents and metal precipitating agents. The metal solubilizing agents include a condensed pyrophosphate compound. For purposes of this invention "condensed phosphate" relates to an inorganic phosphate composition containing two or more phosphate species in a linear or cyclic pyrophosphate form. The condensed phosphate may be sodium pyrophosphate, but may also include tripolyphosphate, hexametaphosphate, cyclic condensed phosphate or other similar phosphates well known in the field. The blend may also include an organic chelating agent. The term "organic phosphate" includes phosphonic acid, di and tri phosphonoc acid

compound or its salts. An example of phosphonic acid is 1-hydroxyethylidene-1,1-diphosphonic acid that is sold under the trade name of Dequest®. The blend may also include a metal precipitating chelating agent. The term "metal precipitating chelating agent" is an agent that binds to metals and causes the metal to precipitate and includes halogens such as fluoride. The chelating agents are incorporated in the oral care compositions of the invention in an amount from about 0.1% to about 8.0% by weight, and particularly from about 0.5% to about 3.0% by weight of the composition, in a ratio of about 3:1:1 w/w organic chelating agent: condensed phosphate chelating agent: metal precipitating agent.

[00268] Another optional ingredient that may be used in oral care compositions is a humectant. For example, a humectant may be added to keep toothpaste compositions from hardening upon exposure to air, to give compositions a moist feel to the mouth, and, for particular humectants, to impart desirable sweetness of flavor to toothpaste compositions. The humectant, on a pure humectant basis, is generally present from about 0% to about 70%, particularly from about 5% to about 25% by weight of the composition.

[00269] Non-limiting examples of suitable humectants include: edible polyhydric alcohols such as glycerin, sorbitol, xylitol, butylene glycol, polyethylene glycol, propylene glycol, trimethyl glycine, and blends thereof.

[00270] The invention also contemplates oral care compositions comprising polymer(s) described herein complexed with hydrogen peroxide. A description of such complexes is present in international application WO 91/07184, the contents of which are hereby incorporated in their entirety by reference.

[00271] Also contemplated are oral care compositions such as those described in the following patents and patent applications, the contents of each are hereby incorporated in their entirety by reference: WO 2011/068514, WO 2011/053877, US 2010/0275394, US 2011/0076090, US 2008/091935, US 2008/0181716, US 2008/0014224, WO 2007/066837, US 2008/0292669, US 2007/0071696, US 2007/0154863, US 2008/0317797, US 2005/0249678, US 2007/0178055, US 2007/0189983, WO 2005/041910, US 7,785,572, WO 1998/005749, WO 1997/022651, and US 5,310,563.

[00272] Oral care compositions may comprise one or more denture adhesives.

[00273] Synthetic materials presently dominate the denture adhesive market. Such materials may consist of mixtures of the salts of short-acting polymers (*e.g.*, carboxymethylcellulose or "CMC") and long-acting polymers (*e.g.*, poly[vinyl methyl ether maleate], or "Gantrez™" and its salts). Polyvinylpyrrolidone (povidone) may also be used.

[00274] Other components of denture adhesive products impart particular physical attributes to the formulations. Petrolatum, mineral oil, and polyethylene oxide may be included in creams to bind the materials and to make their placement easier. Silicon dioxide and calcium stearate may be used in powders to minimize clumping. Menthol and peppermint oils may be used for flavoring, red dye for color, and sodium borate and methyl- or poly-paraben as preservatives.

[00275] It is also contemplated that the composition ingredients may be formulated in a single container, or the ingredients may be formulated in-part in two or more distinct containers of the same or different type, the contents of which may require mixing prior to use.

[00276] The compounds according to the invention may be synthesized according to the examples set out below. The examples are presented for purposes of demonstrating, but not limiting, the preparation of the compounds according to the invention.

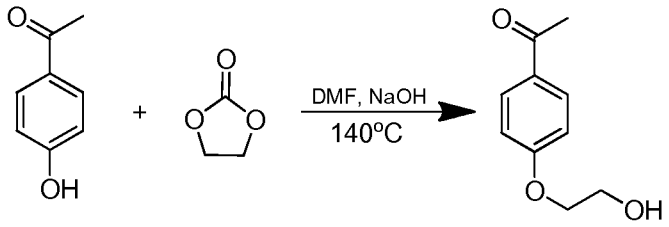
EXAMPLES

[00277] The following non-limiting examples are provided to illustrate a few of the methods for preparing UV absorbers.

Example 1: Synthesis of 1-[4-(2-hydroxyethyl)phenyl]-3-(p-tolyl)propane-1,3-dione

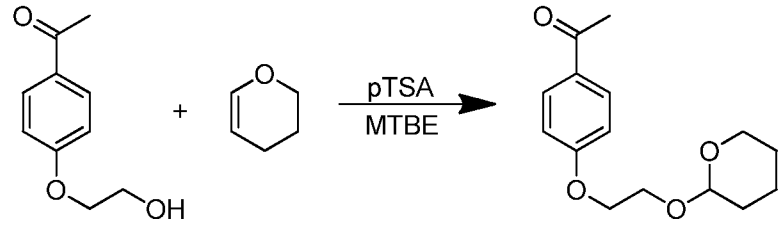
[00278] The compound 1-[4-(2-hydroxyethyl)phenyl]-3-(p-tolyl)propane-1,3-dione was synthesized in four steps the details of which are given below:

[00279] Step 1: Synthesis of 1-[4-(2-hydroxyethoxy)phenyl]ethanone



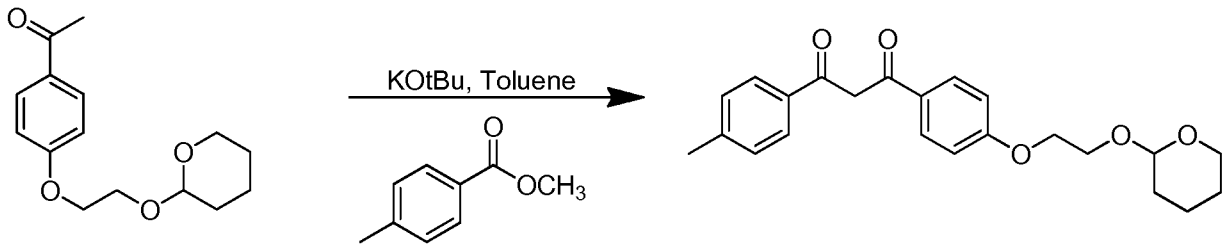
[00280] 4-hydroxyacetophenone (1.00 equivalents) was charged to a reaction flask. Dimethylformamide (~10 times by weight) was charged to the flask and agitation was commenced. Ethylene carbonate (1.20 equivalents) was charged along with NaOH (0.03 equivalents). The reaction mixture was heated to 140°C and stirred for about 6 hours. Samples were taken and analyzed by gas chromatography (GC). The reaction was considered complete when there was no 4-hydroxyacetophenone remaining. DMF was removed under vacuum and the batch was cooled to room temperature. Distilled water was added in a quantity of about 35% of the original DMF charge and the material was stirred. Ethyl acetate was added in an amount equivalent to the distilled water charge. The mixture was stirred for a sufficient period of time and the layers were separated. The aqueous layer was twice re-extracted with equal amounts of ethyl acetate. The three organic layers were combined and washed once with distilled water and once with sodium chloride solution, and dried with magnesium sulfate. The filtered solution was then stripped and dried, resulting in an off-white solid. The yield of the product was about 94% and was used in the second step.

[00281] Step 2: Adduct of 1-[4-(2-hydroxyethoxy)phenyl]ethanone with 3,4-dihydro-2H-pyran



[00282] 1-[4-(2-hydroxyethoxy)phenyl]ethanone (1.00 equivalent) was charged to a reaction flask along with methyl tert-butyl ether (MTBE, 1.7 times the weight). Stirring was commenced and para-toluene sulfonic acid (pTSA, 0.003 equivalent) was charged. An additional funnel was set up and charged with 3,4-dihydro-2H-pyran (1.10 equivalent). The 3,4-dihydro-2H-pyran was added to the reaction mixture controlling the temperature at about 25°C and stirred until completion (monitored by thin layer chromatography). Once the reaction was complete, triethylamine was charged to quench the pTSA. A solution of the product, 1-[4-(2-tetrahydropyran-2-yloxyethoxy)phenyl]ethanone, was used in the third step.

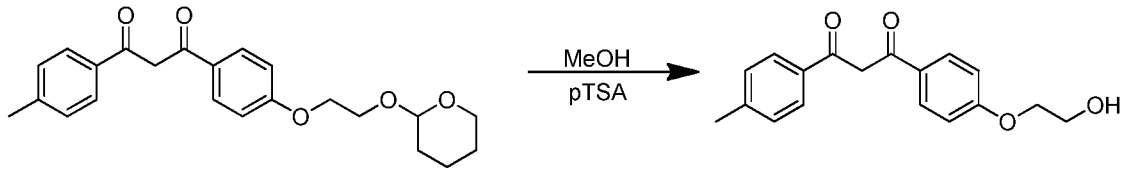
[00283] Step 3: Synthesis of 1-(p-tolyl)-3-[4-(2-tetrahydropyran-2-yloxyethoxy)phenyl]propane-1,3-dione



[00284] A solution of 1-[4-(2-tetrahydropyran-2-yloxyethoxy)phenyl]ethanone in MTBE (1.00 equivalent) was charged to a reaction flask. Toluene is charged in a quantity of about 2 times the solution of the reactant. Potassium-t-butoxide (KOtBu, 2.10 equivalent) was charged and the mixture was heated to 55°C and stirred for two hours. The mixture was very thick at this point. Methyl-p-toluate (1.0 equivalent) was charged at this point. The reaction mix thinned considerably. MTBE was removed upon heating to 100°C. The reaction was continued for about 6.5 hours and cooled to room temperature. Distilled water (quantity equal to toluene charge) was charged and concentrated HCl was charged to a pH of less than 3. The contents of the flask were then heated to 45°C, stirring was stopped and the layers were separated. The organic layer was dried with magnesium sulfate and filtered. The filtered liquid was then charged to a clean reaction flask and toluene was stripped under reduced

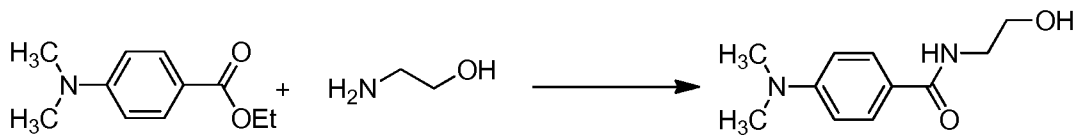
pressure at 80°C, then cooled to about 55°C and methanol was charged. The methanol solution of the product was used in the fourth step.

[00285] Step 4: Synthesis of 1-[4-(2-hydroxyethyl)phenyl]-3-(p-tolyl)propane-1,3-dione



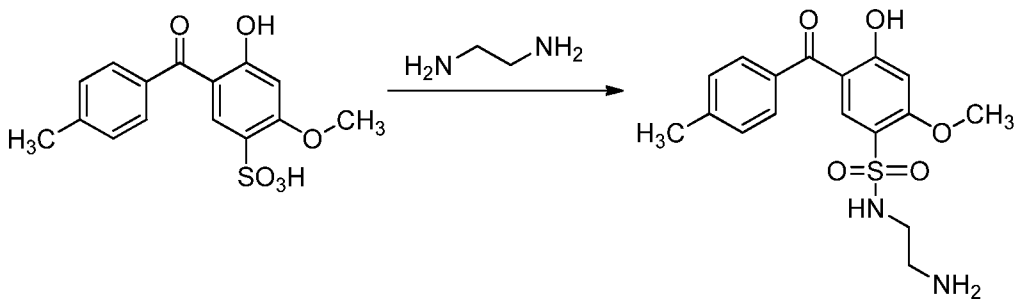
[00286] A methanol of the product of step 3 was heated at 55°C and pTSA (0.006 equivalent) was charged. The reaction was heated at 55°C and stirred until completion as analyzed by GC. The material was then cooled slowly to 20°C and the product, 1-[4-(2-hydroxyethyl)phenyl]-3-(p-tolyl)propane-1,3-dione, crystallized out of methanol. The material was filtered and washed with methanol. The yield was about 65% and the purity was about 100%.

Example 2: Synthesis of 4-(dimethylamino)-*N*-(2-hydroxyethyl)benzamide



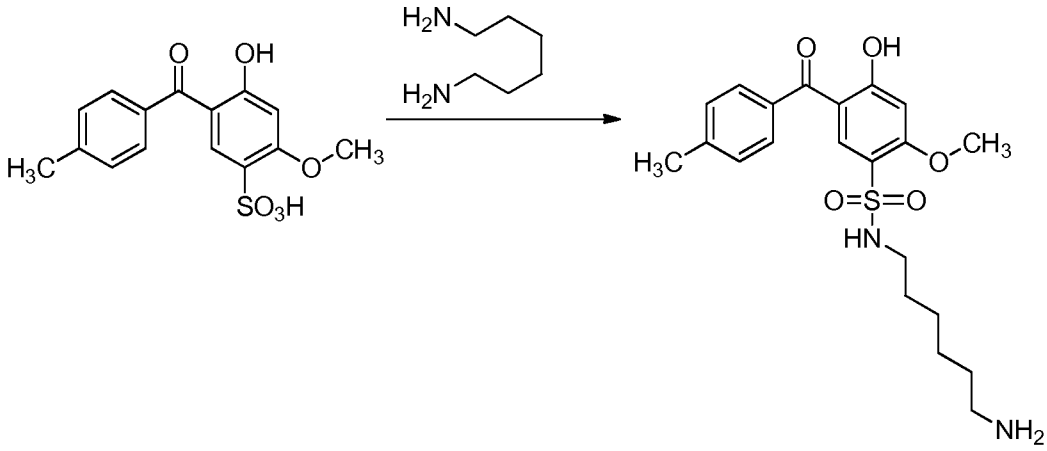
[00287] A quantity of 20.0 grams of ethyl 4-dimethylaminobenzoate (0.1035 mol) and 19.0 grams of ethanolamine (0.31 mol) were heated to about 70°C. A quantity of 56 mg of solid sodium methoxide was added and the mixture was heated until about 90% of the starting material was consumed. Temperature was then increased to 100°C and 100 grams of toluene added. The mixture was slowly cooled down to room temperature, during which the product precipitated out. The solid was recovered by filtration, rinsed with toluene and dried to afford 17.5 grams of the desired compound, 4-(dimethylamino)-*N*-(2-hydroxyethyl)benzamide (purity > 90%).

Example 3: Synthesis of 2-hydroxy-4-methoxy-5-(*N*-2-aminoethyl) sulfonamido-4′-methylbenzophenone



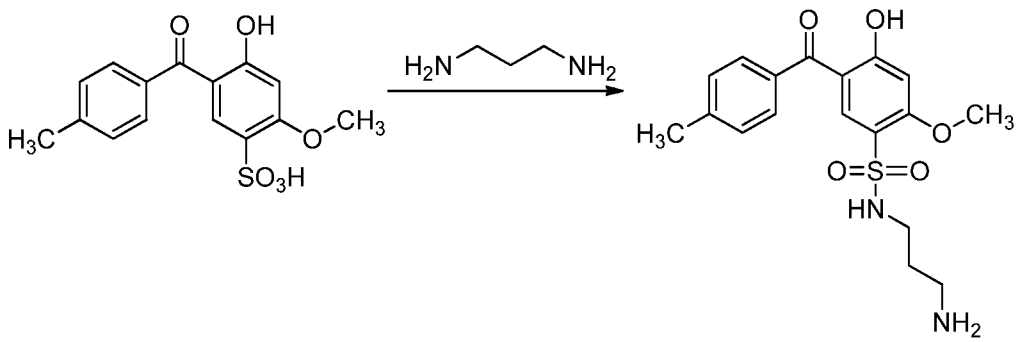
[00288] To a premixed solution of 6.0 g ethylene diamine in 30 ml ethanol was added 30.8 g of 5-benzoyl-4-hydroxy-2-methoxy benzenesulfonic acid and stirred well until a solution was formed. The mixture was heated to 130° C for 16 hours and then cooled to 70° C. The ethanol residue was flashed off in a vacuum oven at 70° C. A lemon-yellow powder was obtained that was insoluble in water.

Example 4: Synthesis of 2-hydroxy-4-methoxy-5-(*N*-6-aminohexyl) sulfonamido-4′-methylbenzophenone



[00289] To a premixed solution of 11.6 g hexamethylene diamine in 40 g ethanol was added 30.8 g of 5-benzoyl-4-hydroxy-2-methoxy benzenesulfonic acid and stirred well until a solution was formed. The mixture was heated to 130° C for 16 hours and then cooled to 70° C. The ethanol residue was flashed off in a vacuum oven at 70° C. A lemon yellow powder was obtained that was insoluble in water.

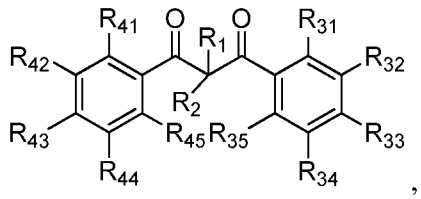
Example 5: Synthesis of 2-hydroxy-4-methoxy-5-(*N*-3-aminopropyl)sulfonamido-4′-methylbenzophenone



[00290] An amount of 7.4 g propylene diamine, 30.8 g of 5-benzoyl-4-hydroxy-2-methoxy benzenesulfonic acid, and 30 ml of 1:1 ethanol-water mixture was stirred well until a clear solution was obtained. The mixture was heated to 135° C for 16 hours and then cooled to 70° C. The ethanol residue was flashed off in a vacuum oven at 70° C. A lemon yellow powder was obtained that was insoluble in water.

We claim:

1. A compound having the structure:



,

wherein

each $\mathbf{R_1}$ and $\mathbf{R_2}$ is independently selected from the group consisting of hydrogen and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms;

each $\mathbf{R_{31}}$, $\mathbf{R_{32}}$, $\mathbf{R_{33}}$, $\mathbf{R_{34}}$ and $\mathbf{R_{35}}$ is independently selected from the group consisting of hydrogen, halogen, amino, alkyl amino, hydroxyl, alkoxyl, sulfonyl, carboxyl, and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms with the proviso that at least one of said $\mathbf{R_{31}}$, $\mathbf{R_{33}}$, and $\mathbf{R_{35}}$ has a structure –**X**–**Q**–**A**;

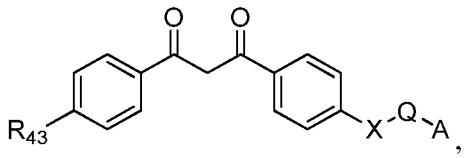
each $\mathbf{R_{41}}$, $\mathbf{R_{42}}$, $\mathbf{R_{43}}$, $\mathbf{R_{44}}$ and $\mathbf{R_{45}}$ is independently selected from the group consisting of hydrogen, halogen, amino, alkyl amino, hydroxyl, alkoxyl, sulfonyl, carboxyl, and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms with the proviso that at least one of said $\mathbf{R_{41}}$, $\mathbf{R_{42}}$, $\mathbf{R_{43}}$, $\mathbf{R_{44}}$ and $\mathbf{R_{45}}$ is non-hydrogen;

each **X** is independently selected from the group consisting of O, N$\mathbf{R_1}$, and S;

each **Q** is independently selected from the group consisting of functionalized and unfunctionalized hydrocarbylene optionally having one or more heteroatoms; and

each **A** is independently selected from the group consisting of OH, NH$\mathbf{R_1}$, and SH.

2. The compound according to claim 1 having the structure:



wherein

X is selected from the group consisting of O, N**R**$_1$, and S;

Q is selected from the group consisting of functionalized and unfunctionalized hydrocarbylene optionally having one or more heteroatoms;

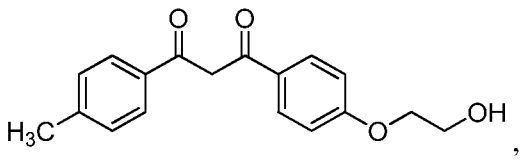
A is selected from the group consisting of OH, NH**R**$_1$, and SH;

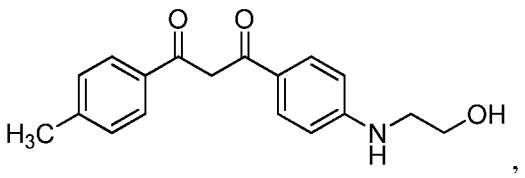
each **R**$_1$ is independently selected from the group consisting of hydrogen and functionalized and unfunctionalized alkyl; and

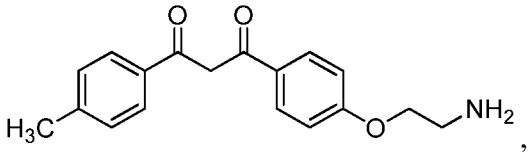
R$_{43}$ is a functionalized or unfunctionalized alkyl.

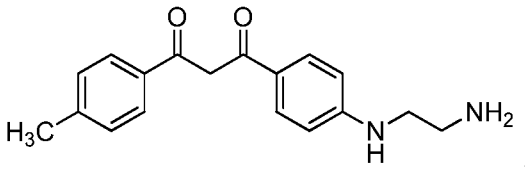
3. The compound according to claim 2 wherein said **Q** is a residue of a compound selected from the group consisting of: diols, diamines, thio alcohols, amino alcohols, polyols, polyether polyols, polyacetal polyethers, polyalkylene polyamines, polyetheramines, polyalkylene imines, polysaccharides, and combinations thereof.

4. The compound according to claim 3 having a structure selected from the group consisting of:



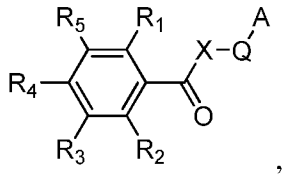




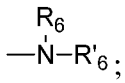


and

5. A compound having the structure:



wherein

each $\mathbf{R_1}$, $\mathbf{R_2}$, $\mathbf{R_3}$, $\mathbf{R_4}$ and $\mathbf{R_5}$ is independently selected from the group consisting of hydrogen, halogen, amino, alkyl amino, hydroxyl, alkoxyl, sulfonyl, carboxyl, and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms with the proviso that at least one of said $\mathbf{R_1}$, $\mathbf{R_2}$, $\mathbf{R_3}$, $\mathbf{R_4}$ and $\mathbf{R_5}$ has a structure ;

X is selected from the group consisting of O, N$\mathbf{R_7}$, and S;

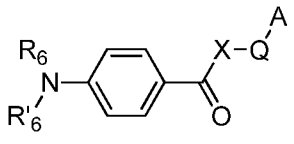
Q is selected from the group consisting of functionalized and unfunctionalized hydrocarbylene optionally having one or more heteroatoms;

A is selected from the group consisting of OH, NH$\mathbf{R_7}$, and SH;

each $\mathbf{R_6}$ and $\mathbf{R'_6}$ are the same or different and independently selected from the group consisting of functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms; and

each $\mathbf{R_7}$ is independently selected from the group consisting of hydrogen and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms.

6. The compound according to claim 5 having the structure:



wherein:

X is selected from the group consisting of O, N$\mathbf{R_7}$, and S;

Q is selected from the group consisting of functionalized and unfunctionalized hydrocarbylene optionally having one or more heteroatoms;

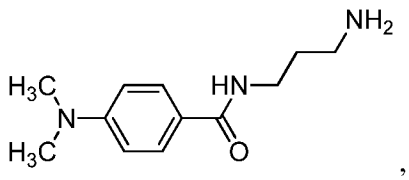
A is selected from the group consisting of OH, NH$\mathbf{R}_7$, and SH;

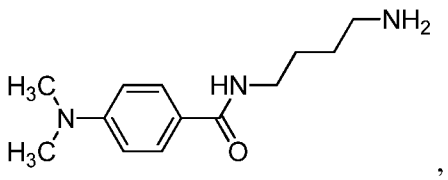
$\mathbf{R}_6$ and $\mathbf{R'}_6$ are the same and selected from the group consisting of functionalized and unfunctionalized alkyl; and

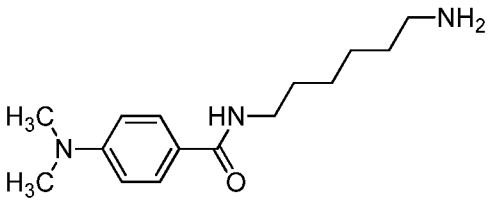
each $\mathbf{R}_7$ is independently selected from the group consisting of hydrogen and functionalized and unfunctionalized alkyl optionally having one or more heteroatoms.

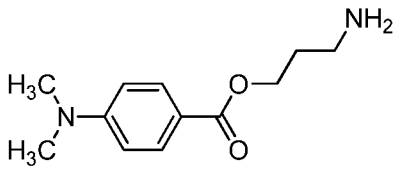
7. The compound according to claim 6 wherein said **Q** is a residue of a compound selected from the group consisting of: diols, diamines, thio alcohols, amino alcohols, polyols, polyether polyols, polyacetal polyethers, polyalkylene polyamines, polyetheramines, polyethylene imines, polysaccharides, and combinations thereof.

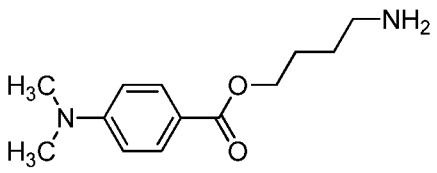
8. The compound according to claim 7 having a structure selected from the group consisting of:

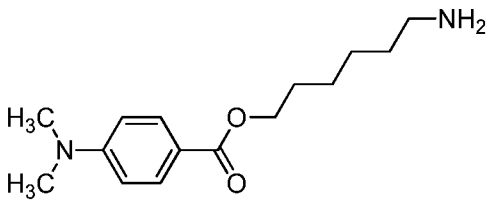

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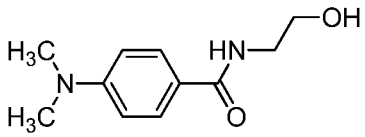

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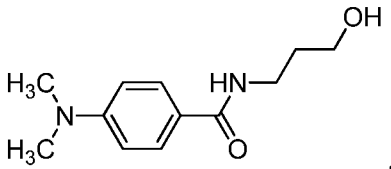

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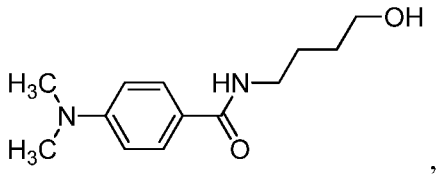

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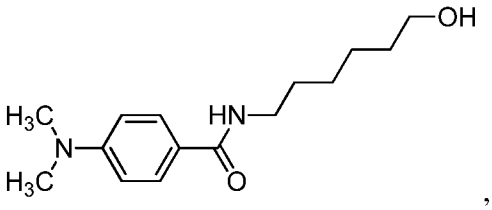

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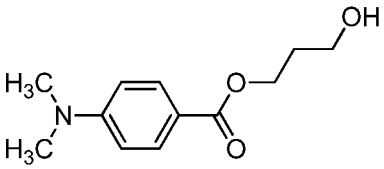

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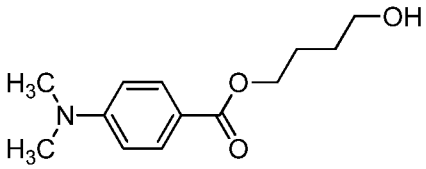

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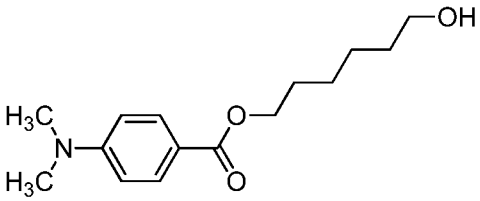

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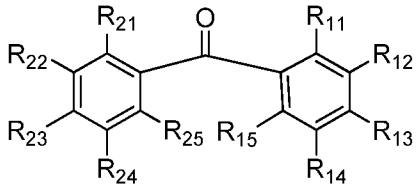

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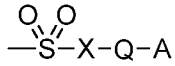

, and


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9. A compound having the structure:


,

wherein

each $\mathbf{R_{11}}$, $\mathbf{R_{12}}$, $\mathbf{R_{13}}$, $\mathbf{R_{14}}$ and $\mathbf{R_{15}}$ is independently selected from the group consisting of hydrogen, halogen, amino, alkyl amino, hydroxyl, alkoxyl, sulfonyl, carboxyl, and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms with the proviso that at least one of said $\mathbf{R_{12}}$ and $\mathbf{R_{14}}$ has a structure  and at least two of said $\mathbf{R_{11}}$, $\mathbf{R_{13}}$, and $\mathbf{R_{15}}$ is selected from the group consisting of hydroxyl, alkoxyl, and combinations thereof;

each $\mathbf{R_{21}}$, $\mathbf{R_{22}}$, $\mathbf{R_{23}}$, $\mathbf{R_{24}}$ and $\mathbf{R_{25}}$ is independently selected from the group consisting of hydrogen, halogen, amino, alkyl amino, hydroxyl, alkoxyl, sulfonyl, carboxyl, and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms;

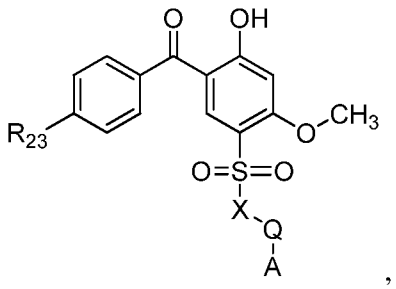
each **X** is independently selected from the group consisting of O and $N\mathbf{R_{16}}$;

each **Q** is independently selected from the group consisting of functionalized and unfunctionalized hydrocarbylene optionally having one or more heteroatoms;

each **A** is independently selected from the group consisting of OH, $NH\mathbf{R_{16}}$, and SH; and

each $\mathbf{R_{16}}$ is independently selected from the group consisting of hydrogen and functionalized and unfunctionalized hydrocarbyl optionally having one or more heteroatoms.

10. The compound according to claim 9 having the structure:



,

wherein

X is selected from the group consisting of O and $N\mathbf{R_{16}}$;

Q is selected from the group consisting of functionalized and unfunctionalized hydrocarbylene optionally having one or more heteroatoms;

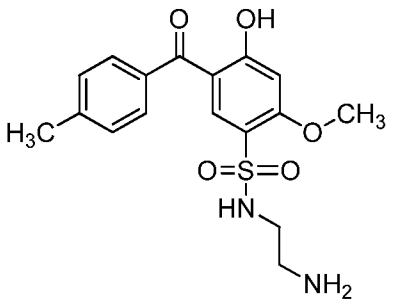
A is selected from the group consisting of OH, $NH\mathbf{R_{16}}$, and SH;

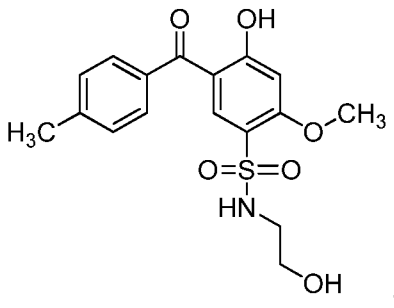
$\mathbf{R_{23}}$ is selected from the group consisting of hydrogen and functionalized and unfunctionalized alkyl; and

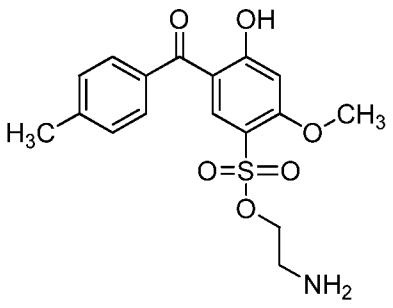
each $\mathbf{R_{16}}$ is independently selected from the group consisting of hydrogen and functionalized and unfunctionalized alkyl.

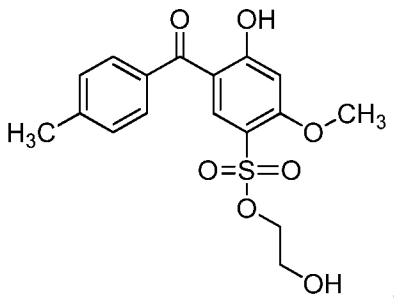
11. The compound according to claim 10 wherein said **Q** is a residue of a compound selected from the group consisting of: diols, amino alcohols, polyols, polyether polyols, polyacetal polyethers, polyalkylene polyamines, polyetheramines, polyethylene imines, polysaccharides, and combinations thereof.

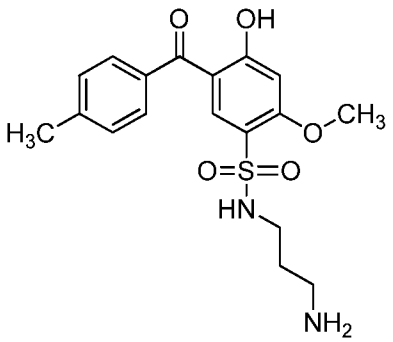
12. The compound according to claim 11 having a structure selected from the group consisting of:

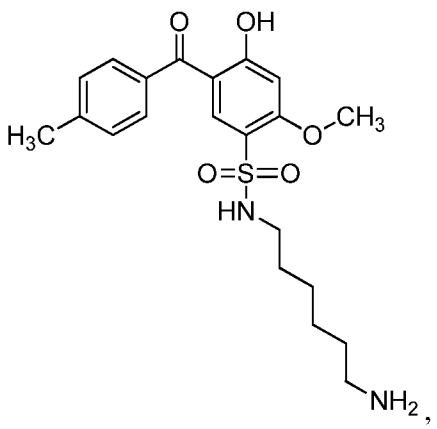

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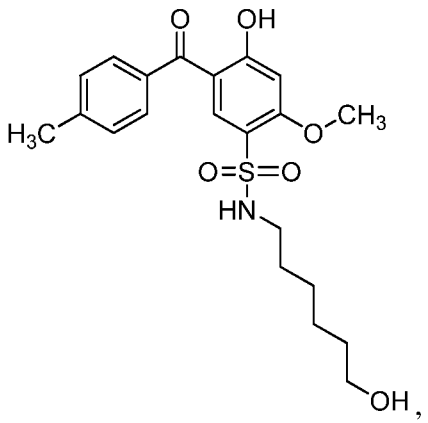

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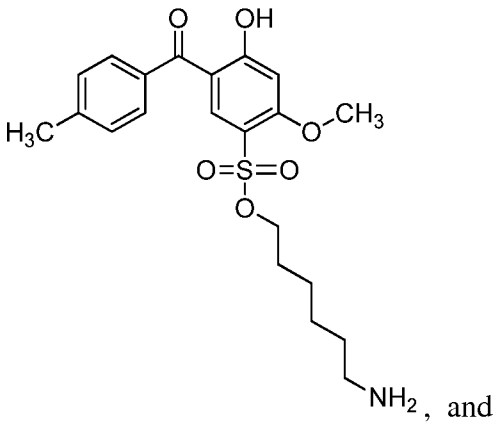

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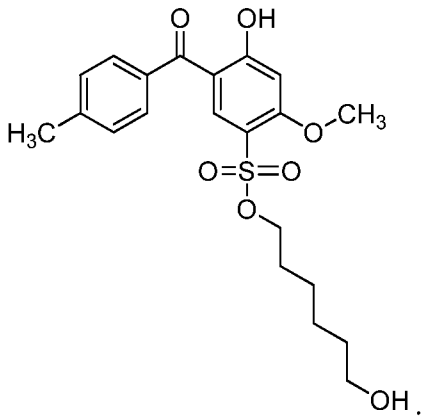

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and



13. A formulation comprising at least one compound of claim 1.

14. The formulation according to claim 13 that is a personal care formulation, pharmaceutical, food, adhesive, coating, electronic, ink, paper, paint, polish, printing, construction, energy, oilfield, lubricant, industrial, biocide, preservative, agrochemical, or wood-care formulation.

15. The formulation according to claim 14 wherein said personal care formulation is a skin lotion, skin crème, skin ointment, skin salve, anti-aging crème, moisturizer, deodorant, tanning agent, sun block, sunscreen, foundation, concealer, eyebrow pencil, eye shadow, eye liner, mascara, rouge, finishing powder, lipstick, lip gloss, nail polish, make-up remover, nail polish remover, shampoo, rinse-off conditioner, leave-on conditioner, hair styling gel, hair mousse, hair spray, styling aide, hair color, or hair color remover.

16. The formulation according to claim 13 that further comprises at least one additional ingredient selected from the group consisting of: propellants, lower molecular weight alcohols, UV absorbers, and combinations thereof.

17. The formulation according to claim 16 wherein said UV active is selected from the group consisting of: 2,4-bis-(2,4-dihydroxyphenyl)-6-(4-methoxyphenyl)-s-triazine, aminobenzoic acid; 2-aminobenzophenone; amyl dimethyl PABA; bemotrizinol; benzophenone-3; benzophenone-4; benzophenone-9; 2-(2H-benzotriazole-2-yl)-4,6-di-tert-pentylphenol; 2-(2H-benzotriazole-2-yl)-4-methylphenol; 2-(2H-benzotriazole-2-yl)-4,6-bis(1-methyl-1-phenylethyl)phenol; bis-benzoxazoyl phenyl ethylhexyl amino triazine; 3-benzylidene camphor sulfonic acid; CAS number 152261-33-1; *N,N'*-bisformyl-*N,N'*-bis-(2,2,6,6-tetramethyl-4-piperidinyl)-hexamethylendiamine; bisoctrizole; 2-[(p-(tert-butylamido)-anilino]-4,6,-bis[(p-(2′-ethylhexyl-1′-oxycarbonyl)-anilino]-1,3,5-triazine; 6-tert-butyl-2-(5-chloro-2H-benzotriazole-2-yl)-4-methylphenol; 2,4-di-tert-butyl-6-(5-chloro-2H-benzotriazole-2-yl)-phenol; camphor benzalkonium methosulfate; diethanolamine p-methoxycinnamate; diethylaminohydroxybenzoylhexylbenzoate; diethylhexyl butamido triazone; digalloyl trioleate; dioxybenzone; disodium phenyl dibenzimidazole tetrasulfonate; drometrizole trisiloxane; ecamsule; ensulizole; ethyl 4-bis(hydroxypropyl) aminobenzoate; ethylhexyl p-methoxycinnamate; 2-ethylhexyl salicylate; ethylhexyl triazone; beta-2-glucopyranoxypropylhydroxybenzophenone; glyceryl aminobenzoate; homomenthyl salicylate; [2-hydroxy-4-(octyloxy)phenyl](phenyl)methanone; 2-[bis(2-hydroxyethyl)amino] ethyl salicylate; (E)-3-(4-hydroxy-3-methoxyphenyl)prop-2-enoic acid; lawsone with dihydroxyacetone; meradimate; methoxycinnamido propyl hydroxy sultaine menthyl anthranilate; meradimate; methyl-2-aminobenzoate; oxybenzone; 2-phenylbenzimidazole-5-sulfonic acid (and its potassium, sodium and triethanolamine salts); sulisobenzone; bis-(2,2,6,6-tetramethyl-4-piperidyl)-sebacate; sterically hindered oligomeric amine, triethanolamine salicylate, and blends thereof.

18. The formulation according to claim 16 wherein said propellant is selected from the group consisting of: dimethyl ether, hydrofluorocarbon 152A, *n*-butane, *iso*-butane, *n*-propane, *iso*-pentane, compressed air, liquified nitrogen, nitrous oxide, liquified carbon dioxide, and combinations thereof.

19. The formulation according to claim 16 wherein said lower molecular weight alcohol is selected from the group consisting of: methanol, ethanol, 1-propanol, 2-propanol, *n*-butanol, *sec*-butanol, *tert*-butanol, and combinations thereof.

INTERNATIONAL SEARCH REPORT

14/017686 28.07.2014

International application No.
PCT/US 14/17686

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61K 8/00; A61Q 17/04 (2014.01)
USPC - 424/59; 424/60
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)
IPC(8): A61K 8/00; A61Q 17/04 (2014.01)
USPC: 424/59; 424/60

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC: 514/679

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase, Google Scholar, SureChem, PubWEST
UV-absorbing, UV protective, sunscreen, topical, dibenzoylmethane, 2-hydroxyethoxy, 2-hydroxyethylamine, 2-aminoethyl, ethylenediamine

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,937,370 A (SABATELLI) 26 June 1990 (26.06.1990) col 3, ln 40-49; col 4, ln 37 - col 5, ln 8; col 8, ln 20; col 10, ln 3-37	1-4 and 13-19
Y	US 3,676,471 A (EGGENSPERGER et al.) 11 July 1972 (11.07.1972) col 1, ln 12-17; col 1, ln 22-47	1-4 and 13-19
Y	WO 2012/078961 A1 (FARES et al.) 14 June 2012 (14.06.2012) para [0033], [0035], [0038], [0055], [0059]-[0071], [0073]	17-19

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 July 2014 (05.07.2014)	28 JUL 2014
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

14/017686 28.07.2014

International application No.
PCT/US 14/17686

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I - Claims 1-4 and 13-19 directed to a dibenzoylmethane derivative of structure shown in claim 1 and a formulation containing the same.

Group II - Claims 5-8 directed to an aryl ester or amide having the structure shown in claim 5.

Group III - Claims 9-12, directed to a benzophenone derivative having the structure shown in claim 9.

--Please see attached sheet----

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
Claims 1-4 and 13-19

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Attachment to Box.No.III:

The inventions listed as Groups I-III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Special technical features:

The compounds of Groups I-III are chemically and structurally different compounds.

Groups II and III do not include the technical feature of a dibenzoylmethane derivative of claim 1 or a formulation containing the same, as required by Group I.

Groups I and III do not include the technical feature of an aryl ester or amide derivative of claim 5 as required by Group II.

Groups I-II do not include the technical feature of a benzophenone derivative of claim 9 as required by Group III.

Common technical features:

The compounds of Groups I-III, however, share the common substructures of a benzoyl group and a X-Q-A moiety in the formulae, wherein X,Q and A are as defined in claim 1.
This shared technical feature, however, does not provide a contribution over the prior art as being anticipated by US 2008/0021126 A1 to Dietliker et al. which discloses a photoinitiator compound having benzoyl and X-Q-A moieties in the molecule, where X is N; Q is unfunctionalized hydrocarbylene and A is OH (para [0084], first structure listed).

As a compound containing said substructures was known in the art at the time of the invention these cannot be considered special technical features that would otherwise unify the groups.

Groups I-III therefore lack unity under PCT Rule 13.2, because they do not share a same or corresponding special technical feature providing a contribution over the prior art.