

RESISTS USING PFAS FREE PAGS**FIELD OF THE INVENTION**

The disclosed and claimed subject matter relates to a chemically amplified resist composition to be used in manufacturing semiconductor devices, semiconductor integrated circuits, and the like, and a method for manufacturing a resist film using the same.

BACKGROUND

[0001] In a fine processing upon manufacturing electronic parts such as a semiconductor and three-dimensional micro structural articles, a photo-lithographic method is being employed generally. In the photo-lithographic method, a positive or negative-working radiation sensitive resin composition is used to form a resist pattern. In these radiation sensitive resin compositions, a radiation sensitive resin composition comprising, for instance, as a non-limiting example, an alkali-soluble resin and a quinonediazide compound that is a photosensitive agent is widely used as a positive-working photoresist.

[0002] The radiation exposure causes a chemical transformation in the exposed areas of the coated surface. Visible light, ultraviolet (UV) light, electron beam and X-ray radiant energy are radiation types commonly used today in microlithographic processes. After this image-wise exposure, the coated substrate is treated with a developer solution to dissolve and remove either the radiation exposed or the unexposed areas of the photoresist. The trend toward the miniaturization of semiconductor devices has led to the use of new photoresists that are sensitive at lower and lower wavelengths of radiation and has also led to the use of sophisticated multilevel systems to overcome difficulties associated with such miniaturization.

[0003] There are two types of photoresist compositions: negative-working and positive-working. The type of photoresist used at a particular point in lithographic processing is determined by the design of the semiconductor device. When negative-working photoresist compositions are exposed image-wise to radiation, the areas of the photoresist composition exposed to the radiation become less soluble to a developer solution (*e.g.*, a cross-linking reaction occurs) while the unexposed areas of the photoresist coating remain relatively soluble to such a solution. Thus, treatment of an exposed negative-working resist with a developer causes removal of the non-exposed areas of the photoresist coating and the creation of a negative image in the coating, thereby uncovering a desired portion of the underlying substrate surface on which the photoresist composition was deposited.

[0004] On the other hand, when positive-working photoresist compositions are exposed image-

wise to radiation, those areas of the photoresist composition exposed to the radiation become more soluble to the developer solution (e.g., a rearrangement reaction occurs) while those areas not exposed remain relatively insoluble to the developer solution. Thus, treatment of an exposed positive-working photoresist with the developer causes removal of the exposed areas of the coating and the creation of a positive image in the photoresist coating. Again, a desired portion of the underlying surface is uncovered.

[0005] Photoresist resolution is defined as the smallest feature, which the resist composition can transfer from the photomask to the substrate with a high degree of image edge acuity after exposure and development. In many leading-edge manufacturing applications today, photoresist resolution on the order of less than one-half micron is necessary. In addition, it is almost always desirable that the developed photoresist wall profiles be near vertical relative to the substrate. Such demarcations between developed and undeveloped areas of the resist coating translate into accurate pattern transfer of the mask image onto the substrate. This becomes even more critical as the push toward miniaturization reduces the critical dimensions on the devices. In cases where the photoresist dimensions have been reduced to below 150 nm, the roughness of the photoresist patterns has become a critical issue. Edge roughness, commonly known as line edge roughness, is typically observed for line and space patterns as roughness along the photoresist line, and for contact holes as side wall roughness. Edge roughness can have adverse effects on the lithographic performance of the photoresist, especially in reducing the critical dimension latitude and in transferring the line edge roughness of the photoresist to the substrate. Hence, photoresists that minimize edge roughness are highly desirable.

[0006] Photoresists sensitive to short wavelengths, between about 100 nm and about 300 nm are often used where sub-half micron geometries are required. Particularly preferred are photoresists comprising non-aromatic polymers, a photoacid generator (PAG), optionally a dissolution inhibitor, and solvent.

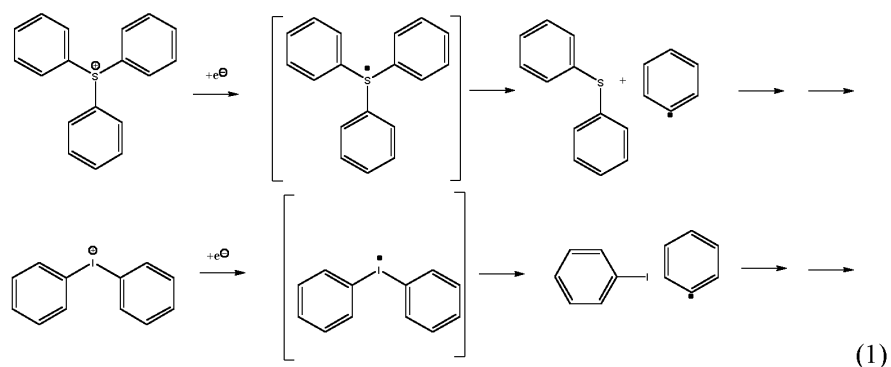
[0007] High resolution, chemically amplified, deep ultraviolet (100-300 nm) positive and negative tone photoresists are available for patterning images with less than quarter micron geometries. To date, there are three major deep ultraviolet (UV) exposure technologies that have provided significant advancement in miniaturization, and these use lasers that emit radiation at 248 nm, 193 nm and 157 nm. Additionally, at the current forefront, extreme ultraviolet (EUV) lithography at 13.5 nm using a laser-pulsed tin droplet plasma is being used to pattern photoresists.

[0008] For use at UV, deep UV and EUV positive and negative chemically amplified photoresists comprise a polymer or oligomer, a photoacid generator (PAG) and an organic spin casting solvent. In positive photoresists the polymer or oligomer is one which undergoes a catalytic deprotection of these materials under the influence of a photoacid generated from the PAG when irradiating a cast film of this composition on a substrate. Conversely, in negative photoresists the polymer or oligomer is one which becomes crosslinked catalytically under the influence of the photoacid and renders the cast film insoluble in the areas irradiated. The PAG is a photoactive component which generates an acid under the influence of radiation, either directly through the absorption of UV or deep UV light directly by the PAG, indirectly through the intermediacy of a sensitizer, or in the case of EUV through the action of a secondary electron generated by the Extreme UV (EUV) radiation.

[0009] Photoresists for 248 nm have typically been based on substituted polyhydroxystyrene and its copolymers, such as those described in US 4,491,628 and US 5,350,660. On the other hand, photoresists for 193 nm exposure require non-aromatic polymers since aromatics are opaque at this wavelength. US 5,843,624 and GB 2,320,718 disclose photoresists useful for 193 nm exposure. Generally, polymers containing alicyclic hydrocarbons are used for photoresists for exposure below 200 nm. Alicyclic hydrocarbons are incorporated into the polymer for many reasons, primarily since they have relatively high carbon to hydrogen ratios which improve etch resistance, they also provide transparency at low wavelengths, and they have relatively high glass transition temperatures. In these types of chemically amplified photoresist generation of photoacid occurs through radiation induced fragmentation through a photochemical process in which the photoacid generator (PAG) itself under the influence of these UV radiations undergoes photodecomposition releasing photoacid in the areas exposed to these UV radiations.

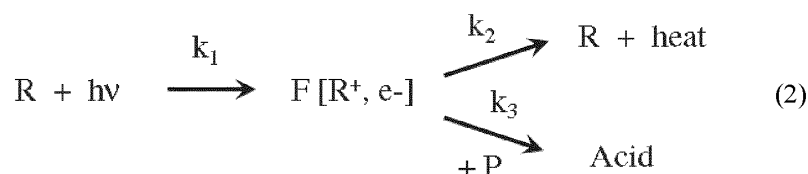
[0010] The use of chemically amplified resists has also been extended to EUV with a wavelength of 13.5 nm or a photon energy of 91.6 eV. At this wavelength, the radiation induced photolysis of the photoacid generator (PAG) occurs through the absorption of the photon by any part of the components in the photoresist film which leads to a primary ionization event in which an electron is ejected from an atom at high energy. This electron then collides with other atoms, leading to further ionization events which generate secondary electrons. In this electron cascade the energy of the original photon is dissipated over a limited area around the original absorption event in the form of electrons and positively charged species ("holes") as well as electronic and thermal excitations.

The size of this area is limited by the path length of the primary and secondary electrons, which has been estimated to be of the order of 2-3 nanometers. This results in a key difference in the mechanism of acid generation by radiation induced fragmentation of a PAG between EUV and the longer UV lithographic wavelengths such as 193 nm and 248 nm: in EUV, the direct absorption of a photon by the PAG is no longer the primary mechanism of photoacid generation. During the exposure, the EUV photon absorption generates a steady state of electrons and holes, with the electrons losing energy in successive collisions until they have reached energies near the thermal equilibrium, or they have recombined with a hole. The PAG comes into play again at the lower energies in the electron cascade when its cation can capture an electron, leading to the formation of a free radical. This free radical is unstable and decomposes into uncharged reaction products, as shown in Eq. (1) for the parent triphenyl sulfonium and diphenyl iodonium cations.



[0011] As a result of the electron capture, an electron is removed from the electron/hole equilibrium that is formed for the duration of the exposure, leaving a hole behind. The cationic species corresponding to these holes then react further to generate the proton needed to form the catalytic species (*i.e.*, the dissociated or undissociated photoacid). The kinetics of this process have been studied in the literature, and the rates of acid formation predicted by the kinetic model are in excellent accordance with experiment. [Craig D. Higgins, Charles R. Szmanda, Alin Antohe, Greg Denbeaux, Jacque Georger, and Robert L. Brainard, Japanese Journal of Applied Physics 50 (2011) 036504, 10.1143/JJAP.50.036504, DOI: 10.1143/JJAP.50.036504]

[0012] In the above-referenced kinetic model, the concentration of the hole species R^+ is reduced from the steady-state concentration $F[R^+, e^-]$ either by acid formation or by recombination with electrons according to Eq. (2).



[0013] The polymers used in a 193 nm or 248 nm photoresist are designed to be transparent to the imaging wavelength, but on the other hand, the photoactive component has either been typically designed to be absorbing at the imaging wavelength to maximize photosensitivity. The photosensitivity of the photoresist is dependent on the absorption characteristics of the photoactive component, the higher the absorption, the less the energy required to generate the acid, and the more photosensitive is the photoresist. However, in EUV absorption by the polymer matrix can be beneficial as this may lead to the aforementioned primary ionization event leading to secondary electrons which may interact with the PAG leading to the generation of acid in the area of the photoresist film impacted by EUV radiation.

[0014] Photoacid generators (PAG) are key components of chemically amplified resists used in photolithography. However, the majority of photoresist formulations generate PFAS (Per and PolyFluoroAlkyl Substances) superacids upon exposure. Nowadays, the use of PFAS is subjected under increasing regulatory scrutiny due to their extreme persistence and bioaccumulation in environment. It is of general interest to find photoresist formulations containing environmentally-friendly PAGs that are free of perfluoroalkyl moieties. Furthermore, these latent acid catalysts should possess high stability and good solubility in the field of chemically amplified photoresists.

[0015] Specific onium salts of organic sulfates [1] (Yamato et al., US 20040053158 A1) have shown to generate strong superacids that could initiate deprotection reactions of high activation energy groups [1] or acid-catalyzed cross-linking [2] (Kunimoto et al., US 2014005301 A1). However, up to date, no pattern formation has been reported. Furthermore, the solubility of the reported PAGs in PGMEA is limited to rather thin film resists (film thickness of 800nm).

DETAILED DESCRIPTION OF DRAWINGS

[0016] FIG. 1 Table 2A Results of first lithographic experiments with P(PHS/S/TBA) resin and comparing aryl sulfate based onium salt PAGs to PAGs which photorelease perfluoroalkyl containing super acids.

[0017] FIG. 2 Table 2B Results of first lithographic experiments with P(PHS/S/TBA) resin and

comparing aryl sulfate based onium salt PAGs to PAGs which photorelease perfluoroalkyl containing super acids as shown in FIG. 1 Comparative Example.

[0018] FIG. 3 Table 3A Results of second lithographic experiments with P(PHS/S/TBA) resin and comparing aryl sulfate based onium salt PAGs to PAGs which photorelease perfluoroalkyl containing super acids as shown in FIG. 1 Comparative Example.

[0019] FIG. 4 Table 3B Results of second lithographic experiments with P(PHS/S/TBA) resin and comparing aryl sulfate based onium salt PAGs to PAGs which photorelease perfluoroalkyl containing super acids as shown in FIG. 1 Comparative Example.

[0020] FIG. 5. Table 4A Results of third lithographic experiments with P(PHS/S/TBA) resin and comparing aryl sulfate based onium salt PAGs to PAGs which photorelease perfluoroalkyl containing super acids.

[0021] FIG. 6 Table 4B Results of third lithographic experiments with P(PHS/S/TBA) resin and comparing aryl sulfate based onium salt to PAGs PAGs which photorelease perfluoroalkyl containing super acids as shown in FIG. 1 Comparative Example.

[0022] FIG. 7 Table 5 Results of lithographic experiments with P(PHS/PTBST/TBA) resin comparing aryl sulfate based onium salt PAGs to PAGs which photorelease perfluoroalkyl containing super acids.

[0023] FIG. 8 Table 6A Results of lithographic experiments with poly[p-(1-ethoxyethoxy)styrene-*co*-p-hydroxy styrene] resin and comparing aryl sulfate based onium salt PAGs to PAGs which photorelease perfluoroalkyl containing super acids.

[0024] FIG. 9 Table 6B Results lithographic experiments with poly[p-(1-ethoxyethoxy)styrene-*co*-p-hydroxy styrene] resin and comparing aryl sulfate based onium salt PAGs to PAGs which photorelease perfluoroalkyl containing super acids as shown in FIG. 8 Comparative Example..

[0025] FIG. 10 Table 7 Results of dose-to-print values in (PHS/S/TBA) resin of aryl sulfates based onium salt PAGs.

SUMMARY OF INVENTION

[0026] The disclosed and claimed subject matter provides new photoresist compositions comprising perfluoroalkyl and fluoroalkyl free aryl onium salts of aryl sulfate based PAGs for use in photoresists sensitive to shorter wavelength radiation for example: in Deep UV (DUV) (e.g., 248 nm, 193 nm) photoresists, in extreme ultraviolet (EUV) photoresists. It has been found that these compositions have unexpectedly been enhanced through the use of acid quencher additives and also

through the use of different substituents on the aryl portion of said aryl sulfate portion of these aryl onium aryl sulfate PAGs aimed at improving photoacid strength and solubility. The photoresist composition in the disclosed and claimed subject matter provide a viable alternative to PAG which contain perfluorinated alkyl or fluoroalkyl, which are currently used in the industry, such as aryl onium perfluoroalkyl sulfonate (PFAS) salts such as for example triphenylsulfonium perfluorobutanesulfonate or diphenyliodonium perfluorobutanesulfonate. The disclosed and claimed subject matter also provides photoresist compositions containing perfluoroalkyl or fluoroalkyl free PAGs that show excellent lithographic performance that is comparable with photoresists using commercial PFC-containing PAGs.

DETAILED DESCRIPTION OF THE INVENTION

[0027] It is to be understood that both the foregoing general description and the following detailed description are illustrative and explanatory, and are not restrictive of the subject matter, as claimed. In this application, the use of the singular includes the plural, the word "a" or "an" means "at least one", and the use of "or" means "and/or," unless specifically stated otherwise. Furthermore, the use of the term "including," as well as other forms such as "includes" and "included," is not limiting. Also, terms such as "element" or "component" encompass both elements and components comprising one unit and elements or components that comprise more than one unit, unless specifically stated otherwise. As used herein, the conjunction "and" is intended to be inclusive and the conjunction "or" is not intended to be exclusive unless otherwise indicated. For example, the phrase "or, alternatively" is intended to be exclusive. As used herein, the term "and/or" refers to any combination of the foregoing elements including using a single element.

[0028] The term "alicyclic" refers to compounds containing one or more carbon chains forming rings which can be saturated hydrocarbons or may contain unsaturation but are not aromatic.

[0029] The term alkyl encompasses, linear alkyls (which includes methyl and n-alkyls), branched alkyls and alicyclic alkyls, which encompasses both cyclic and multicyclic alkyls. More specifically if a given number of carbons is given such as a C-1 to C-4 alkyl, this embodies both methyl, C-2 to C-4 linear alkyls, C-3 to C-4 branched alkyl moieties and C-3 to C-4 alicyclic moieties, for example as follows: methyl, (-CH₃), ethyl (-CH₂-CH₃), n-propyl (-CH₂-CH₂-CH₃), isopropyl (-CH(CH₃)₂), n-butyl (-CH₂-CH₂-CH₂-CH₃), tert-butyl (-C(CH₃)₃), isobutyl (-CH₂-CH(CH₃)₂), 2-butyl (-CH(CH₃)CH₂-CH₃), cyclopropyl, cyclobutyl. Similarly, the term C-1 to C-12 alkyl embodies methyl, C-2 to C-12 linear alkyls, C-3 to C-12 branched alkyls, C-3 to C-12 alicyclic moieties

which encompass 1 or more rings (*e.g.*, cyclopentyl, cyclohexyl, bicyclic such as bicyclo[2.2.1]hept-2-yl, bicyclo[2.2.1]hept-1-yl, bicyclo[2.2.2]oct-2-yl, and the like), C-5 to C-8 alkenecycloalkyls, and C-3 to C-8 alicyclic (*e.g.* cyclopropyl, cyclopentyl, cyclohexyl, bicyclic such as bicyclo[2.2.1]hept-2-yl, bicyclo[2.2.1]hept-1-yl, bicyclo[2.2.2]oct-2-yl, bicyclo[2.2.2]oct-1-yl and the like). Also, the term “C-1 to C-18 alkyl” includes methyl, C-2 to C-18 linear, C-3 to C-18 branched alkyls, C-4 to C-18 cycloalkyls, C-5 to C-18 alkenecycloalkyls, C-3 to C-18 alicyclic (*e.g.* cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, bicyclic such as bicyclo[2.2.1]hept-2-yl, bicyclo[2.2.1]hept-1-yl, bicyclo[2.2.2]oct-2-yl, bicyclo[2.2.2]oct-1-yl, adamantan-1-yl, adamantan-2-yl, octahydro-1*H*-4,7-methanoinden-5-yl, and the like). Similarly, other carbon number ranges designated herein for alkyl groups embody within them the possible linear, branched, and cyclic alkyls.

[0030] The phrase “linear C-2 to C-4 alkylene” includes C-2 to C-4 alkylene moieties which are not branched (*e.g.*, ethylene, propylene *etc.*) and excludes C-3 to C-4 branched alkylene moieties where the attachment points of the alkylene are on the same carbon of the alkylene (*e.g.*, -CH(CH₃)-, -C(CH₃)₂-, -C(CH₃)(CH₂CH₃)- *etc.*) but includes branched alkylene moieties which have at least two carbon between the attachment point of the alkylene (*e.g.* -CH-CH(CH₃)-, -(C(CH₃)-CH(CH₃)-, -CH₂-CH(CH₃)-CH₂-, -CH₂-C(CH₃)₂-CH₂-).

[0031] The phrase “a linear alkoxy moiety comprising within its chain at least one (-CH₂-O-CH₂-) alkyl ether functionality but which does not contain any (-CH₂-O-CH₂-O-) moieties,” encompasses any linear alkoxy which encompasses within its alkyl chain at least one alkyl ether moiety but excludes any (-CH₂-O-CH₂-O-) moieties that form a 1,1 attachment of two oxygen atoms on a single carbon. In embodiments containing more than one (-CH₂-O-CH₂-) alkyl ether moieties this includes such moieties which contain within their chain one or more linear glycolic moieties (-O-alkylene-O-) which do not form an attachment of two oxygen atoms on a single carbon. Within this larger definition is also encompassed alkoxy ether moiety having structure -R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}, where R_{eth} is a C-1 to C-4 alkylene, R_{eth1} is a linear C-2 to C-4 alkylene, neth is an integer ranging from 1 to 6, and R_{eth3} is a C-1 to C-4 alkyl.

[0032] The term “substituted” when designating an alkyl, an alkylene, or an aryl as described herein, unless otherwise indicated, entails that substituents may be present such as alkyl, aryl, benzyl, -O-R_w, -S(=O)₂-R_w, -S(=O)₂-R_w, -O-S(=O)₂-R_{w1}, -O-S(=O)₂-O-R_{w1}, -Br, -Cl, hydroxy, -NO₂, -CN, -C(=O)-H, -C(=O)-R_w, -C(=O)-R_{w1}, -C(=O)-O-R_w, -C(=O)-O-R_{w1}, -O-

C(=O)-O-Rw, O-C(=O)-O-Rw1, -C(=O)-S-Rw, C(=O)-S-Rw1, -S-Rw, -S-Rw1, -C(=S)-Rw, -C(=S)-Rw1, -C(=S)-O-Rw, -C(=S)-O-Rw1, -C(=S)-S-Rw, -C(=S)-S-Rw1, -O-C(=S)-S-Rw, -O-C(=S)-S-Rw1, an alkynyl, an alkenyl and the like, where Rw is an unsubstituted or substituted alkyl. Rw1 is a substituted or unsubstituted aryl moiety which may be substituted by F directly on the aryl, where the selection of substituent on any alkyl, alkylene, or aryl moieties specifically excludes the presence of fluorinated alkyls, perfluorinated alkyls or any other substituents which would contain fluorinated alkyls, or perfluorinated alkyls, but does not exclude substituents which contain a fluorinated aryl, fluorinated arylene, and a perfluorinated aryl because such moieties do not contain any fluorinated alkyls or perfluorinated alkyls.

[0033] The terms an unsubstituted C-1 to C-12 alkoxy, encompass in their alkyl portions, C-1 to C-12 linear alkyls, C-3 to C-12 branched alkyls, C-3 to C-12 alicyclic alkyls.

[0034] The term "aryl" or "aromatic groups" refers to such groups which contain 6 to 24 carbon atoms including phenyl, tolyl, xylyl, naphthyl, anthracenyl, biphenyls, bis-phenyls, tris-phenyls, and the like. These aryl groups may further be substituted with any of the appropriate substituents, *e.g.*, alkyl, alkoxy, acyl or aryl groups mentioned herein.

[0035] The terms "fluoroalkyl" refers to an alkyl or alkylene moiety that contains at least one fluorine (*e.g.* -CFH-, -CF₂H).

[0036] The term "perfluorinated alkyl" or perfluoroalkyl refers to a fluoroalkyl or fluoroalkylene moiety that does not contain any hydrogen atoms (*e.g.* -CF₂-, -CF₃).

[0037] The term fluoroalkyl or fluorinated alkyl entails partially fluorinated alkyls or partially fluorinated alkenes (*e.g.* -CHF-, -CFH₂-, -CF₂H), and perfluoroalkyl.

[0038] When the term free of any fluoroalkyls, any perfluoroalkyls or mixtures of fluoroalkyls and perfluoroalkyls, is employed herein this refers both to alkyl moieties which contain perfluoroalkyls, perfluoroalkylenes, fluoroalkyls, fluoroalkylenes, and mixtures of these and to such moieties which incorporate within their length a carbon to carbon double bond (=), a carbon to carbon triple bond ($\equiv$), and/or a heteroatom comprising moiety selected from -O-, -S-, -C(=O)-, -C(=S)-, -S(=O)₂-, -S(=O)-, -C(=O)-O-, -C(=O)-S-, -O-S(=O)₂-, -O-C(=O)-O-, -C(=O)-NH-, -O-C(=O)-NH-, and -C(=O)-NR-, and mixtures thereof, where R is a C-1 to C-18 alkyl.

[0039] The term "arylene" refers to an aromatic hydrocarbon moiety which has two or more attachment points (*e.g.*, 2-5), this moiety may be a single benzene moiety (*e.g.*, having two

attachment points 1,4-phenylene, 1,3-phenylene and 1,2-phenylene; three attachment points 1,2,4-substituted benzene, 1,3,5-substituted benzene and the like), a polycyclic aromatic moiety with two attachment points such derived from naphthalene, anthracene, pyrene and the like, or a multiple benzene rings in a chain which have two attachment point (*e.g.*, biphenylene). In those instances where the aromatic moiety is a fused aromatic ring, these may be called fused ring arylenes, and more specifically named, for instance, naphthalenylene, anthracenylene, pyrenylene, and the like. Fused ring arylenes may be substituted or unsubstituted as described below, additionally these fused ring arylenes may also contain a hydrocarbon substituent which has two attachment sites on the fused ring forming an additional aliphatic or unsaturated ring forming by attachment to the fused ring a ring having 5 to 10 carbon atoms.

[0040] As used herein, “about” or “approximately” is intended to correspond to $\pm 5\%$ of the stated value.

[0041] When referring to compositions (or solutions) herein in terms of weight %, it is understood that in no event shall the weight % of all components, including non-essential components, such as impurities, add to more than 100 weight %. In compositions “consisting essentially of” recited components, such components may add up to 100 weight % of the compositions or may add up to less than 100 weight %. Where the components add up to less than 100 weight %, such compositions may include some small amounts of a non-essential contaminants or impurities. For example, in one such embodiment, the compositions can contain 2% by weight or less of impurities. In another embodiment, the compositions can contain 1% by weight or less than of impurities. In a further embodiment, the compositions can contain 0.05% by weight or less than of impurities. In other such embodiments, the ingredients can form at least 90 weight %, more preferably at least 95 weight %, more preferably at least 99 weight %, more preferably at least 99.5 weight %, most preferably at least 99.8 weight %, and can include other ingredients that do not affect the performance of the wet etchant. Otherwise, if no significant non-essential impurity component is present, it is understood that the composition of all essential constituent components will essentially add up to 100 weight %.

[0042] The disclosed and claimed subject matter provides for resist compositions which comprise PAGs which are an aryl onium (*e.g.* diaryliodonium or triarylsulfonium cations) salt in which the anion is that of a strong acid selected from aryl sulfates (*e.g.* anion of aryl hydrogen sulfate super acids) which are free of any fluoroalkyls, any perfluoroalkyls or mixtures of fluoroalkyls and

perfluoroalkyls moieties, which release upon radiation induced fragmentation an aryl hydrogen sulfate; an acid quencher additive having a pK_a higher than -0.5 and a boiling point of at least 150°C at 1 atmosphere; a resin essentially insoluble in aqueous 0.26 N tetramethylammonium hydroxide (TMAH) at room temperature which comprises at least one type of repeat unit which contains a base solubilizing moiety masked by an acid labile group, where the catalytic cleaving of this acid labile group by an acid, formed by radiation induced fragmentation of the aryl onium aryl sulfate based PAG, releasing an aryl hydrogen sulfate acid, unmasks the base solubilizing moiety and the renders the resin soluble in aqueous 0.26 N TMAH at room temperature; and an organic spin casting solvent component.

[0043] These aryl onium aryl sulfate salts based photoacid generator (PAG), unexpectedly, have comparable thermal stability in chemically amplified photoresist formulation compared to that of aryl onium salts of super acids containing fluoroalkyl or perfluoroalkyl moieties (e.g. triflic acid, nonaflic acid and the like) and have acidities which are higher than those of perfluoroalkyl sulfonic acids. Table 1 compares the pK_a of various aryl hydrogen sulfates compared to that of triflic acid. Even the unsubstituted aryl hydrogen sulfate, phenyl hydrogen sulfate, has a pK_a which is lower than that of triflic acid (more acidic). Although not bound by theory the higher electronegativity of the oxygen atom (3.5) linked adjacent to the sulfur atom (2.5) in these aryl hydrogen sulfate PAGs may be responsible for their higher acidity. Moreover, as also seen in Table 1, substitution of the phenyl moiety in these aryl hydrogen sulfate acids even with substituents which are electron donating by resonance in a para position still imparts very high acidities while substitution at the meta positions with substituents which are electron donating by resonance imparts much greater acidity than that found for perfluoroalkyl sulfonic acids such as triflic acid. Substitution at a para position with a substituent which is electron withdrawing by resonance and induction such as an alkylsulfone substituent imparts even greater acidity.

[0044] Select aryl onium salts with aryl sulfate anions in this disclosed and claimed subject matter were tested in different types of photoresist compositions and showed excellent lithographic performance that is comparable with references using the commercial perfluorocarbon (PFC)-containing onium salt PAGs.

[0045] One aspect of this disclosed and claimed subject matter is a Chemically amplified photoresist composition which comprises Component A, Component B, Component C and component D:

[0046] Component A: at least one aryl sulfate aryl onium salt PAG (PAG), wherein in said aryl sulfate moiety its aryl moiety is either unsubstituted or substituted with at least one substituent selected from the group consisting of an alkyl, an alkoxy, an aryl, -CN, -NO₂, -S(=O)₂-alkyl, -S(=O)₂-aryl, -F, -Cl, and -Br, a linear alkoxy moiety comprising within its chain at least one (-CH₂-O-CH₂-) alkyl ether functionality but which does not contain any (-CH₂-O-CH₂-O-) moieties, and in said aryl onium salt its aryl moieties are either unsubstituted or have at least one aryl moiety substituted with at least one substituent selected from the group consisting of an alkyl, and an alkoxy,

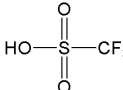
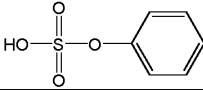
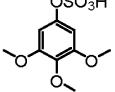
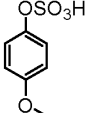
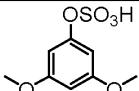
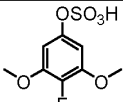
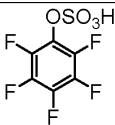
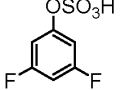
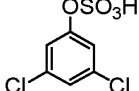
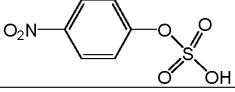
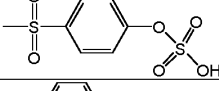
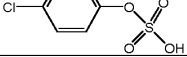
[0047] Component B: a resin essentially insoluble in aqueous 0.26 N TMAH at room temperature comprising at least one type of repeat unit which contains a base solubilizing moiety masked by an acid labile group, where the catalytic cleaving of this acid labile group by an acid, formed by radiation induced fragmentation of Component A, unmasks the base solubilizing moiety and renders the resin soluble in aqueous 0.26 N TMAH at room temperature,

[0048] Component C: at least one acid quencher additive having a pK_a higher than -0.5 and a boiling point of at least 150°C at 1 atmosphere.

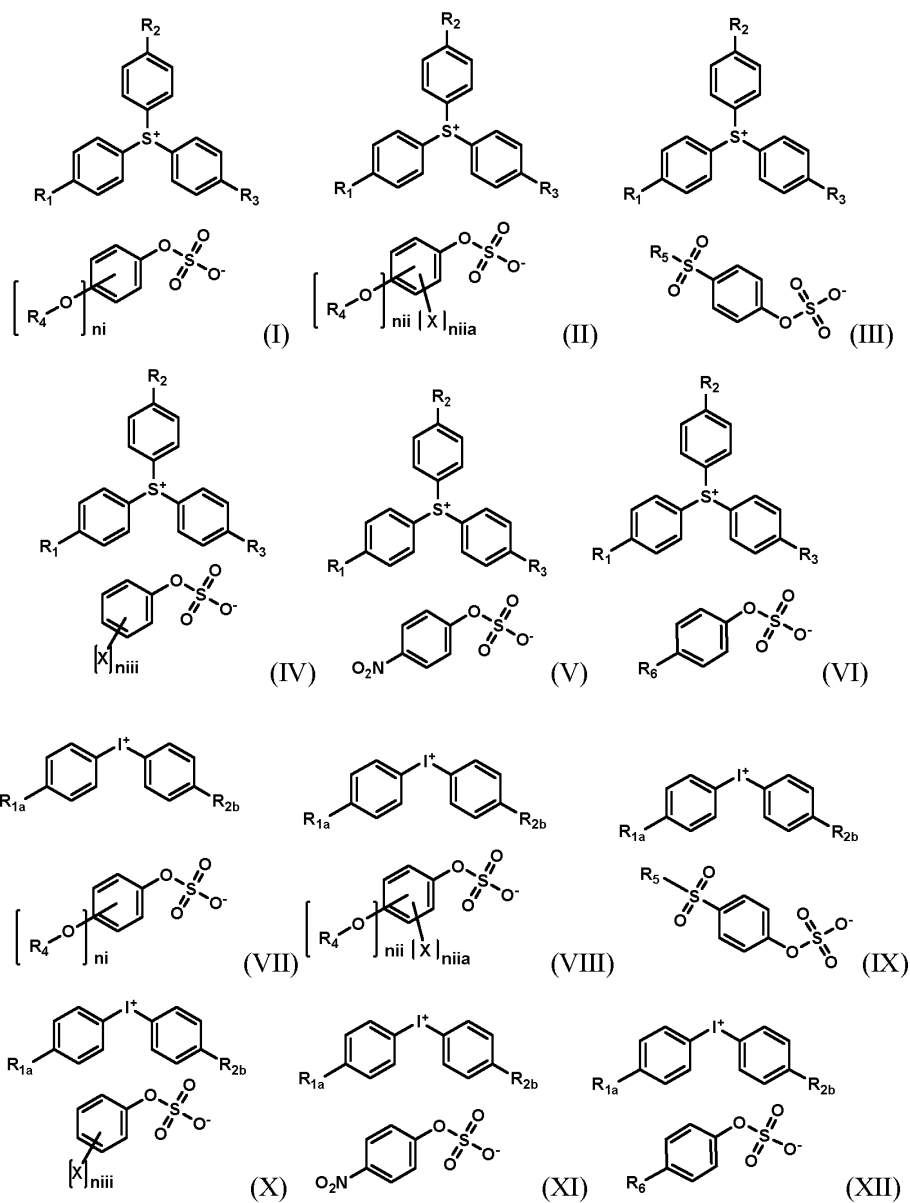
[0049] Component D: an organic spin casting solvent, wherein further said composition is free of any perfluoroalkyl, fluoroalkyl moieties or mixture thereof.

[0050] Another aspect of this disclosed and claimed subject matter is one wherein said **Component A** is at least one aryl sulfate onium salt photoacid generator (PAG) selected from the group consisting of ones having structure (I), (II), (III), (IV), (V), (VI), (VII), (VIII), (IX), (X), (XI) and (XII), wherein in these structures, R₁, R₂, R₃, R_{1a}, R_{2b}, are independently selected from hydrogen, a C-1 to C-12 alkyl, or a C-1 to C-12 alkoxy, R₄ is independently selected from the group consisting of a C-1 to C-12 alkyl, an alkyl moiety comprising an alkyl ether moiety having structure -R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}, where R_{eth} is a C-1 to C-4 alkylene, R_{eth1} is a linear C-2 to C-4 alkylene, neth is an integer ranging from 1 to 6, and R_{eth3} is a C-1 to C-4 alkyl, R₅ is independently selected from a C-1 to C-12 alkyl, an unsubstituted aryl and a substituted aryl, R₆ is independently selected from H or a C-1 to C-12 alkyl, X is independently a halide selected from the group consisting of F, Cl and Br and ni, and niii, are independently a integer from 1 to 5, nii and niia are integers from 1 to 4, where the sum of nii and niia ranges from 2 to 5:

Table 1

Photoacid Formed	Predicted pK _a (ACD/Labs)*
 Triflic Acid	-3.9
 phenyl hydrogen sulfate	-4.3
	-4.3
	-3.7
	-4.62
	-4.8
	-4.04
	-4.91
	-4.84
	-5.72
	-4.95
	-4.43

*ACD/pK_a software version 4.0 for Microsoft windows, Advanced Chemistry development Inc 8 King Street East, Suite 107, Toronto, Ontario Canada)



[0051] Component B: a resin essentially insoluble in aqueous 0.26 N tetramethylammonium hydroxide (TMAH) at room temperature which comprises at least one type of repeat unit which contains a base solubilizing moiety masked by an acid labile group, where the catalytic cleaving of this acid labile group by an acid, formed by radiation induced fragmentation of Component A, unmasks the base solubilizing moiety and renders the resin soluble in aqueous 0.26 N TMAH at room temperature,

[0052] **Component C:** at least one acid quencher additive having a pK_a higher than -0.5 and a boiling point of at least 150°C at 1 atmosphere.

[0053] **Component D:** an organic spin casting solvent.

[0054] In one aspect of said composition it is free of any alkyl sulfate onium salt PAGs or substituted alkyl sulfate onium salt PAGs. Structure (AS) shows a general structure for these materials where Ras is an unsubstituted alkyl or a substituted alkyl, Xas is I or S, as1 is 2 when Xas is I, and 3 when Xas is S, and Ra is individually selected from an unsubstituted aryl, a substituted aryl, an unsubstituted alkyl, and a substituted alkyl, where at least one Ra in structure (AS) is either an unsubstituted aryl or a substituted aryl.



[0055] In one aspect of said composition, one or more optional components may be present such as the following:

Optional Component E: A surfactant additive.

Optional Component F: Other type of PAGs which do not contain any fluoroalkyl moieties and are not alkyl sulfate onium salt PAGs or substituted alkyl sulfate onium salt PAGs.

[0056] In one aspect of this general embodiment these compositions are ones consisting essentially of Component A, Component B, Component C and Component D. In another aspect of this embodiment these compositions are ones which consist of Component A, Component B, Component C and Component D. In another aspect of this embodiment these compositions are ones consisting essentially of Component A, Component B, Component C, Component D and Component E. In another aspect of this embodiment said these compositions are ones which consist of Component A, Component B, Component C, Component D and Component E. In another aspect of this embodiment these compositions are ones consisting essentially of Component A, Component B, Component C, Component D, Component E and Component F. In another aspect of this embodiment said these compositions are ones which consist of Component A, Component B, Component C, Component D, Component E, and Component F. In another aspect of this embodiment these compositions are ones consisting essentially of Component A, Component B, Component C, Component D and Component F. In another aspect of this embodiment said these compositions are ones which consist of Component A, Component B, Component C, Component D and Component F.

General Examples of Component B**Component B for 248 nm Photoresists**

[0057] In another aspect of said composition Component B, said resin, essentially insoluble in aqueous 0.26 N TMAH at room temperature comprises repeat units derived from 4-hydroxystyrene in addition to at least one type of repeat unit which contains a base solubilizing moiety masked by an acid labile group, where the catalytic cleaving of this acid labile group by an acid formed by radiation induced fragmentation of Component A, unmaskes the base solubilizing group and renders the resin soluble in aqueous 0.26 N TMAH at room temperature and further, where it does not contain any repeat units comprising moieties which impart a high absorbance at 248 nm greater than 0.8 Absorbance Unit (AU)/micron to a coated film of said resin. In one embodiment said resin has an absorbance at 248 nm from about 0.4 Absorbance Units(AU) per micron to about 0.5 (AU)/micron.

[0058] Photoresists resins suitable for 248 nm normally comprise polyhydroxystyrene or substituted polyhydroxystyrene derivatives possibly copolymerized with acrylate or methacrylate repeat units. In one aspect of this embodiment these composition for use in 248 nm are ones consisting essentially of Component A, Component B, Component C and Component D. In another aspect of this embodiment said these compositions are ones which consist of Component A, Component B, Component C and Component D. In another aspect of this embodiment these compositions are ones consisting essentially of Component A, Component B, Component C, Component D and Component E. In another aspect of this embodiment said these compositions are ones which consist of Component A, Component B, Component C, Component D and Component E. In another aspect of this embodiment these compositions are ones consisting essentially of Component A, Component B, Component C, Component D, Component E and Component F. In another aspect of this embodiment said these compositions are ones which consist of Component A, Component B, Component C, Component D, Component E, and Component F. In another aspect of this embodiment these compositions are ones consisting essentially of Component A, Component B, Component C, Component D and Component F. In another aspect of this embodiment said these compositions are ones which consist of Component A, Component B, Component C, Component D and Component F.

Component B for 193 nm Photoresists

[0059] In another aspect of said composition Component B, is resin suitable for 193 nm

lithography (wet or dry) where said resin is essentially insoluble in aqueous 0.26 N TMAH at room temperature, does not contain any repeat units comprising moieties which impart a high absorbance at 193 nm greater than 0.8 Absorbance Unit (AU)/micron to a coated film of said resin, and comprises a base solubilizing moiety masked by an acid labile group, which is derived from an acrylate or methacrylate repeat unit wherein, in these, the carboxylic acid moiety is masked by said acid labile group where the catalytic cleaving of said acid labile group by an acid, formed by the radiation induced fragmentation of Component A, unmask the base solubilizing group and renders this resin soluble in aqueous 0.26 N TMAH at room temperature. In one embodiment said resin film has an absorbance at 193 nm from about 0.4 AU/micron to about 0.5 AU/micron.

[0060] Particularly preferred for 193 nm are photoresist resins comprising non-aromatic polymers. Optionally a solubility inhibitor may be present along with these resins. Photoresists resins suitable for 193 nm that are known in the prior art are described in the following documents and incorporated herein, WO 97/33198, U.S. Pat. No. 5,585,219, Proc. SPIE, vols. 3333 (1998), 3678 (1999), 3999 (2000), 4345 (2001). Particularly preferred for 193 nm exposure are photoresists resins comprising non-aromatic polymers, apart from the PAG, optionally a solubility inhibitor component may be present. Photoresists sensitive at 193 nm that are known in the prior art are described in the following references and incorporated herein, Proc. SPIE, vols. 3999 (2000), 4345 (2001), although any photoresist resin suitable for 193 nm lithography may be used.

[0061] In one aspect of this embodiment these composition for use in 193 nm lithography they are ones consisting essentially of Component A, Component B, Component C and Component D. In another aspect of this embodiment said these compositions are ones which consist of Component A, Component B, Component C and Component D. In another aspect of this embodiment these compositions are ones consisting essentially of Component A, Component B, Component C, Component D and Component E. In another aspect of this embodiment said these compositions are ones which consist of Component A, Component B, Component C, Component D and Component E. In another aspect of this embodiment these compositions are ones consisting essentially of Component A, Component B, Component C, Component D, Component E and Component F. In another aspect of this embodiment said these compositions are ones which consist of Component A, Component B, Component C, Component D, Component E, and Component F. In another aspect of this embodiment these compositions are ones consisting essentially of Component A, Component B, Component C, Component D and Component F. In another aspect

of this embodiment said these compositions are ones which consist of Component A, Component B, Component C, Component D and Component F.

Component B for EUV (e.g., 13.5 nm) Photoresists

[0062] In another aspect of said composition, Component B, said resin essentially insoluble in aqueous 0.26 N TMAH at room temperature, is a EUV resin which comprises at least one base solubilizing moiety masked by an acid labile group, which is derived from a phenolic repeat unit, an acrylate repeat unit, a methacrylate repeat unit or a mixture of these, wherein the carboxylic acid moiety and/or the phenolic moiety of these are masked by said acid labile group where the catalytic cleaving of said acid labile group by an acid, formed by the radiation induced fragmentation of Component A, unmasks the base solubilizing group and renders this resin soluble in aqueous 0.26 N TMAH at room temperature. In one embodiment said resin film has an absorbance at 13.5 nm from about 0.4 AU/micron to about 0.5 AU/micron.

[0063] The review article “Trends in photoresist materials for extreme ultraviolet Lithography: A review (Materials Today Volume 627 July/August 2023, pages 299-319) describes several types of resins which may be used in chemically amplified photoresists developable by aqueous base. This reference is incorporated by reference. For examples as described in this reference, resins may be of various types such as Conventional Chemically amplified photoresists such as those used in 193 nm or 248 nm resists. For examples those based upon 4-hydroxystyrene/styrene/tert-butyl acrylate terpolymers. Another type are photoresist resins based on protected poly(4-hydroxystyrene) with bulky acetal groups. Another type are main-chain scission type chemically amplified photoresists where the acid catalyzed cleavage from photogenerated acid in the exposed areas under the influence of photogenerated acid concept leads to the generation of polymer fragments which are soluble in aqueous based developer.

[0064] In one aspect of this embodiment these compositions for use in EUV nm lithography they are ones consisting essentially of Component A, Component B, Component C and Component D. In another aspect of this embodiment said these compositions are ones which consist of Component A, Component B, Component C and Component D. In another aspect of this embodiment these compositions are ones consisting essentially of Component A, Component B, Component C, Component D and Component E. In another aspect of this embodiment said these compositions are ones which consist of Component A, Component B, Component C, Component D and Component E. In another aspect of this embodiment these compositions are ones consisting

essentially of Component A, Component B, Component C, Component D, Component E and Component F. In another aspect of this embodiment said these compositions are ones which consist of Component A, Component B, Component C, Component D, Component E, and Component F. In another aspect of this embodiment these composition are ones consisting essentially of Component A, Component B, Component C, Component D and Component F. In another aspect of this embodiment said these compositions are ones which consist of Component A, Component B, Component C, Component D and Component F.

[0065] In one aspect of this disclosed and claimed subject matter the above described Embodiments of Component B, said resin essentially insoluble in aqueous 0.26 N TMAH at room temperature, are ones that when coated as a film as part of these inventive photoresist compositions on a substrate, and not subjected to irradiation, undergo a dark erosion of less than 1 % of the thickness of said coated film when it is exposed to an aqueous 0.26 N TMAH based developer at room temperature (dark erosion). In another aspect, this dark erosion is less than 0.5 %. In another aspect it is less than 0.4 %. In another aspect it is less than 0.3 %. In another aspect it is less than 0.2 %. In another aspect it is less than 0.1%. Generally, in this disclosed and claimed subject matter it is preferred to have less % dark erosion of film thickness with decreasing wavelength of the radiation used to expose a photoresist composition, decreasing thickness of the photoresist composition, and decreasing size of the patterns being imaged by these inventive photoresist compositions containing the various above-described embodiments or Component B which are all resins essentially insoluble in aqueous 0.26 N TMAH at room temperature.

[0066] Component A: Aryl sulfate Onium Salt PAGs

Detailed Description

Structure (Ia)

[0067] In one aspect of the embodiments of the compositions described above Component A, said aryl sulfate PAG, has structure (I). In a more specific aspect of this embodiment it has structure (Ia), in one aspect of this embodiment R_1 , R_2 , and R_3 , are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a

C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkoxy, and at least one of R_1 , R_2 , and R_3 , is H. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 are individually selected from is selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkyl and at least one of R_1 , R_2 , and R_3 , is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl.

[0068] In another aspect of these embodiments of structure (Ia), R_4 is a C-1 to C-12 linear alkyl.

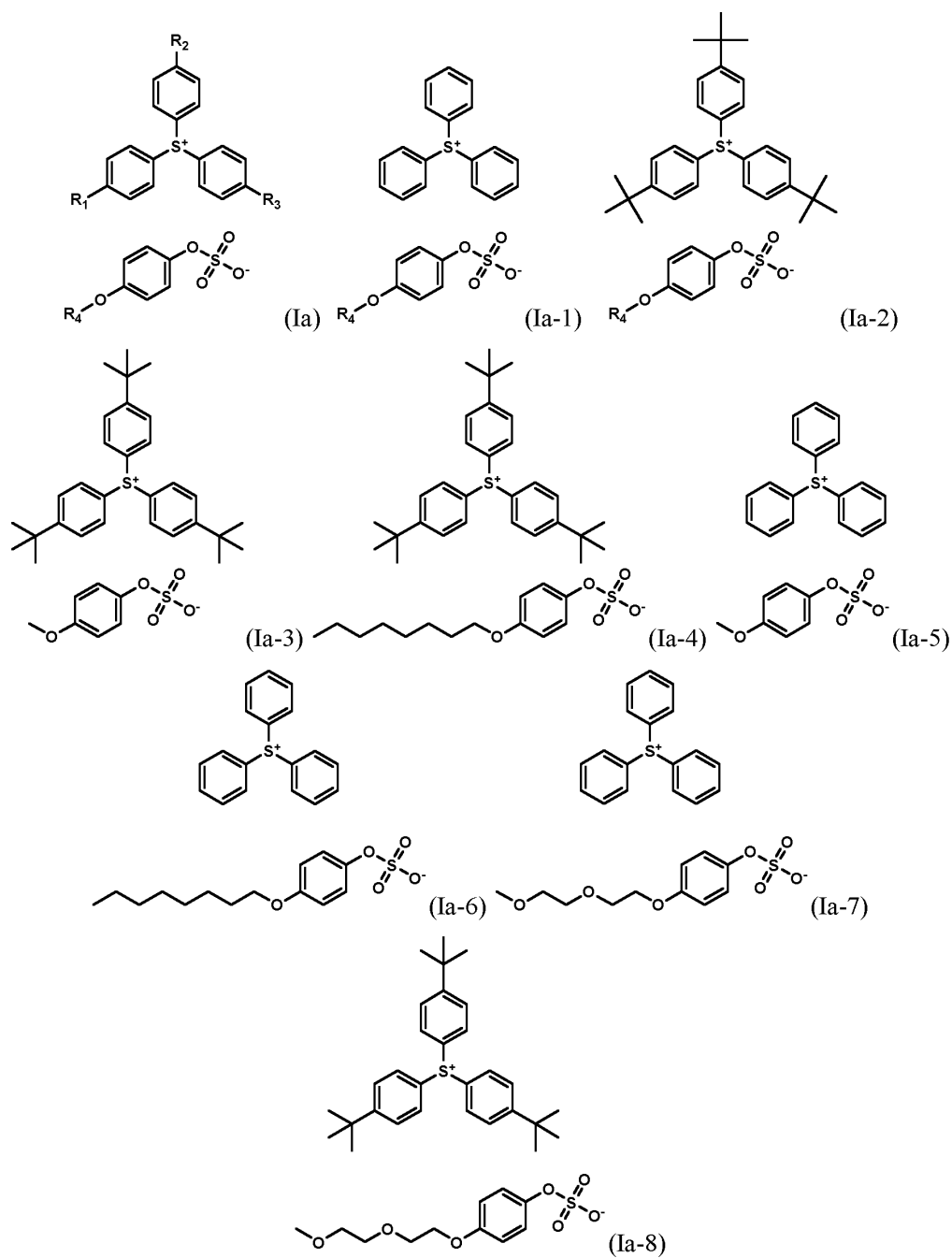
[0069] In another aspect of these embodiments of structure (Ia), R_4 is a C-3 to C-12 branched alkyl.

[0070] In another aspect of these embodiments of structure (Ia), R_4 is a C-3 to C-12 alicyclic alkyl.

In one aspect of this embodiment R_4 is cyclopropyl, in another it is cyclobutyl, in another it is cyclohexyl, in another it is cycloheptyl, in another it is cyclooctyl, in another is it adamantyl, in another it is Tetrahydrodicyclopentadienyl (octahydro-1*H*-4,7-methanoindenyl).

[0071] In another aspect of these embodiments of structure (Ia), when R_4 it is an alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, it is one where R_{eth3} is a C-1 to C-3 alkyl, in another aspect it is a C-1 to C-2 alkyl and in yet another embodiment it is methyl. In another aspect of these embodiments R_{eth} is a linear C-2 to C-4 alkylene, in another aspect it is a C-2 to C-3 alkylene, in yet another embodiment it is ethylene. In another aspect of these embodiment R_{eth1} is a linear C-2 to C-4 alkylene, in another embodiment it is a C-2 to C-3 alkylene and in yet another embodiment it is ethylene. In another aspect of these embodiments $neth$ is an integer from 2 to 5, in another embodiment this integer is from 2 to 3, in yet another embodiment it is 2. In another aspect of these embodiments R_{eth3} is a C-1 to C-3 alkylene, in another aspect it is a C-1 to C-2 alkyl, in yet another it is methyl.

[0072] In another aspect of these embodiments for structure (Ia), it more specifically has structure (Ia-1). In yet another aspect of this embodiment it has structure (Ia-2). In yet another aspect of this embodiment it has structure (Ia-3). In yet another aspect of this embodiment it has structure (Ia-4). In yet another aspect of this embodiment it has structure (Ia-5). In yet another aspect of this embodiment it has structure (Ia-6). In yet another aspect of this embodiment it has structure (Ia-7). In yet another aspect of this embodiment it has structure (Ia-8), as follows:

**Structure (Ib)**

[0073] In one aspect of the embodiments of the compositions described above Component A, said aryl sulfate PAG has structure (I), in a more specific aspect it has structure (Ib), where in one aspect

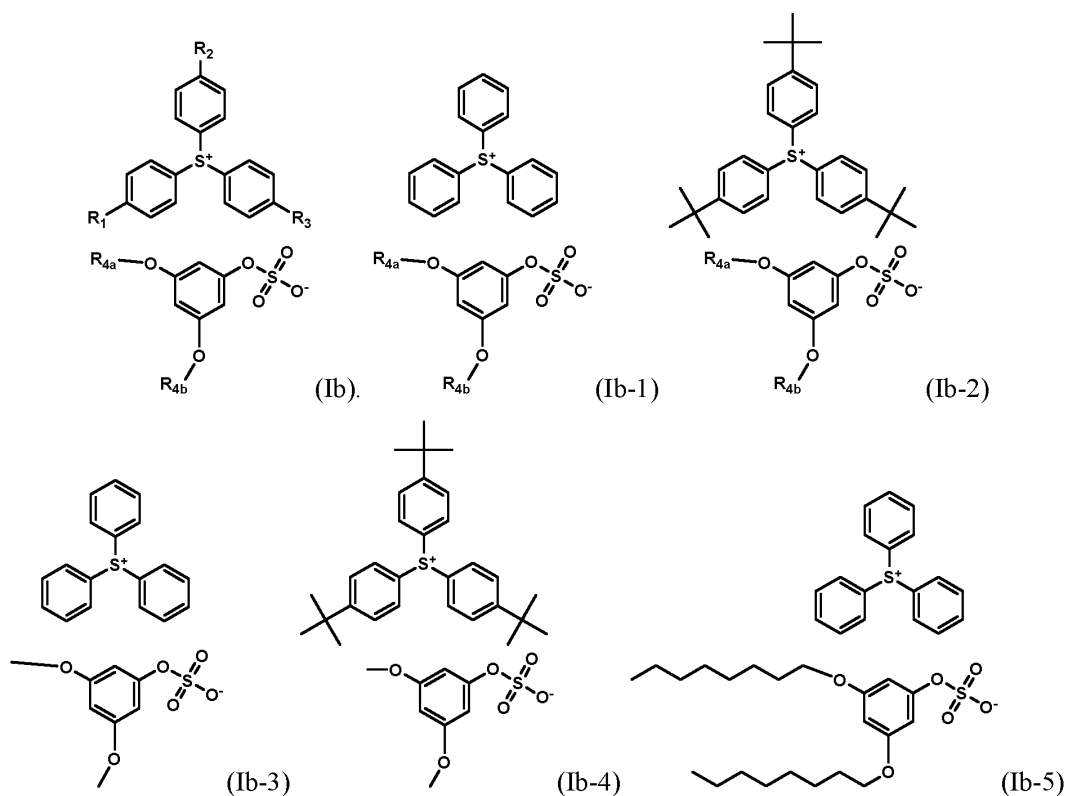
of this embodiment R_1 , R_2 , and R_3 , are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkoxy, and at least one of R_1 , R_2 , and R_3 , is H. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkyl and at least one of R_1 , R_2 , and R_3 , is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In another aspect of this embodiment R_1 , R_2 , and R_3 are H.

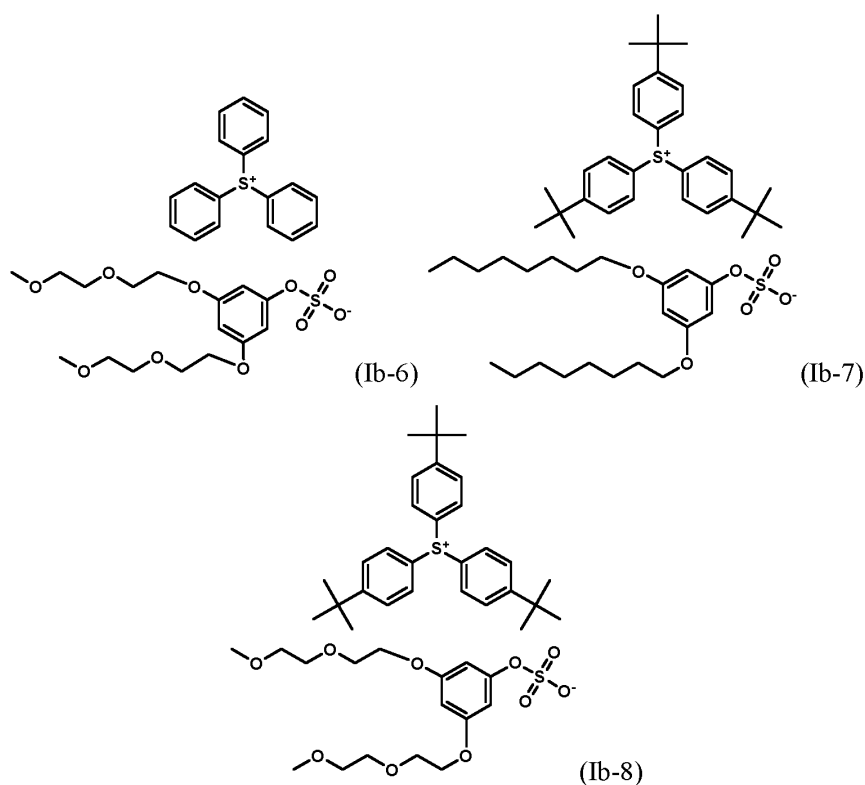
[0074] In structure (Ib), R_{4a} and R_{4b} are independently selected from the group consisting of a C-1 to C-12 alkyl, an alkyl moiety comprising an alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, where R_{eth} is a C-1 to C-4 alkylene, R_{eth1} is a linear C-2 to C-4 alkylene, $neth$ is an integer ranging from 1 to 6, and R_{eth3} is a C-1 to C-4 alkyl. In another aspect of these embodiments of structure (Ib), R_{4a} and R_{4b} are individually selected from a C-1 to C-12 linear alkyl. In one aspect of this R_{4a} and R_{4b} are individually selected from a C-3 to C-12 branched alkyl. In another aspect of this embodiment of structure (Ib), R_{4a} and R_{4b} are a C-3 to C-12 alicyclic alkyl. In one aspect of this embodiment R_{4a} and R_{4b} are cyclopropyl, in another cyclobutyl, in another cyclohexyl, in another cycloheptyl, in another cyclooctyl, in another adamantyl, in yet another Tetrahydrotetrahydronicotadienyl (octahydro-1*H*-4,7-methanoindenyl).

[0075] In another aspect of these embodiments of structure (Ib), when R_{4a} and R_{4b} these are individually selected from said alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, it is one where R_{eth3} is a C-1 to C-3 alkyl, in another aspect it is a C-1 to C-2 alkyl and in yet another embodiment it is methyl. In another aspect of these embodiments R_{eth} is a linear C-2 to C-4 alkylene, in another aspect it is a C-2 to C-3 alkylene, in yet another embodiment it is ethylene. In another aspect of these embodiment R_{eth1} is a linear C-2 to C-4 alkylene, in another embodiment it is a C-2

to C-3 alkylene and in yet another embodiment it is ethylene. In another aspect of these embodiments n is an integer from 2 to 5, in another embodiment this integer is from 2 to 3, in yet another embodiment it is 2. In another aspect of these embodiments R_{eth3} is a C-1 to C-3 alkylene, in another aspect it is a C-1 to C-2 alkyl, in yet another it is methyl.

[0076] In yet another aspect of these embodiment said aryl sulfate PAG more specifically has structure (Ib-1). In yet another aspect of these embodiments said aryl sulfate PAG has structure (Ib-2). In yet another aspect of these embodiments said aryl sulfate PAG has structure (Ib-3). In yet another aspect of these embodiments said aryl sulfate PAG has structure (Ib-4). In yet another aspect of these embodiments said aryl sulfate PAG has structure (Ib-5). In yet another aspect of these embodiments said aryl sulfate PAG has structure (Ib-6). In yet another aspect of these embodiments said aryl sulfate PAG has structure (Ib-7). In yet another aspect of these embodiments said aryl sulfate PAG has structure (Ib-8), as follows:



**Structure (Ic)**

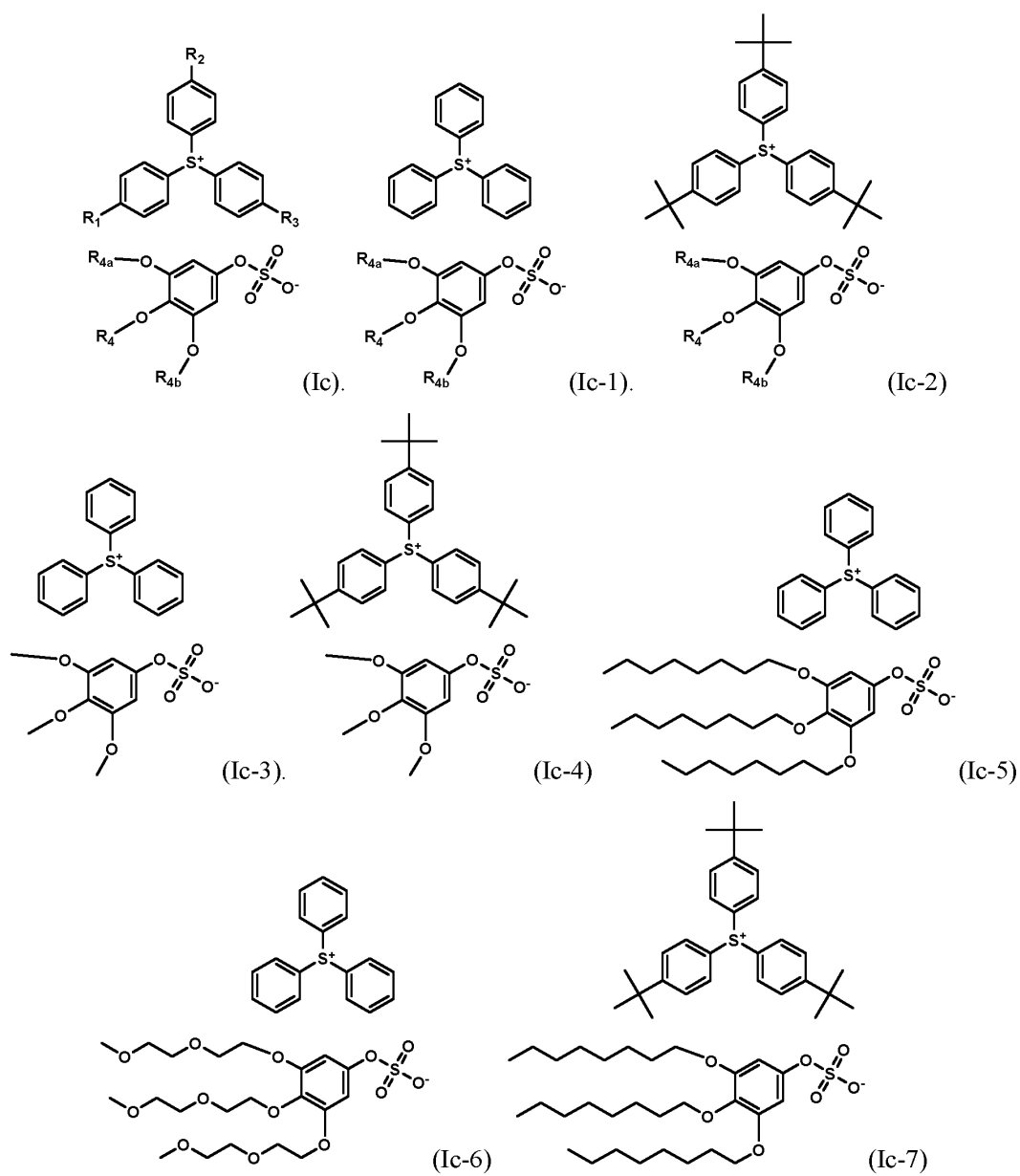
[0077] In one aspect of the embodiments of the compositions described above Component A, said aryl sulfate PAG, has structure (I), in one aspect of this embodiment it more specifically has structure (Ic), in one aspect of this embodiment R_1 , R_2 , and R_3 , are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkoxy, and at least one of R_1 , R_2 , and R_3 , is H. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment

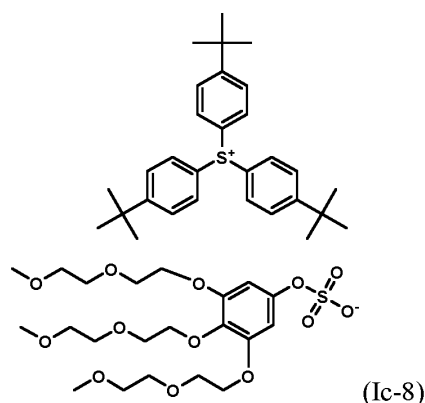
at least one of R_1 , R_2 , and R_3 is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkyl and at least one of R_1 , R_2 , and R_3 , is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In another aspect of this embodiment R_4 , R_{4a} and R_{4b} are independently selected from the group consisting of a C-1 to C-12 alkyl, an alkyl moiety comprising an alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, where R_{eth} is a C-1 to C-4 alkylene, R_{eth1} is a linear C-2 to C-4 alkylene, $neth$ is an integer ranging from 1 to 6, and R_{eth3} is a C-1 to C-4 alkyl.

[0078] In another aspect of this embodiment of structure (Ic), R_4 , R_{4a} and R_{4b} are a C-3 to C-12 branched alkyl. In another aspect of this embodiment of structure (Ic), R_4 , R_{4a} and R_{4b} are a C-3 to C-12 alicyclic alkyl. In one aspect of this embodiment R_4 , R_{4a} and R_{4b} are cyclopropyl, in another cyclobutyl, in another cyclohexyl, in another cycloheptyl, in another cyclooctyl, in another adamantyl, in yet another Tetrahydrodicyclopentadienyl (octahydro-1*H*-4,7-methanoindenyl).

[0079] In another aspect of this embodiment of structure (Ic), when R_4 , R_{4a} and R_{4b} are individually selected from said alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, it is one where R_{eth3} is a C-1 to C-3 alkyl, in another aspect it is a C-1 to C-2 alkyl and in yet another embodiment it is methyl. In another aspect of these embodiments R_{eth} is a linear C-2 to C-4 alkylene, in another aspect it is a C-2 to C-3 alkylene, in yet another embodiment it is ethylene. In another aspect of this embodiment R_{eth1} is a linear C-2 to C-4 alkylene, in another embodiment it is a C-2 to C-3 alkylene and in yet another embodiment it is ethylene. In another aspect of this embodiments $neth$ is an integer from 2 to 5, in another embodiment this integer is from 2 to 3, in yet another embodiment it is 2. In another aspect of these embodiments R_{eth3} is a C-1 to C-3 alkylene, in another aspect it is a C-1 to C-2 alkyl, in yet another it is methyl.

[0080] In another aspect of this embodiment wherein said aryl sulfate PAG has structure (Ic) it more specifically has structure (Ic-1). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Ic-2). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Ic-3). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Ic-4). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Ic-5). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Ic-6); in yet another aspect of this embodiment said aryl sulfate PAG has structure (Ic-7). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Ic-8), as follows:





Structure IIa

[0081] In one aspect of the embodiments of the compositions described above Component A, wherein, said aryl sulfate PAG, has structure (II), it more specifically has structure (IIa), in one aspect of this embodiment R_1 , R_2 , and R_3 , are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkoxy, and at least one of R_1 , R_2 , and R_3 , is H. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 are individually selected from is selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkyl and at least one of R_1 , R_2 , and R_3 , is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In another embodiment R_1 , R_2 , and R_3 are H.

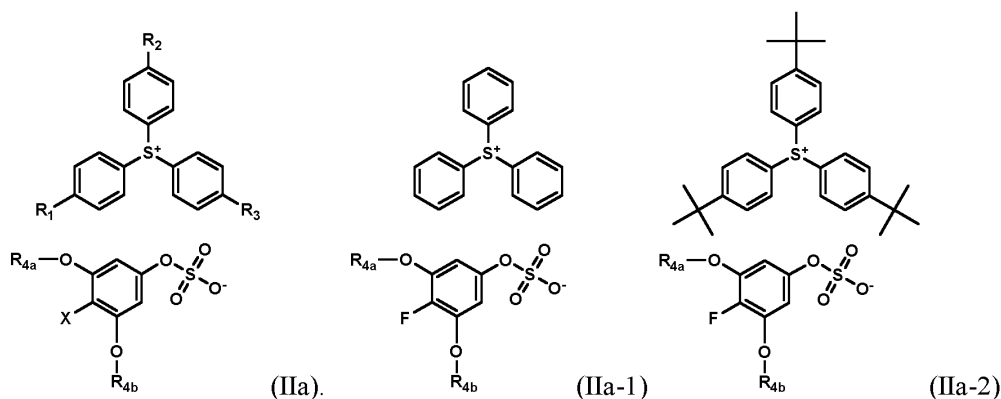
[0082] In another aspect of these embodiments of structure (IIa), X, is selected from F, Cl and I, in one aspect it is F, in another it is Cl and in yet another it is Br. In another aspect of these embodiments of structure (IIa), R_{4a} and R_{4b} are individually selected from a C-1 to C-12 linear alkyl.

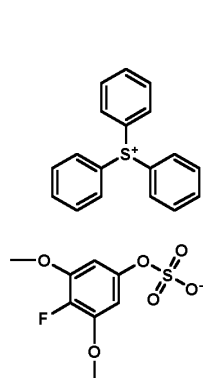
[0083] In another aspect of this embodiment of structure (IIa), R_{4a} and R_{4b} are a C-3 to C-12 branched alkyl.

[0084] In another aspect of this embodiment of structure (IIa), R_{4a} and R_{4b} are a C-3 to C-12 alicyclic alkyl. In one aspect of this embodiment R_{4a} and R_{4b} are cyclopropyl, in another cyclobutyl, in another cyclohexyl, in another cycloheptyl, in another cyclooctyl, in another adamantyl, in yet another Tetrahydrodicyclopentadienyl (octahydro-1*H*-4,7-methanoindenyl).

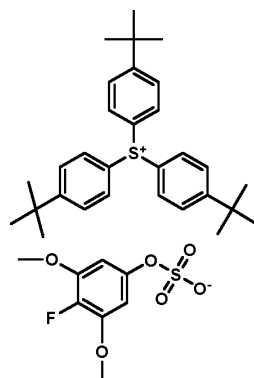
[0085] In one aspect of the embodiments of the compositions described above Component A, said aryl sulfate PAG, has structure (II). In another aspect of this embodiment said aryl sulfate PAG has structure (IIa), where R_{4a} and R_{4b} are independently selected from the group consisting of a C-1 to C-12 alkyl, an alkyl moiety comprising an alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, where R_{eth} is a C-1 to C-4 alkylene, R_{eth1} is a linear C-2 to C-4 alkylene, $neth$ is an integer ranging from 1 to 6, and R_{eth3} is a C-1 to C-4 alkyl.

[0086] In yet another aspect of this embodiment said aryl sulfate PAG has structure (IIa-1). In yet another aspect of this embodiment said aryl sulfate PAG has structure (IIa-2). In yet another aspect of this embodiment said aryl sulfate PAG has structure (IIa-3). In yet another aspect of this embodiment said aryl sulfate PAG has structure (IIa-4). In yet another aspect of this embodiment said aryl sulfate PAG has structure (IIa-5). In yet another aspect of this embodiment said aryl sulfate PAG has structure (IIa-6). In yet another aspect of this embodiment said aryl sulfate PAG has structure (IIa-7). In yet another aspect of this embodiment said aryl sulfate PAG has structure (IIa-8), as follows:

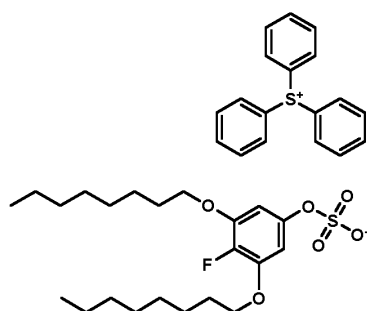




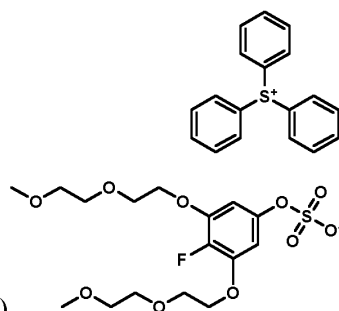
(IIa-3)



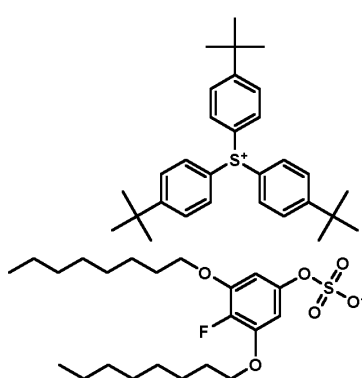
(IIa-4)



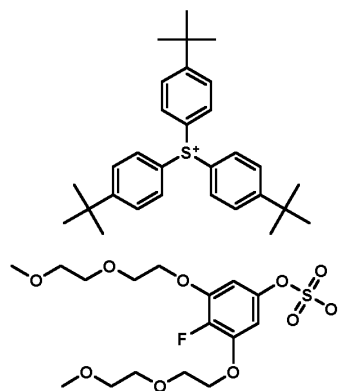
(IIa-5)



(IIa-6)



(IIa-7)



(IIa-8)

Structure (IIb)

[0087] In one aspect of the embodiments of the compositions described above Component A, where said aryl sulfate PAG, has structure (II), it more specifically has structure (IIb). In one aspect of this embodiment R_1 , R_2 , and R_3 , are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected

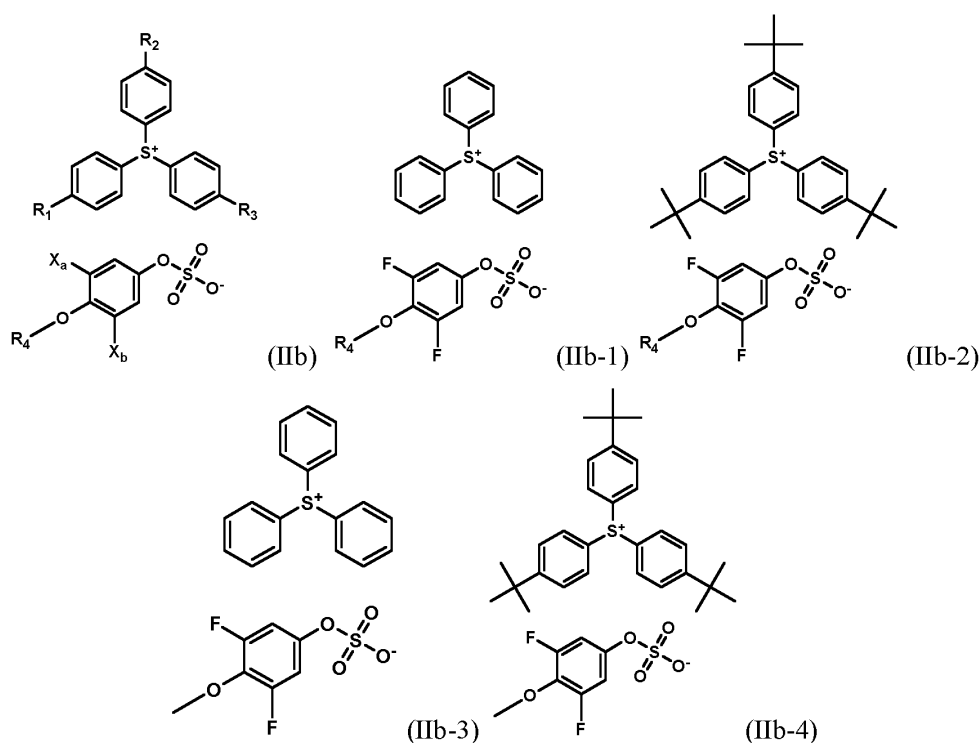
from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkoxy, and at least one of R_1 , R_2 , and R_3 , is H. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkyl and at least one of R_1 , R_2 , and R_3 , is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In another embodiment R_1 , R_2 , and R_3 are H.

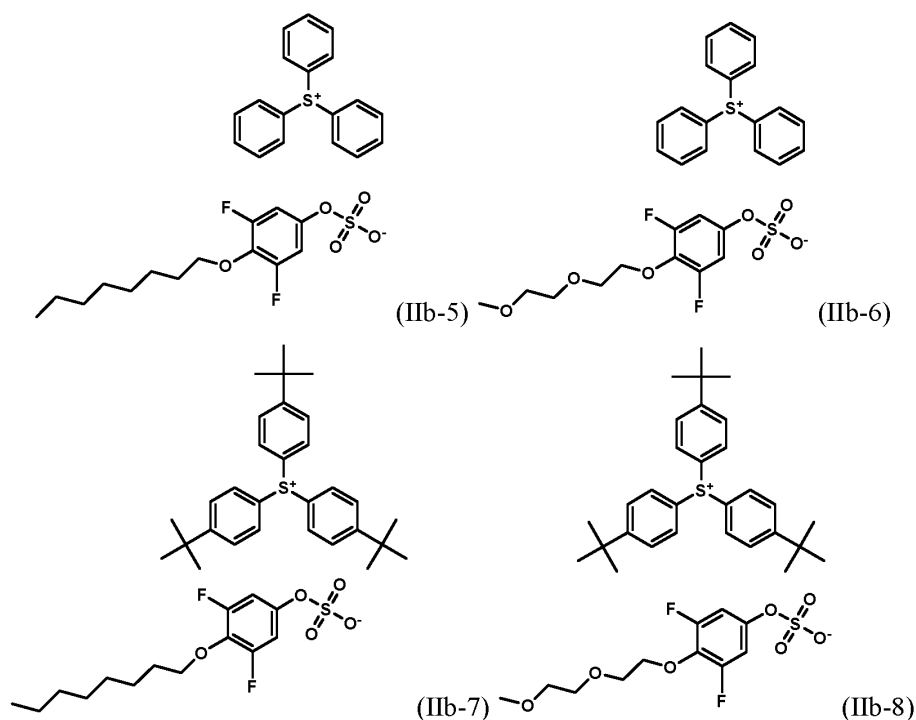
[0088] In another aspect of this embodiment of structure (IIb), X_a and X_b are individually selected from F, Cl and I, in one X_a and X_b aspect are F, in another X_a and X_b are Cl, and in yet another X_a and X_b are Br. In another aspect of this embodiment of structure (IIb), X_a and X_b are individually selected from F, Cl and Br.

[0089] In another aspect of this embodiment of structure (IIb), R_4 is a C-1 to C-12 linear alkyl. In another aspect of this embodiment of structure (IIb), R_4 is a C-3 to C-12 branched alkyl. In another aspect of this embodiment of structure (IIb), R_4 is C-3 to C-12 alicyclic alkyl. In one aspect of this embodiment R_4 is cyclopropyl, in another cyclobutyl, in another cyclohexyl, in another cycloheptyl, in another cyclooctyl, in another adamantyl, in yet another Tetrahydrodicyclopentadienyl (octahydro-1*H*-4,7-methanoindenyl).

[0090] In another aspect of this embodiment of structure (IIb), when R_4 is said alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, it is one where R_{eth3} is a C-1 to C-3 alkyl, in another aspect it is a C-1 to C-2 alkyl and in yet another embodiment it is methyl. In another aspect of these embodiments R_{eth} is a linear C-2 to C-4 alkylene, in another aspect it is a C-2 to C-3 alkylene, in yet another embodiment it is ethylene. In another aspect of these embodiment R_{eth1} is a linear C-2 to C-4 alkylene, in another embodiment it is a C-2 to C-3 alkylene and in yet another embodiment it is ethylene. In another aspect of these embodiments neth is an integer from 2 to 5, in another embodiment this integer is from 2 to 3, in yet another embodiment it is 2. In another aspect of these embodiments R_{eth3} is a C-1 to C-3 alkylene, in another aspect it is a C-1 to C-2 alkyl, in yet another it is methyl.

[0091] In yet another aspect of these embodiments said aryl sulfate PAG has structure (IIb-1). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IIb-2). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IIb-3). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IIb-4). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IIb-5). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IIb-6). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IIb-6). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IIb-7). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IIb-8), as follows:



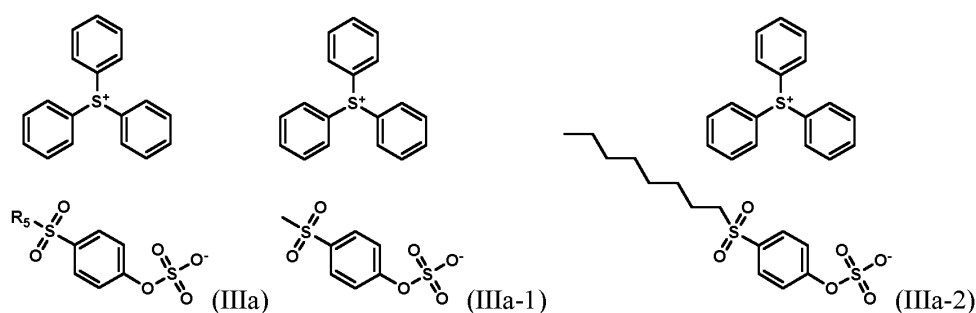


Structure (IIIa)

[0092] In one aspect of the embodiments of the compositions described above Component A, said aryl sulfate PAG, has structure (III). In one aspect of this embodiment R_1 , R_2 , and R_3 , are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkoxy, and at least one of R_1 , R_2 , and R_3 , is H. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1

to C-12 alkyl and at least one of R_1 , R_2 , and R_3 , is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In one aspect of this embodiment said aryl sulfate PAG has structure (IIIa). In one aspect of this embodiment R_5 is a C-1 to C-12 linear alkyl. In one aspect of this embodiment R_5 is a C-3 to C-12 branched alkyl. In another aspect of this embodiment of structure (IIIa), R_5 is C-3 to C-12 alicyclic alkyl. In one aspect of this embodiment R_5 is cyclopropyl, in another cyclobutyl, in another cyclohexyl, in another cycloheptyl, in another cyclooctyl, in another adamantyl, in yet another Tetrahydrodicyclopentadienyl (octahydro-1*H*-4,7-methanoindenyl). In another aspect of this embodiment R_5 is an unsubstituted aryl. In another aspect of this embodiment R_5 is a substituted aryl.

[0093] In yet another aspect of these embodiments said aryl sulfate PAG has structure (IIIa-1). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IIIa-2). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IIIa-2), as follows:



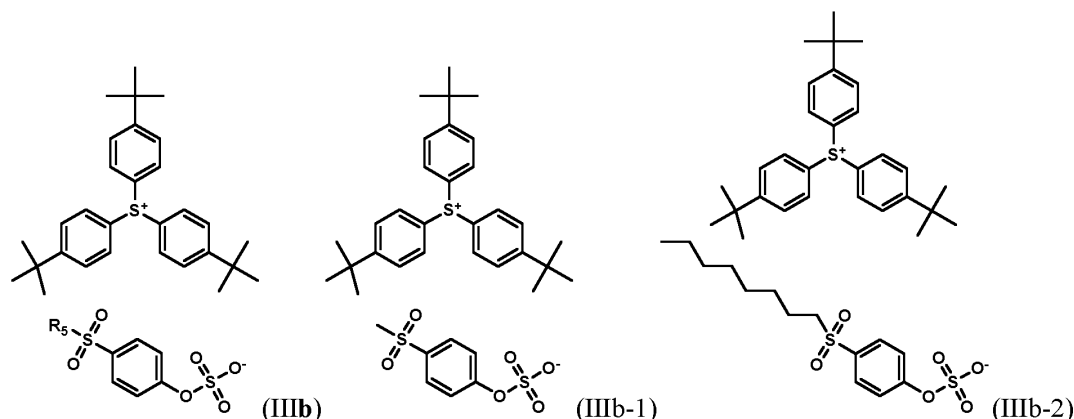
Structure (IIIb)

[0094] In one aspect of the embodiments of the compositions described above Component A, said aryl sulfate PAG, has structure (III). In one aspect of this embodiment said aryl sulfate PAG has structure (IIIb).

[0095] In one aspect of this embodiment R_5 is a C-1 to C-12 linear alkyl. In another aspect of these embodiment of structure (IIIb), R_5 is a C-3 to C-12 branched alkyl. In another aspect of this embodiment of structure (IIIb), R_5 is C-3 to C-12 alicyclic alkyl. In one aspect of this embodiment R_5 is cyclopropyl, in another cyclobutyl, in another cyclohexyl, in another cycloheptyl, in another cyclooctyl, in another adamantyl, in yet another Tetrahydrodicyclopentadienyl (octahydro-1*H*-4,7-methanoindenyl). In another aspect of this embodiment R_5 is an unsubstituted aryl. In another aspect of this embodiment R_5 is a substituted aryl.

[0096] In one aspect of the embodiments of the compositions described above Component A, where

said aryl sulfate PAG has structure (IIIb), it more specifically has structure (IIIb-1). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IIIb-2).



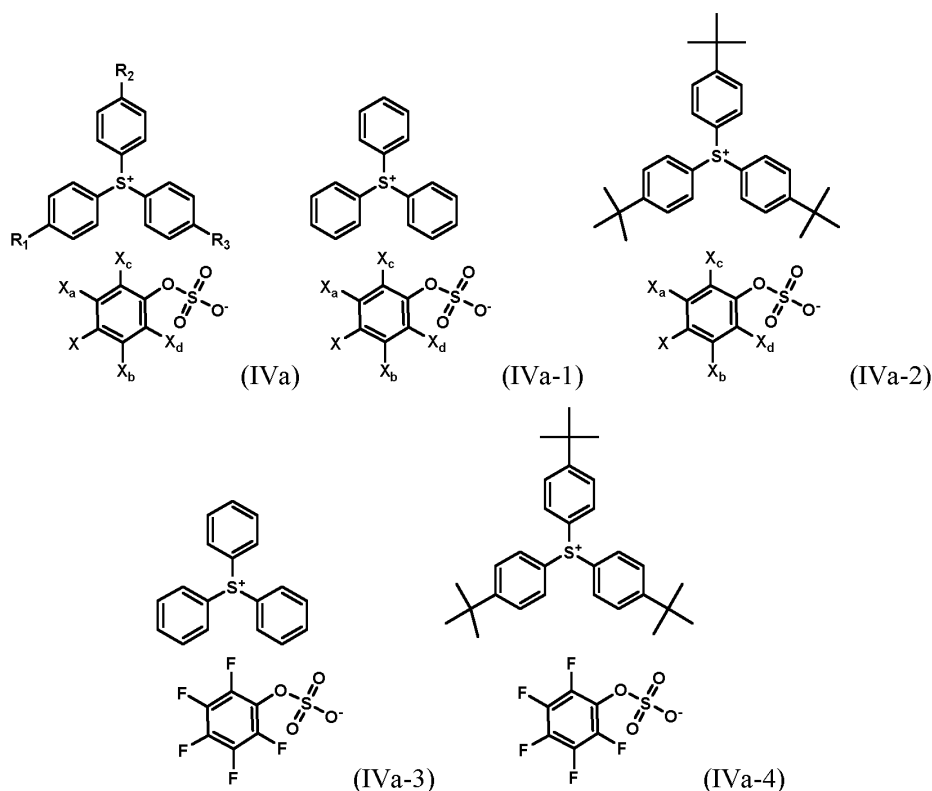
Structure (IVa)

[0097] In one aspect of the embodiments of the compositions described above Component A, said aryl sulfate PAG, has structure (IV). In one aspect of this embodiment *niii* is 4 or 5. In another aspect of this embodiment *niii* is 5 and said aryl sulfate PAG has structure (IVa). In one aspect of this embodiment R_1 , R_2 , and R_3 , are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkoxy, and at least one of R_1 , R_2 , and R_3 , is H. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkyl and at least one of R_1 , R_2 , and R_3 , is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In one embodiment R_1 , R_2 , and R_3 are H.

[0098] In one embodiment X_a , X_b , X_c and X_d are independently a halide selected from the group

consisting of F, Cl and Br. In one embodiment X, X_a, X_b, X_c and X_d are F. In another embodiment X, X_a, X_b, X_c and X_d are Cl. In another embodiment X, X_a, X_b, X_c and X_d are Br.

[0099] In yet another aspect of these embodiments of said aryl sulfate PAG having structure (IVa) it has structure (IVa-1). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVa-2). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVa-3). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVa-4), as follows:



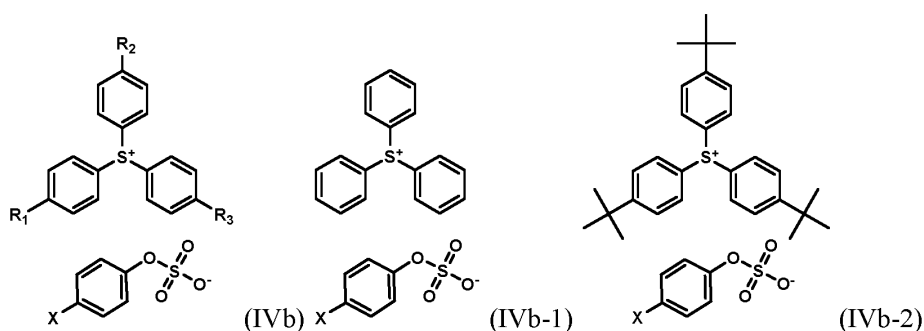
Structure (IVb)

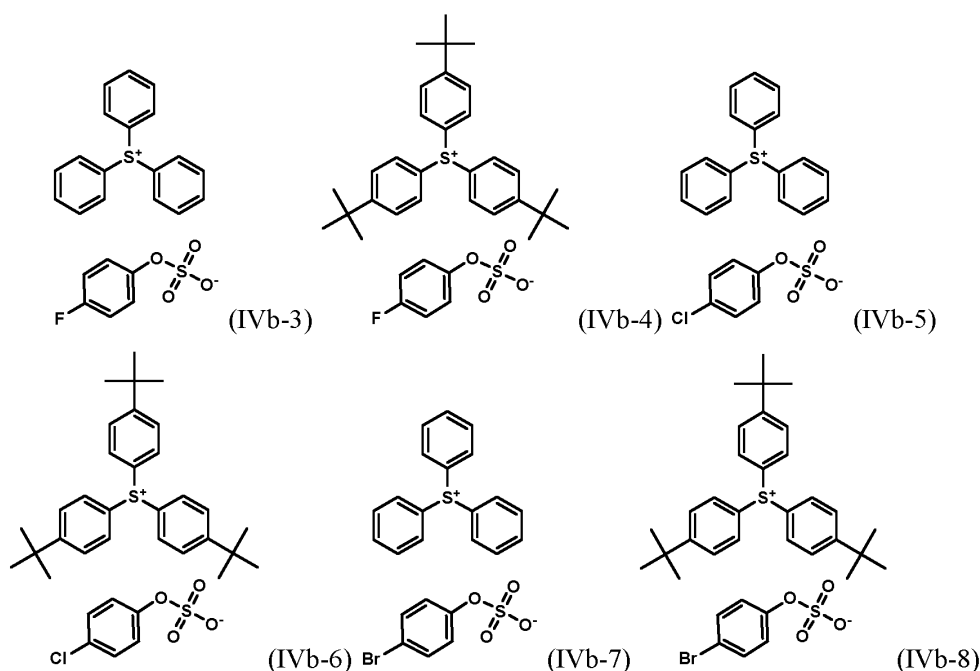
[0100] In one aspect of the embodiments of the compositions described above Component A, where said aryl sulfate PAG, has structure (IV) it more specifically has structure (IVb). In one aspect of this embodiment R₁, R₂, and R₃, are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected

from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkoxy, and at least one of R_1 , R_2 , and R_3 , is H. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkyl and at least one of R_1 , R_2 , and R_3 , is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In one embodiment R_1 , R_2 , and R_3 are H.

[0101] In one aspect of this embodiment X is F. In another aspect of this embodiment X is Cl. In another aspect of this embodiment X is Br.

[0102] In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVb-1). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVb-2). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVb-3). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVb-4). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVb-5). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVb-6). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVb-7). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVb-8), as follows:





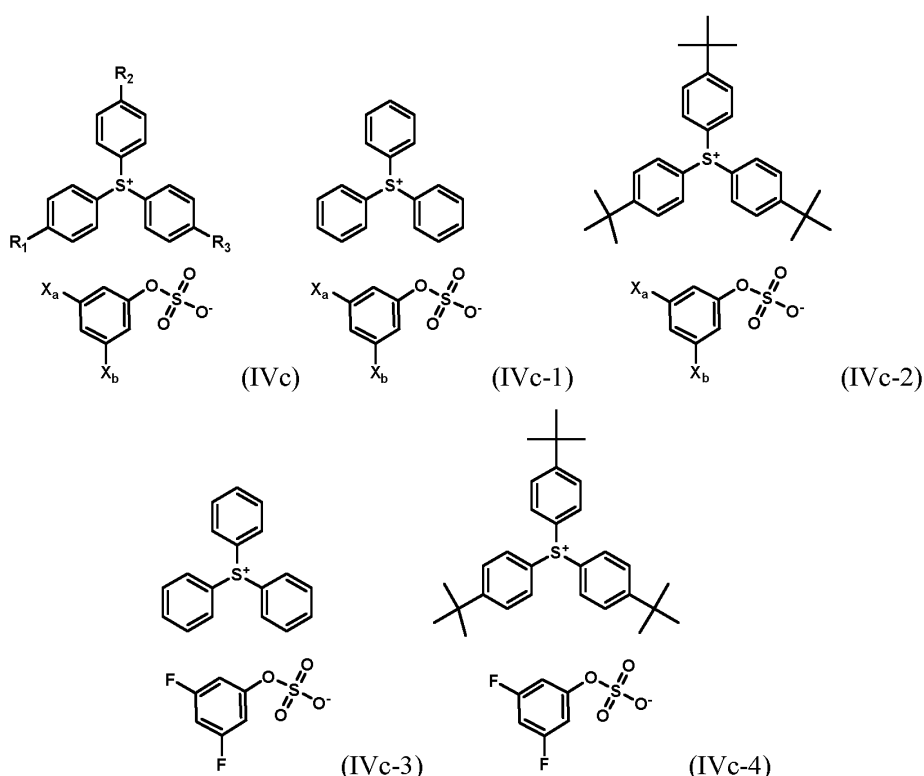
Structure (IVc)

[0103] In one aspect of the embodiments of the compositions described above Component A, where said aryl sulfate PAG, has structure (IV) it more specifically has structure (IVc). In one aspect of this embodiment R_1 , R_2 , and R_3 , are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkoxy, and at least one of R_1 , R_2 , and R_3 , is H. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkyl and at least one of R_1 , R_2 , and R_3 , is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In one embodiment R_1 , R_2 , and

R₃ are H.

[0104] In one aspect of this embodiment, X_a, X_b are independently a halide selected from the group consisting of F, Cl and Br. In one aspect of this embodiment X_a and X_b are F. In another aspect of this embodiment X_a and X_b are Cl. In another aspect of this embodiment X_a and X_b are Br.

[0105] In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVc-1). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVc-2). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVc-3). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVc-4), as follows:



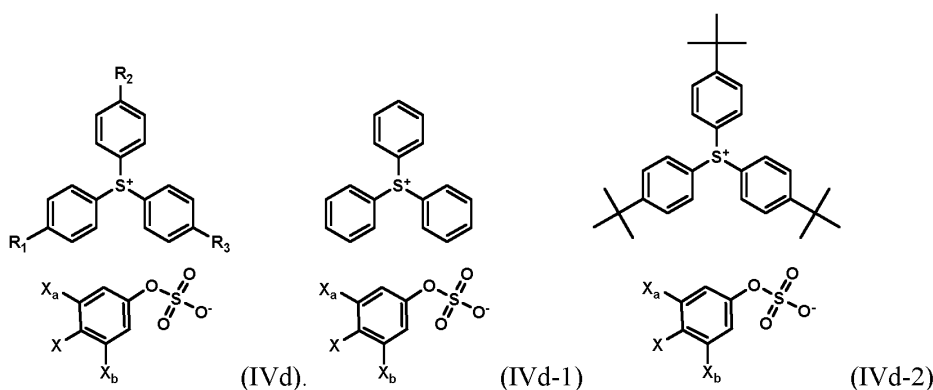
Structure (IVd)

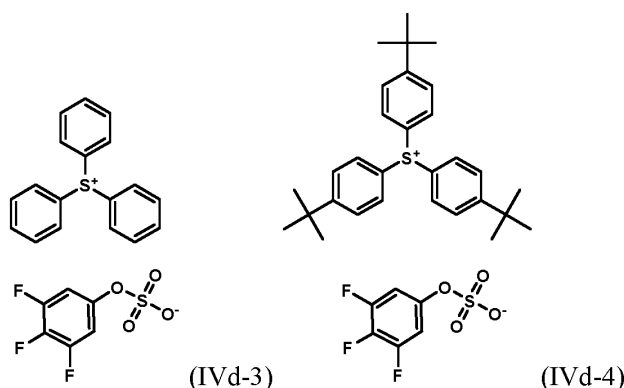
[0106] In one aspect of the embodiments of the compositions described above Component A, where said aryl sulfate PAG, has structure (IV) it more specifically has structure (IVd). In one aspect of this embodiment R₁, R₂, and R₃, are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected

from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkoxy, and at least one of R_1 , R_2 , and R_3 , is H. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkyl and at least one of R_1 , R_2 , and R_3 , is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In one embodiment R_1 , R_2 , and R_3 are H.

[0107] In one aspect of this embodiment, X_a , X_b are independently a halide selected from the group consisting of F, Cl and Br. In one embodiment X, X_a and X_b are F. In another embodiment X, X_a and X_b are Cl. In another embodiment X, X_a and X_b are Br.

[0108] In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVd-1). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVd-2). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVd-3). In yet another aspect of these embodiments said aryl sulfate PAG has structure (IVd-4), as follows:

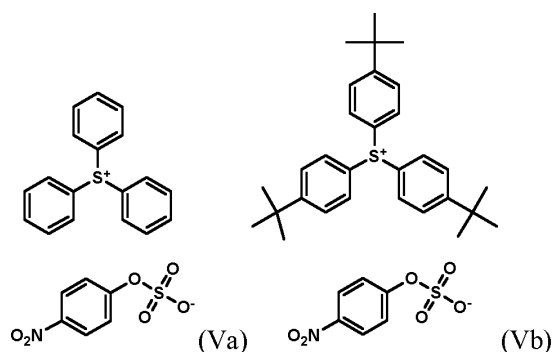




Structure (V)

[0109] In one aspect of the embodiments of the compositions described above Component A, said aryl sulfate PAG, has structure (V). In one aspect of this embodiment R_1 , R_2 , and R_3 , are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkoxy, and at least one of R_1 , R_2 , and R_3 , is H. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkyl and at least one of R_1 , R_2 , and R_3 , is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In one embodiment R_1 , R_2 , and R_3 are H.

[0110] In another aspect of this embodiment said aryl sulfate PAG has structure (Va). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Vb), as follows:



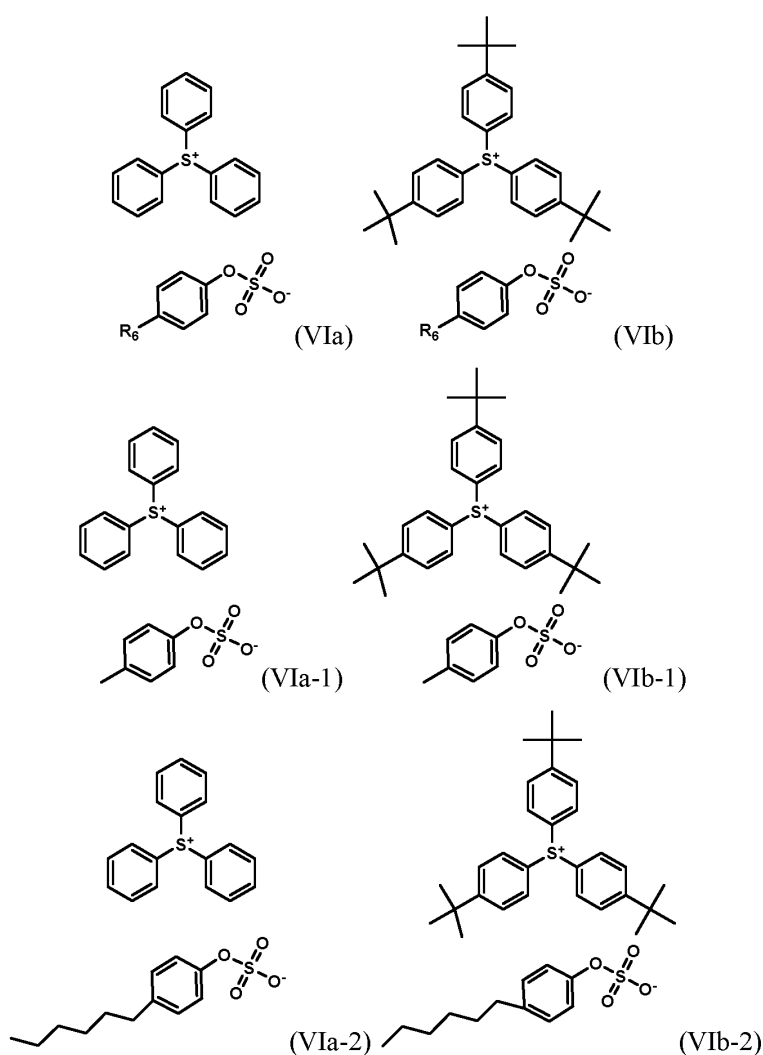
Structure (VI)

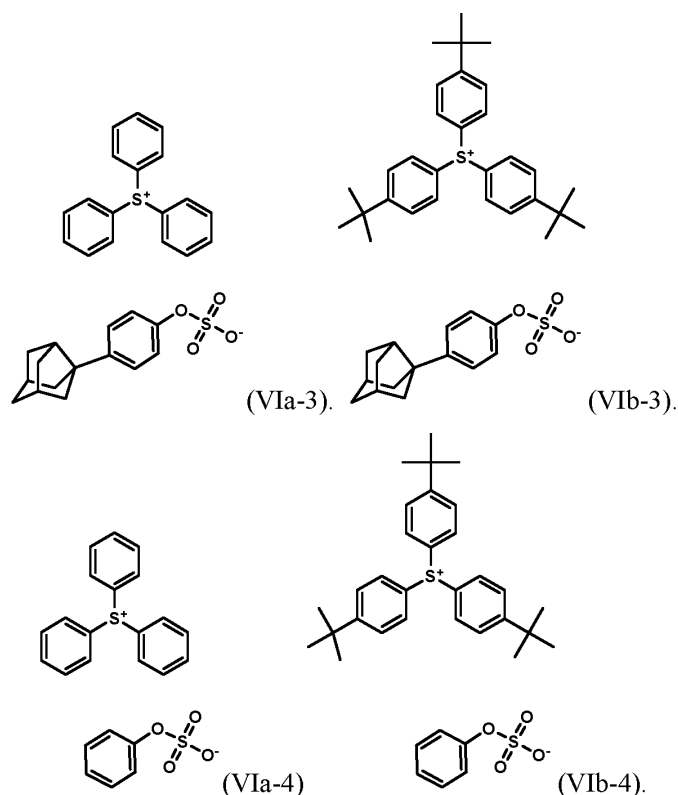
[0111] In one aspect of the embodiments of the compositions described above Component A, said aryl sulfate PAG, has structure (VI). In one aspect of this embodiment R_1 , R_2 , and R_3 , are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkoxy, and at least one of R_1 , R_2 , and R_3 , is H. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_1 , R_2 , and R_3 is selected from a C-1 to C-12 alkyl and at least one of R_1 , R_2 , and R_3 , is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In one embodiment R_1 , R_2 , and R_3 are H. In one aspect of the embodiments of the compositions described above Component A, said aryl sulfate PAG, has structure (VIa) or structure (VIb).

[0112] In one embodiment R_6 is a C-1 to C-12 linear alkyl. In another aspect of this embodiment of structure (VI), R_6 is a C-3 to C-12 branched alkyl. In another aspect of this embodiment of structure (VI), R_6 is a C-3 to C-12 alicyclic alkyl. In one aspect of this embodiment R_6 is cyclopropyl, in another cyclobutyl, in another cyclohexyl, in another cycloheptyl, in another cyclooctyl, in another adamantyl, in yet another Tetrahydrodicyclopentadienyl (octahydro-1*H*-4,7-

methanoindenyl).

[0113] In another aspect of this embodiment, it has structure (VIa). In another aspect of this embodiment, it has structure (VIa-1). In yet another aspect of this embodiment, it has structure (VIa-2). In another aspect of this embodiment, it has structure (VIa-3). In yet another aspect of this embodiment, it has structure (VIa-4). In another aspect of this embodiment, it has structure (VIb). In another aspect of this embodiment, it has structure (VIb-1). In another aspect of this embodiment, it has structure (VIb-2). In yet another aspect of this embodiment, it has structure (VIb-3). In yet another aspect of this embodiment, it has structure (VIb-4), as follows:



**Structure (VIIa)**

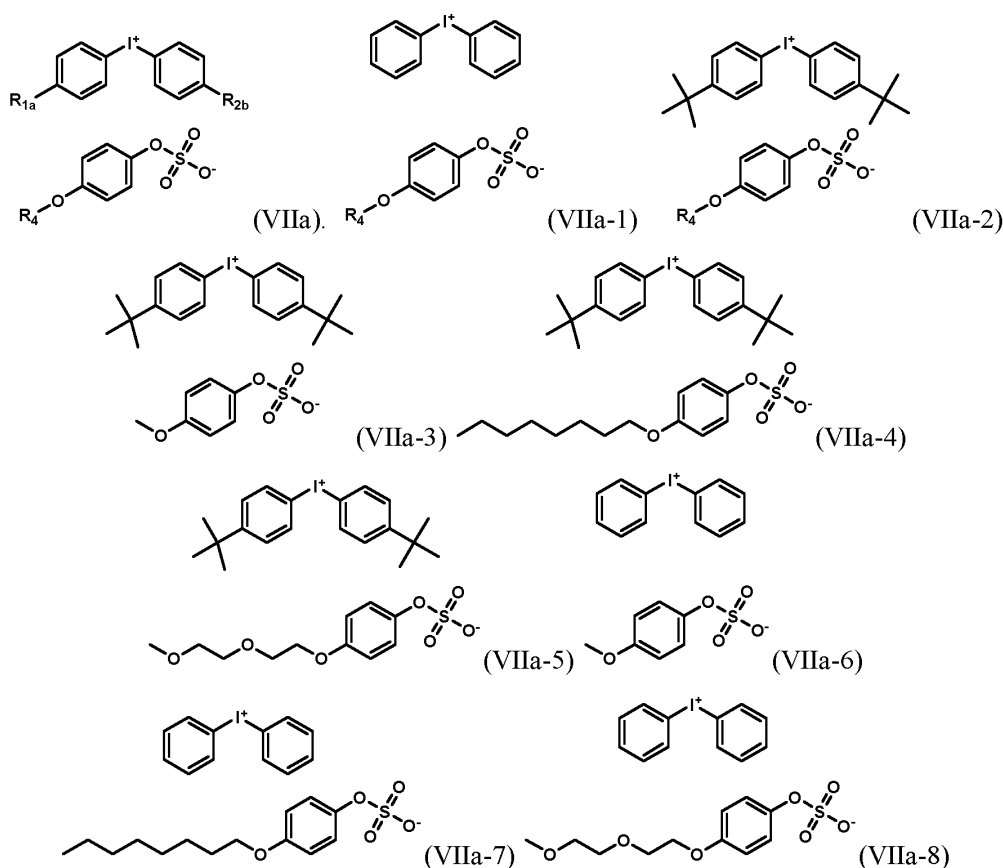
[0114] In one aspect of the embodiments of the compositions described above Component A, said aryl sulfate PAG, has structure (VII). In a more specific aspect of this embodiment it has structure (VIIa), in one aspect of this embodiment R_{1a} , R_{2b} are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_{1a} or R_{2b} is selected from a C-1 to C-12 alkoxy, and at least one of R_{1a} , R_{2b} is H. In another aspect of this embodiment at least one of R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of R_{1a}

or R_{2b} is either t-butyl or t-amyl. In another aspect of this embodiment at least one R_{1a} or R_{2b} is selected from a C-1 to C-12 alkyl and at least one of R_{1a} or R_{2b} is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In another aspect of this embodiment R_{1a} and R_{2b} are H.

[0115] In another aspect of this embodiment of structure (VIIa), R_4 is a C-1 to C-12 alkyl, it is a C-1 to C-12 linear alkyl. In another aspect of this embodiment of structure (VIIa), R_4 is a C-3 to C-12 branched alkyl. In another aspect of this embodiment of structure (VIIa), R_4 is a C-3 to C-12 alicyclic alkyl. In one aspect of this embodiment is cyclopropyl, in another it is cyclobutyl, in another it is cyclohexyl, in another it is cycloheptyl, in another it is cyclooctyl, in another it is adamantyl, in another it is Tetrahydrodicyclopentadienyl (octahydro-1*H*-4,7-methanoindenyl).

[0116] In another aspect of this embodiment of structure (VIIa), when R_4 it is an alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, it is one where R_{eth3} is a C-1 to C-3 alkyl, in another aspect it is a C-1 to C-2 alkyl and in yet another embodiment it is methyl. In another aspect of these embodiments R_{eth} is a linear C-2 to C-4 alkylene, in another aspect it is a C-2 to C-3 alkylene, in yet another embodiment it is ethylene. In another aspect of this embodiment R_{eth1} is a linear C-2 to C-4 alkylene, in another embodiment it is a C-2 to C-3 alkylene and in yet another embodiment it is ethylene. In another aspect of these embodiments $neth$ is an integer from 2 to 5, in another embodiment this integer is from 2 to 3, in yet another embodiment it is 2. In another aspect of these embodiments R_{eth3} is a C-1 to C-3 alkylene, in another aspect it is a C-1 to C-2 alkyl, in yet another it is methyl.

[0117] In one aspect of the embodiments of the compositions described above Component A, said aryl sulfate PAG, has structure (VII). In another aspect of this embodiment said aryl sulfate PAG has structure (VIIa). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIa-1). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIa-2). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIa-3). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIa-4). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIa-5). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIa-6). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIa-7). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIa-8), as follows:

**Structure (VIIb)**

[0118] In one aspect of the embodiments of the compositions described above Component A, where said aryl sulfate PAG, has structure (VII), it more specifically has structure (VIIb), where R_{4a} and R_{4b} are independently selected from the group consisting of a C-1 to C-12 alkyl, an alkyl moiety comprising an alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, where R_{eth} is a C-1 to C-4 alkylene, R_{eth1} is a linear C-2 to C-4 alkylene, $neth$ is an integer ranging from 1 to 6, and R_{eth3} is a C-1 to C-4 alkyl. In one aspect of this embodiment R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this

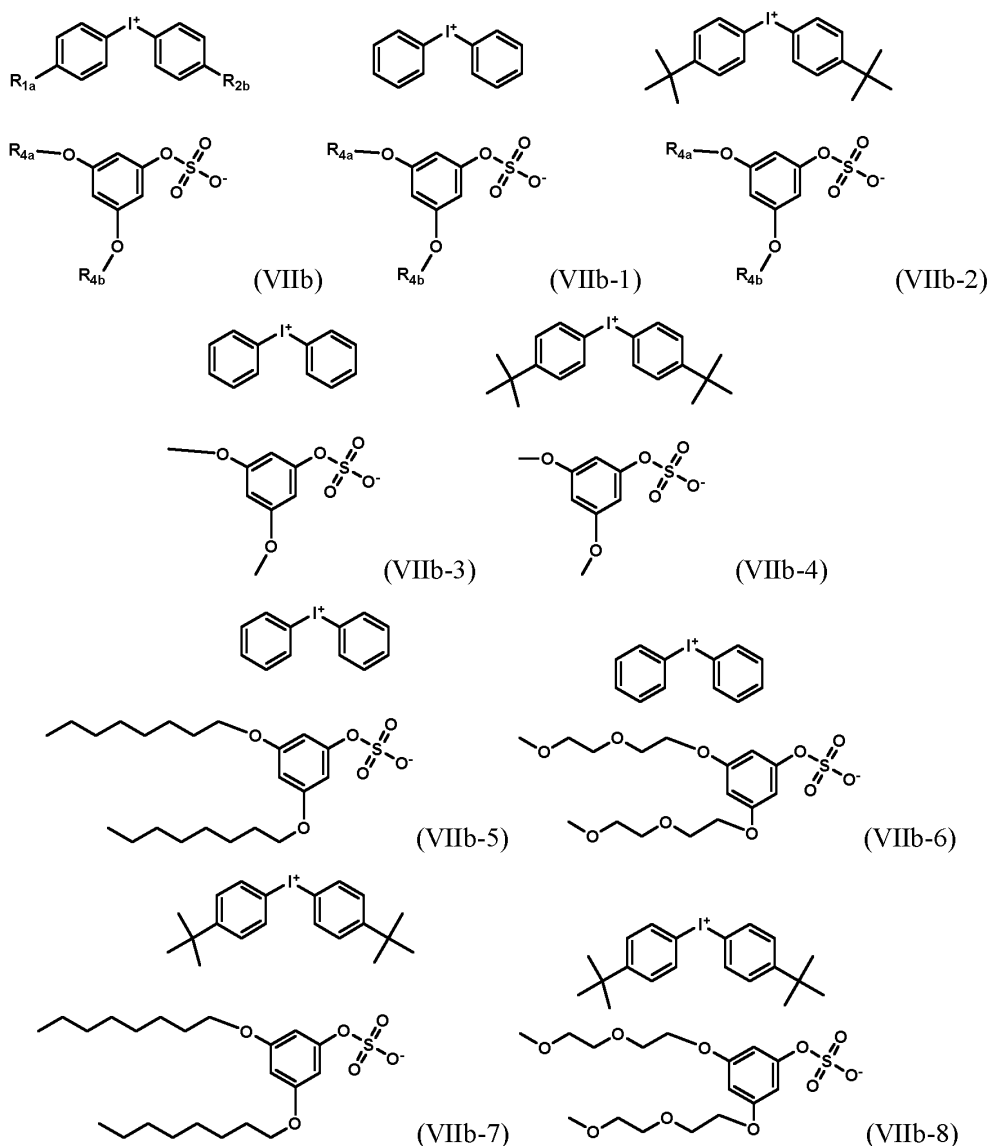
embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkoxy, and at least one of R_{1a} and R_{2b} is H. In another aspect of this embodiment at least one of R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of them is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkyl and at least one of R_{1a} and R_{2b} is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In another embodiment R_{1a} and R_{2b} are H

[0119] In another aspect of this embodiment of structure (VIIb), R_{4a} and R_{4b} are individually selected from a C-1 to C-12 linear alkyl. In one aspect of this embodiment R_{4a} and R_{4b} are individually selected from a C-3 to C-12 branched alkyl. In another aspect of this embodiment of structure (VIIb), R_{4a} and R_{4b} are a C-3 to C-12 alicyclic alkyl. In one aspect of this embodiment R_{4a} and R_{4b} are cyclopropyl, in another cyclobutyl, in another cyclohexyl, in another cycloheptyl, in another cyclooctyl, in another adamantyl, in yet another Tetrahydrotetracyclopentadienyl (octahydro-1H-4,7-methanoindenyl).

[0120] In another aspect of this embodiment of structure (VIIb), when R_{4a} and R_{4b} are individually alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, it is one where R_{eth3} is a C-1 to C-3 alkyl, in another aspect it is a C-1 to C-2 alkyl and in yet another embodiment it is methyl. In another aspect of these embodiments R_{eth} is a linear C-2 to C-4 alkylene, in another aspect it is a C-2 to C-3 alkylene, in yet another embodiment it is ethylene. In another aspect of these embodiment R_{eth1} is a linear C-2 to C-4 alkylene, in another embodiment it is a C-2 to C-3 alkylene and in yet another embodiment it is ethylene. In another aspect of these embodiments $neth$ is an integer from 2 to 5, in another embodiment this integer is from 2 to 3, in yet another embodiment it is 2. In another aspect of these embodiments R_{eth3} is a C-1 to C-3 alkylene, in another aspect it is a C-1 to C-2 alkyl, in yet another it is methyl.

[0121] In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIb-1). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIb-2). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIb-3). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIb-4). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIb-5). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIb-6). In yet another aspect of this embodiment said aryl

sulfate PAG has structure (VIIb-7). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIb-8), as follows:



[0122] In one aspect of the embodiments of the compositions described above Component A, where said aryl sulfate PAG, has structure (VII), it more specifically has structure (VIIc) where R_4 , R_{4a} and R_{4b} are independently selected from the group consisting of a C-1 to C-12 alkyl, an alkyl moiety comprising an alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, where R_{eth} is a C-1 to C-4 alkylene, R_{eth1} is a linear C-2 to C-4 alkylene, $neth$ is an integer ranging from 1 to 6, and R_{eth3}

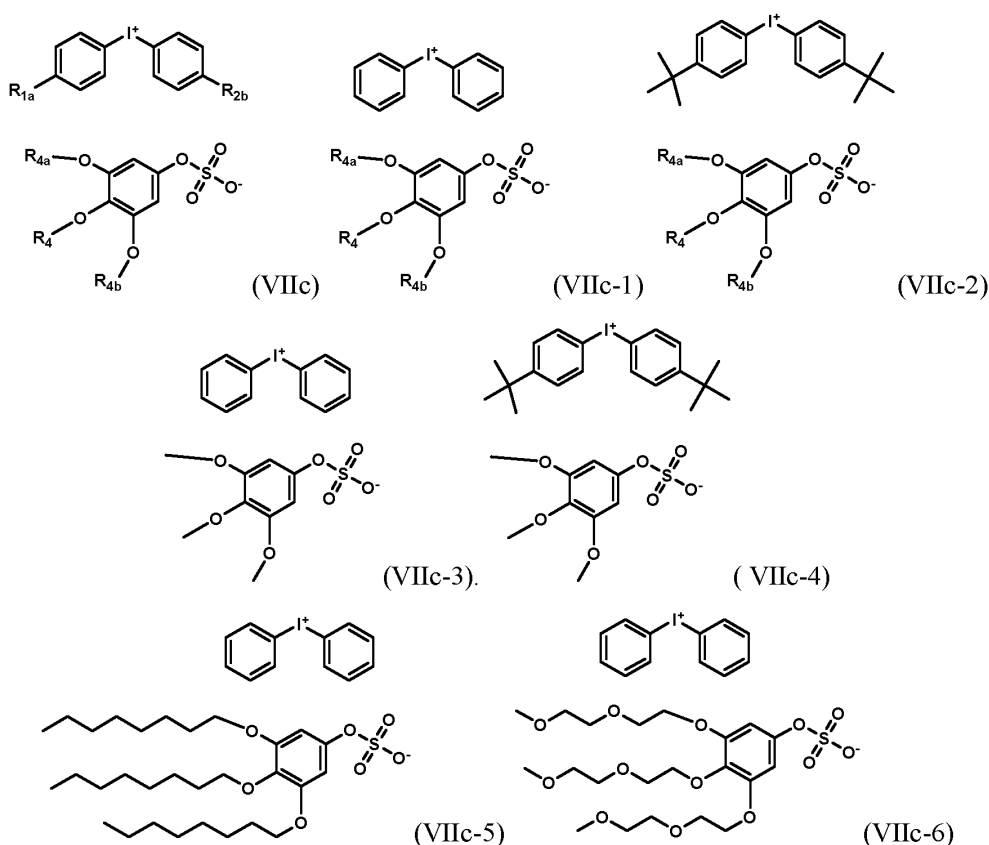
is a C-1 to C-4 alkyl. In one aspect of this embodiment R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkoxy, and at least one of R_{1a} and R_{2b} is H. In another aspect of this embodiment at least one of R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of n is either *t*-butyl or *t*-amyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkyl and at least one of R_{1a} and R_{2b} is H, in a more specific aspect of this embodiment said alkyl is *t*-butyl or *t*-amyl. In another embodiment R_{1a} and R_{2b} are H.

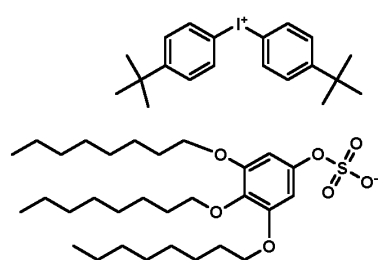
[0123] In another aspect of this embodiment of structure (VIIc), R_4 , R_{4a} and R_{4b} are individually selected from a C-1 to C-12 linear alkyl. In another aspect of this embodiment of structure (VIIc), R_{4a} and R_{4b} are a C-3 to C-12 branched alkyl. In another aspect of this embodiment of structure (VIIc), R_{4a} and R_{4b} are a C-3 to C-12 alicyclic alkyl. In one aspect of this embodiment R_{4a} and R_{4b} are cyclopropyl, in another cyclobutyl, in another cyclohexyl, in another cycloheptyl, in another cyclooctyl, in another adamantyl, in yet another Tetrahydrodicyclopentadienyl (octahydro-1*H*-4,7-methanoindenyl).

[0124] In another aspect of this embodiment of structure (VIIc), when R_4 , R_{4a} and R_{4b} are individually selected from an alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, it is one where R_{eth3} is a C-1 to C-3 alkyl, in another aspect it is a C-1 to C-2 alkyl and in yet another embodiment it is methyl. In another aspect of these embodiments R_{eth} is a linear C-2 to C-4 alkylene, in another aspect it is a C-2 to C-3 alkylene, in yet another embodiment it is ethylene. In another aspect of these embodiment R_{eth1} is a linear C-2 to C-4 alkylene, in another embodiment it is a C-2 to C-3 alkylene and in yet another embodiment it is ethylene. In another aspect of these embodiments $neth$ is an integer from 2 to 5, in another embodiment this integer is from 2 to 3, in yet another embodiment it is 2. In another aspect of these embodiments R_{eth3} is a C-1 to C-3

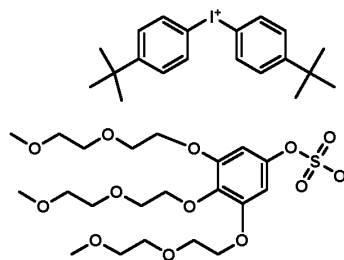
alkylene, in another aspect it is a C-1 to C-2 alkyl, in yet another it is methyl.

[0125] In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIc-1). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIc-2). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIc-3). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIc-4). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIc-5). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIc-6). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIc-7). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIc-8), as follows:





(VIIc-7)



(VIIc-8)

[0126] In one aspect of the embodiments of the compositions described above Component A, said aryl sulfate PAG, has structure (VIII). In one aspect of this embodiment R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkoxy, and at least one of R_{1a} and R_{2b} is H. In another aspect of this embodiment at least one of R_{1a} and R_{2b} are individually selected from is selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of them is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkyl and at least one of R_{1a} and R_{2b} is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In another embodiment R_{1a} and R_{2b} are H.

[0127] In another aspect of these embodiments of structure (VIIIa), X, is selected from F, Cl and I, in one aspect it is F, in another it is Cl and in yet another it is Br. In another aspect of these embodiments of structure (VIIIa), R_{4a} and R_{4b} are individually selected from a C-1 to C-12 linear alkyl.

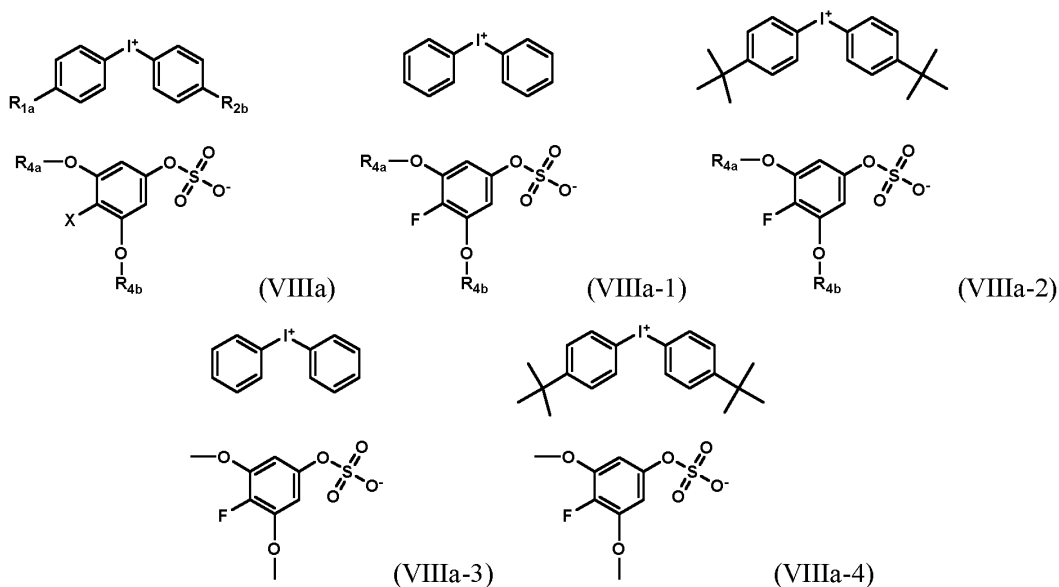
[0128] In another aspect of this embodiment of structure (VIIIa), R_{4a} and R_{4b} are a C-3 to C-12 branched alkyl.

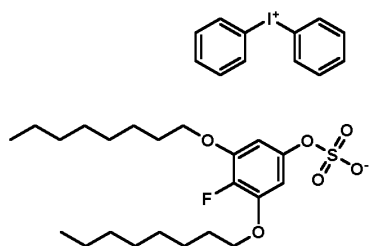
[0129] In another aspect of this embodiment of structure (VIIIa), R_{4a} and R_{4b} are a C-3 to C-12 alicyclic alkyl. In one aspect of this embodiment R_{4a} and R_{4b} are cyclopropyl, in another cyclobutyl, in another cyclohexyl, in another cycloheptyl, in another cyclooctyl, in another adamantyl, in yet

another Tetrahydrodicyclopentadienyl (octahydro-1*H*-4,7-methanoindenyl).

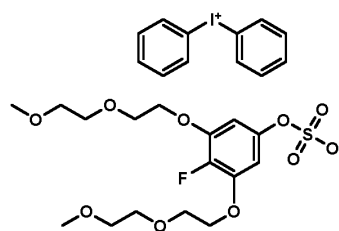
[0130] In another aspect of this embodiment said aryl sulfate PAG has structure (VIIIa), where R_{4a} and R_{4b} are independently selected from the group consisting of a C-1 to C-12 alkyl, an alkyl moiety comprising an alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, where R_{eth} is a C-1 to C-4 alkylene, R_{eth1} is a linear C-2 to C-4 alkylene, $neth$ is an integer ranging from 1 to 6, and R_{eth3} is a C-1 to C-4 alkyl.

[0131] In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIIa-1). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIIa-2). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIIa-3). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIIa-4). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIIa-5). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIIa-6). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIIa-7). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIIa-8), as follows:

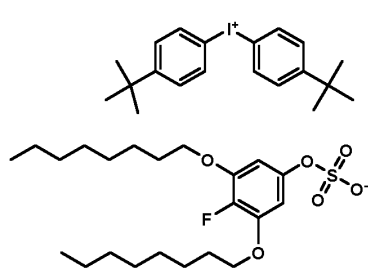




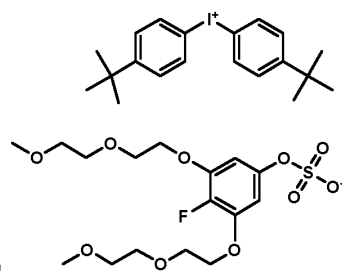
(VIIIa-5)



(VIIIa-6)



(VIIIa-7)



(VIIIa-8)

[0132] In another aspect of the embodiments of the compositions described above Component A, wherein said aryl sulfate PAG, has structure (VIII) it more specifically has structure (VIIIb). In one aspect of this embodiment R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkoxy, and at least one of R_{1a} and R_{2b} is H. In another aspect of this embodiment at least one of R_{1a} and R_{2b} are individually selected from is selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of them is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkyl and at least one of R_{1a} and R_{2b} is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In another embodiment R_{1a} and R_{2b} are H.

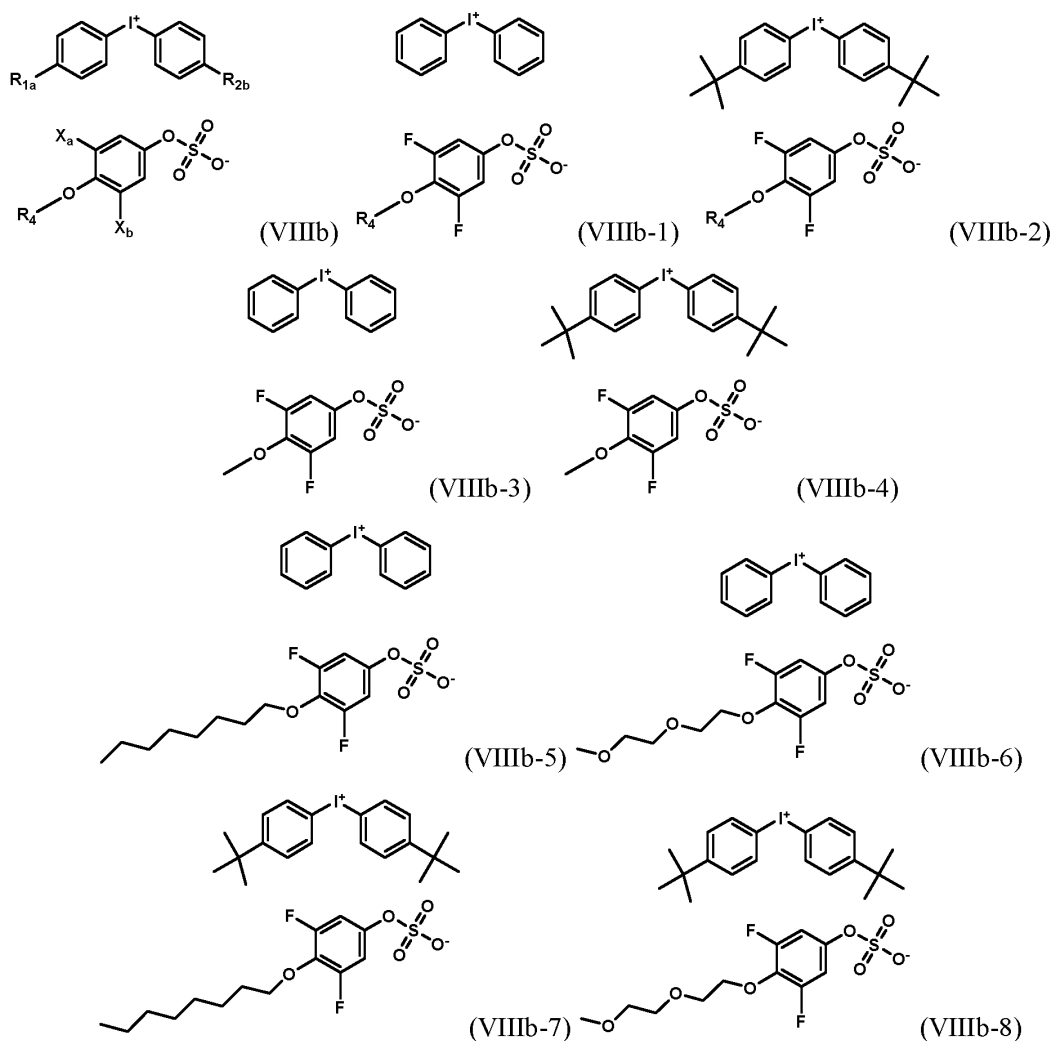
[0133] In another aspect of this embodiment of structure (VIIIb), X_a and X_b are individually selected from F, Cl and I, in one X_a and X_b aspect are F, in another X_a and X_b are Cl and in yet

another X_a and X_b are Br. In another aspect of this embodiment of structure (VIIIb), X_a and X_b are individually selected from F, Cl and Br. In another aspect of this embodiment of structure (VIIIb), R_4 is selected from the group consisting of a C-1 to C-12 alkyl, an alkyl moiety comprising an alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, where R_{eth} is a C-1 to C-4 alkylene, R_{eth1} is a linear C-2 to C-4 alkylene, $neth$ is an integer ranging from 1 to 6, and R_{eth3} is a C-1 to C-4 alkyl.

[0134] In another aspect of this embodiment of structure (VIIIb), R_4 is a C-1 to C-12 linear alkyl. In another aspect of these embodiment of structure (VIIIb), R_4 is a C-3 to C-12 branched alkyl. In another aspect of this embodiment of structure (VIIIb), R_4 is C-3 to C-12 alicyclic alkyl. In one aspect of this embodiment R_4 is cyclopropyl, in another cyclobutyl, in another cyclohexyl, in another cycloheptyl, in another cyclooctyl, in another adamantyl, in yet another Tetrahydrodicyclopentadienyl (octahydro-1*H*-4,7-methanoindenyl).

[0135] In another aspect of this embodiment of structure (VIIIb), when R_4 is said alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, it is one where R_{eth3} is a C-1 to C-3 alkyl, in another aspect it is a C-1 to C-2 alkyl and in yet another embodiment it is methyl. In another aspect of these embodiments R_{eth} is a linear C-2 to C-4 alkylene, in another aspect it is a C-2 to C-3 alkylene, in yet another embodiment it is ethylene. In another aspect of these embodiments R_{eth1} is a linear C-2 to C-4 alkylene, in another embodiment it is a C-2 to C-3 alkylene and in yet another embodiment it is ethylene. In another aspect of these embodiments $neth$ is an integer from 2 to 5, in another embodiment this integer is from 2 to 3, in yet another embodiment it is 2. In another aspect of these embodiments R_{eth3} is a C-1 to C-3 alkylene, in another aspect it is a C-1 to C-2 alkyl, in yet another it is methyl.

[0136] In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIIb-1). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIIb-2). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIIb-3). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIIb-4). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIIb-5). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIIb-6). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIIb-7). In yet another aspect of this embodiment said aryl sulfate PAG has structure (VIIIb-8), as follows:

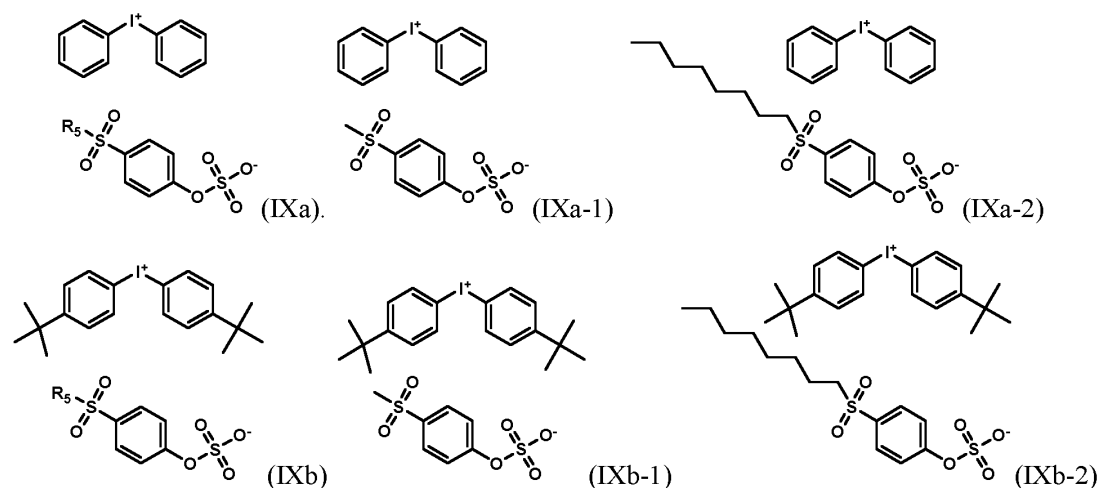


[0137] In one aspect of the embodiments of the compositions described above Component A, said aryl sulfate PAG, has structure (IX). In one aspect of this embodiment R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkoxy, and at least

one of R_{1a} and R_{2b} is H. In another aspect of this embodiment at least one of R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of them is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkyl and at least one of R_{1a} and R_{2b} is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In another embodiment R_{1a} and R_{2b} are H. In another aspect of this embodiment said aryl sulfate PAG has structure (IXa) or (IXb).

[0138] In one aspect of this embodiment R_5 is a C-1 to C-12 linear alkyl. In another aspect of this embodiment of structure (IXa) or (IXb), R_5 is a C-3 to C-12 branched alkyl. In another aspect of this embodiment of structure (IXa) or (IXb), R_5 is C-3 to C-12 alicyclic alkyl. In one aspect of this embodiment R_5 is cyclopropyl, in another cyclobutyl, in another cyclohexyl, in another cycloheptyl, in another cyclooctyl, in another adamantyl, in yet another Tetrahydrodicyclopentadienyl (octahydro-1*H*-4,7-methanoindenyl). In another aspect of this embodiment R_5 is an unsubstituted aryl. In another aspect of this embodiment R_5 is a substituted aryl.

[0139] In yet another aspect of this embodiment said aryl sulfate PAG has structure (IXa-1). In yet another aspect of this embodiment said aryl sulfate PAG has structure (IXa-2). In yet another aspect of this embodiment said aryl sulfate PAG has structure (IXb). In yet another aspect of this embodiment said aryl sulfate PAG has structure (IXb-1). In yet another aspect of this embodiment said aryl sulfate PAG has structure (IXb-2), as follows:

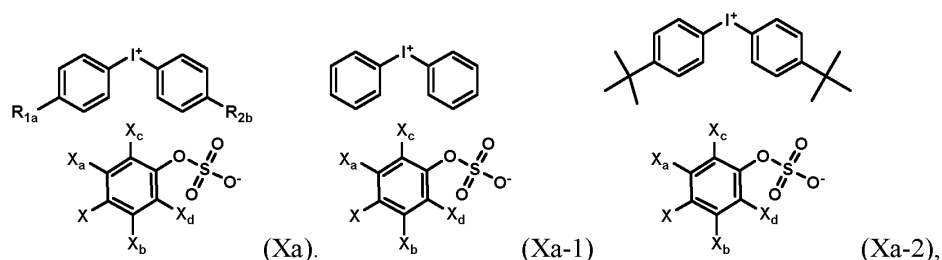


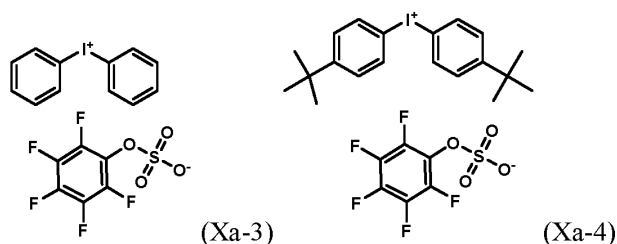
[0140] In one aspect of the embodiments of the compositions described above Component A, said

aryl sulfate PAG, has structure (X). In one aspect of this embodiment R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkoxy, and at least one of R_{1a} and R_{2b} is H. In another aspect of this embodiment at least one of R_{1a} and R_{2b} are individually selected from is selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of them is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkyl and at least one of R_{1a} and R_{2b} is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In another embodiment R_{1a} and R_{2b} are H.

[0141] In another aspect of this embodiment said aryl sulfate PAG has structure (Xa), where X_a , X_b , X_c , X_d are independently a halide selected from the group consisting of F, Cl and Br. In one embodiment X, X_a , X_b , X_c and X_d are F. In another embodiment X, X_a , X_b , X_c and X_d are Cl. In another embodiment X, X_a , X_b , X_c and X_d are Br.

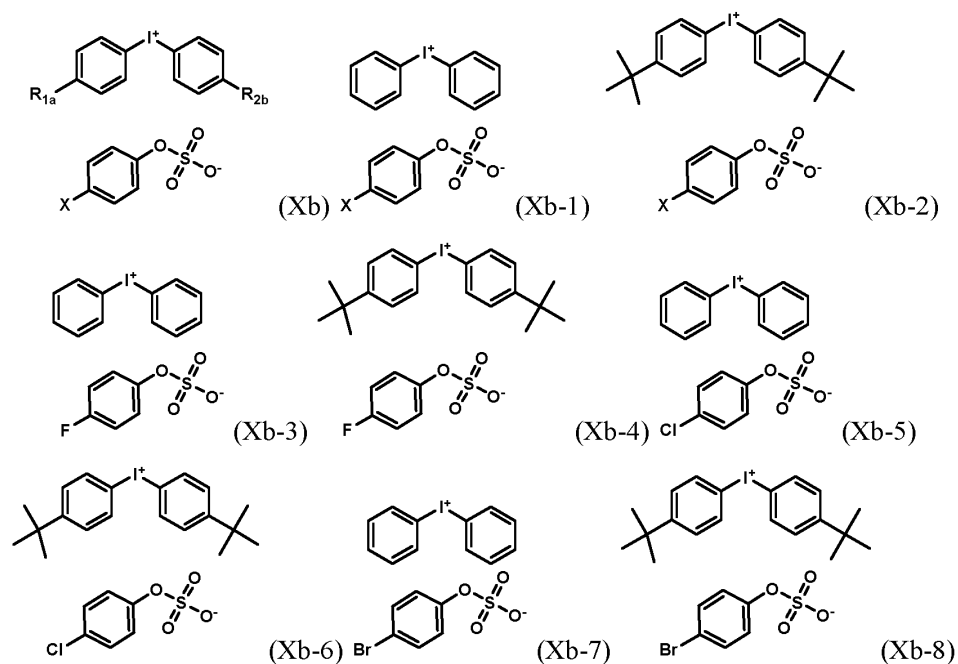
[0142] In another aspect of this embodiment said aryl sulfate PAG has structure (Xa). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Xa-1). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Xa-2). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Xa-3). In yet another aspect of this embodiment said aryl sulfate PAG has structure (IXa-4), as follows:





[0143] In one aspect of the embodiments of the compositions described above wherein Component A, is said aryl sulfate PAG of structure (X) it more specifically has structure (Xb). In one aspect of this embodiment R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkoxy, and at least one of R_{1a} and R_{2b} is H. In another aspect of this embodiment at least one of R_{1a} and R_{2b} are individually selected from is selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of them is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkyl and at least one of R_{1a} and R_{2b} is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In another embodiment R_{1a} and R_{2b} are H. In one aspect of this embodiment X is F. In another aspect of this embodiment X is Cl. In another aspect of this embodiment X is Br.

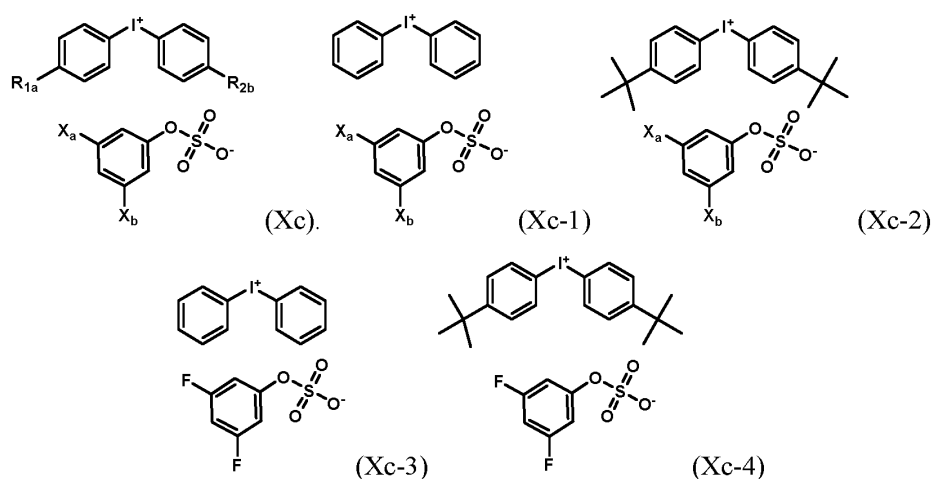
[0144] In yet another aspect of this embodiment said aryl sulfate PAG has structure (Xb-1). In yet another aspect of this embodiments said aryl sulfate PAG has structure (Xb-2). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Xb-3). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Xb-4). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Xb-5). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Xb-6). In yet another aspect of this embodiment said aryl sulfate PAG has structure (IXb-7). In yet another aspect of this embodiment said aryl sulfate PAG has structure (IXb-8), as follows:



[0145] In one aspect of the embodiments of the compositions described above wherein Component A, is said aryl sulfate PAG of structure (X) it more specifically has structure (Xc) where X_a and X_b are independently a halide selected from the group consisting of F, Cl and Br. In one aspect of this embodiment R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkoxy, and at least one of R_{1a} and R_{2b} is H. In another aspect of this embodiment at least one of R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of them is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkyl and at least one of R_{1a} and R_{2b} is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In another embodiment R_{1a} and R_{2b} are H. In one aspect of this

embodiment X_a and X_b are F. In another aspect of this embodiment X_a and X_b are Cl. In another aspect of this embodiment X_a and X_b are Br.

[0146] In yet another aspect of this embodiment said aryl sulfate PAG has structure (Xc-1). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Xc-2). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Xc-3). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Xc-4), as follows:



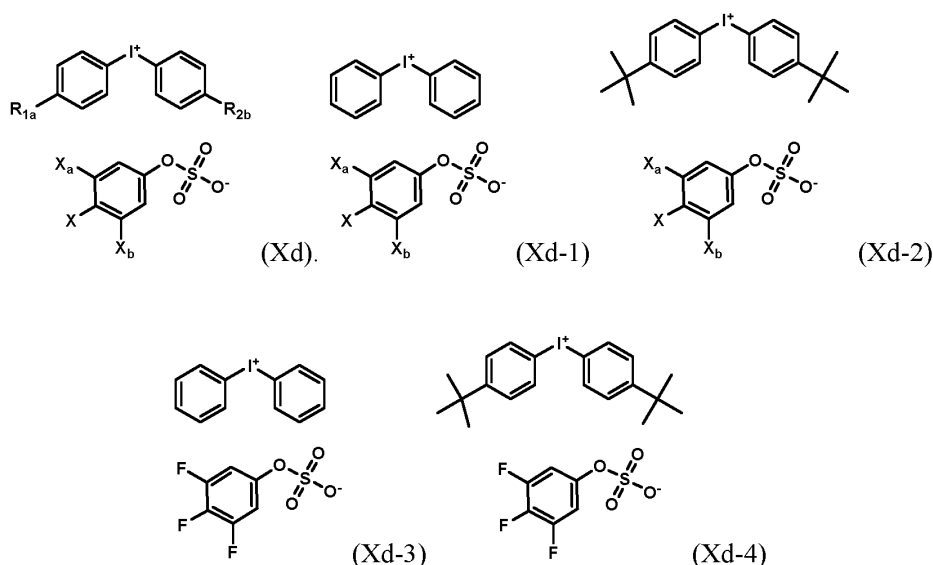
[0147] In one aspect of the embodiments of the compositions described above wherein Component A, is said aryl sulfate PAG of structure (X) it more specifically has structure (Xd) where X_a and X_b are independently a halide selected from the group consisting of F, Cl and Br.

[0148] In one aspect of this embodiment R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkoxy, and at least one of R_{1a} and R_{2b} is H. In another aspect of this embodiment at least one of R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of them is either *t*-butyl or *t*-amyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b}

is selected from a C-1 to C-12 alkyl and at least one of R_{1a} and R_{2b} is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In another embodiment R_{1a} and R_{2b} are H.

[0149] In one embodiment X, X_a and X_b are F. In another embodiment X, X_a and X_b are Cl. In another embodiment X, X_a and X_b are Br.

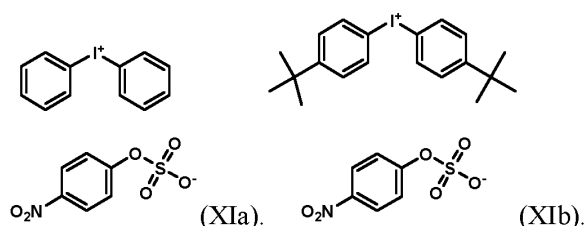
[0150] In yet another aspect of this embodiment said aryl sulfate PAG has structure (Xd-1). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Xd-2). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Xd-3). In yet another aspect of this embodiment said aryl sulfate PAG has structure (Xd-4), as follows:



[0151] In one aspect of the embodiments of the compositions described above Component A, said aryl sulfate PAG, has structure (XI). In one aspect of this embodiment R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkoxy, and at least one of R_{1a} and R_{2b} is H. In another aspect of this embodiment at least one of R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected

from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of them is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkyl and at least one of R_{1a} and R_{2b} is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In another embodiment R_{1a} and R_{2b} are H.

[0152] In yet another aspect of this embodiment said aryl sulfate PAG has structure (XIa). In yet another aspect of this embodiment said aryl sulfate PAG has structure (XIb).



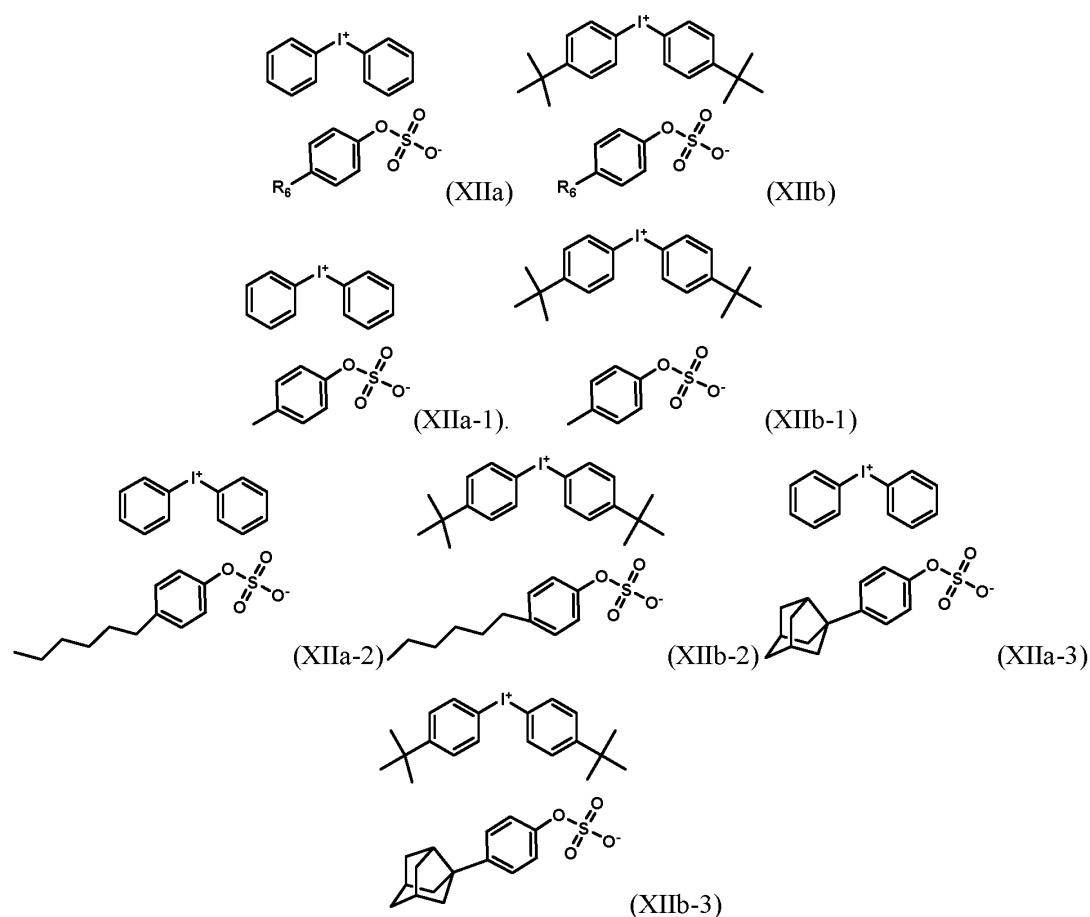
[0153] In one aspect of the embodiments of the compositions described above Component A, said aryl sulfate PAG, has structure (XII).

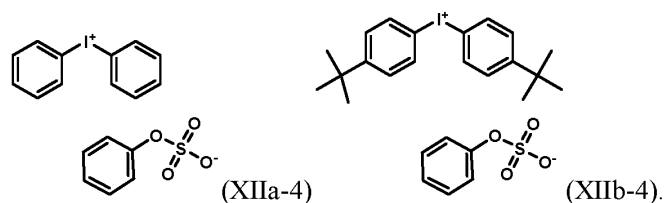
[0154] In one aspect of this embodiment R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-11 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-10 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-9 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-8 alkoxy, in another aspect of this embodiment they are selected from a C-1 to C-7 alkoxy, in another a C-1 to C-6 alkoxy, in another a C-1 to C-5 alkoxy, in another a C-1 to C-4 alkoxy, in another a C-1 to C-4 alkyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkoxy, and at least one of R_{1a} and R_{2b} is H. In another aspect of this embodiment at least one of R_{1a} and R_{2b} are individually selected from a C-1 to C-12 alkyl, in another aspect of this embodiment it is selected from a C-1 to C-7 alkyl, in another a C-1 to C-6 alkyl, in another a C-1 to C-5 alkyl. In another aspect of this embodiment at least one of them is either t-butyl or t-amyl. In another aspect of this embodiment at least one of R_{1a} and R_{2b} is selected from a C-1 to C-12 alkyl and at least one of R_{1a} and R_{2b} is H, in a more specific aspect of this embodiment said alkyl is t-butyl or t-amyl. In another embodiment R_{1a} and R_{2b} are H.

[0155] In one embodiment R_6 is a C-1 to C-12 linear alkyl. In another aspect of this embodiment of structure (XII), R_6 is a C-3 to C-12 branched alkyl. In another aspect of this embodiment of structure (XII), R_6 is a C-3 to C-12 alicyclic alkyl. In one aspect of this embodiment R_6 is

cyclopropyl, in another cyclobutyl, in another cyclohexyl, in another cycloheptyl, in another cyclooctyl, in another adamantyl, in yet another Tetrahydrodicyclopentadienyl (octahydro-1*H*-4,7-methanoindenyl).

[0156] In yet another aspect of this embodiment said aryl sulfate PAG has structure (XIIa). In yet another aspect of this embodiment said aryl sulfate PAG has structure (XIIb). In yet another aspect of this embodiment said aryl sulfate PAG has structure (XIIa-1). In yet another aspect of this embodiment said aryl sulfate PAG has structure (XIIb-1). In yet another aspect of this embodiment said aryl sulfate PAG has structure (XIIa-2). In yet another aspect of this embodiment said aryl sulfate PAG has structure (XIIb-2). In yet another aspect of this embodiment said aryl sulfate PAG has structure (XIIa-3). In yet another aspect of this embodiment said aryl sulfate PAG has structure (XIIb-3). In yet another aspect of this embodiment said aryl sulfate PAG has structure (XIIa-4). In yet another aspect of this embodiment said aryl sulfate PAG has structure (XIIb-4).





Component C: Acid quencher Additive

[0157] In one aspect of said compositions described above Component C: at least one acid quencher additive having a pK_a higher than -0.5 and a boiling point of at least 150°C at 1 atmosphere, said acid quencher may be selected from an amine, and amide, a triarylsulfonium carboxylate, a tetraalkylammonium carboxylate salt, a trialkylammonium carboxylate salt, a dialkylammonium carboxylate salt, a monoalkylammonium salt, and mixtures of these. In another aspect of this embodiment, said acid quencher is selected from amine. In another aspect of this embodiment said acid quencher is a tetraalkylammonium carboxylate salt. In another aspect of this embodiment said basic an acid quencher is a trialkylammonium carboxylate. In another aspect of this embodiment said basic an acid quencher is a triarylsulfonium carboxylate. In one aspect it is a mixtures of an amine, a triarylsulfonium carboxylate. In another aspect it is a mixture of an amine, and a trialkylammonium carboxylate salt.

[0158] In another aspect of said acid quencher additive is selected from the group consisting of compounds having structures (C-1), (C-2), (C-3) (C-4), (C-5), (C-6), (C-7), (C-8), (C-9), and (C-10) as follows:

In the acid quencher additive of structure (C-1) R_{q1} , R_{q2} , R_{q3} are independently a C-1 to C-4 alkyl, L_1 , L_{1a} , L_2 , L_{2a} , L_3 L_{3a} are independently a linear C-2 to C-4 alkylene spacer or a mixture of compounds from this group.

In the acid quencher additive of structure (C-2), R_{q4} is a C-1 to C-4 alkyl, and R_{ac1} , R_{ac2} and R_{ac3} are independently selected from H, a C-1 to C-12 alkyl and a C-1 to C-12 alkoxy.

In the acid quencher additive of structure (C-3), R_{q5} , R_{q6} , R_{q7} are independently a C-1 to C-4 alkyl.

In the acid quencher additive of structure (C-4), L_4 , L_5 and L_6 are independently a linear C-2 to C-4 alkylene spacer.

In the acid quencher additive of structure (C-5), R_{c3} is a C-1 to C-4 alkyl and R_{c1} and R_{c2} are independently selected from a C-5 to C-8 cyclic alkyl.

In the acid quencher additive of structure (C-6), R_{c4} , R_{c5} , and R_{c6} are independently selected from a C-4 to C-8 alkyl.

In the acid quencher additive of structure (C-7), R_{b1} is C-1 to C-20 saturated alkyl chain or a C-2 to C-20 unsaturated alkyl chain.

In the acid quencher additive of structure (C-8), R_{b2} is either H, or a C-1 to C-20 alkyl.

In the acid quencher additive of structure (C-9), R_{b3} is a C-1 to C-20 alkyl.

In the acid quencher additive of structure (C-10), R_{b4} is H or a C-1 to C-20 alkyl.

In the acid quencher additive of structure (C-11), R_{b5} , R_{b6} , R_{b7} , R_{b8} are individually selected from H or a C-1 to C-20 alkyl.

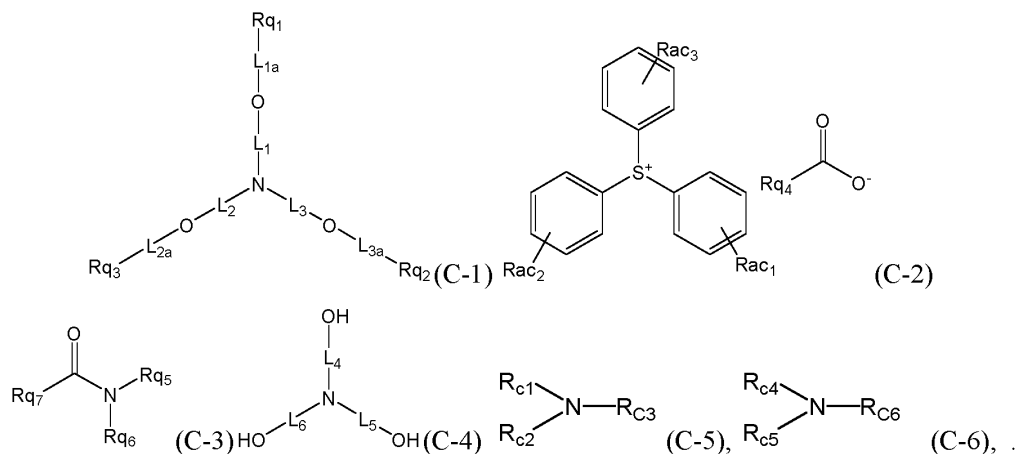
In the acid quencher additive of structure (C-12), R_{b9} , R_{b10} , R_{b11} are individually selected from H or a C-1 to C-20 alkyl.

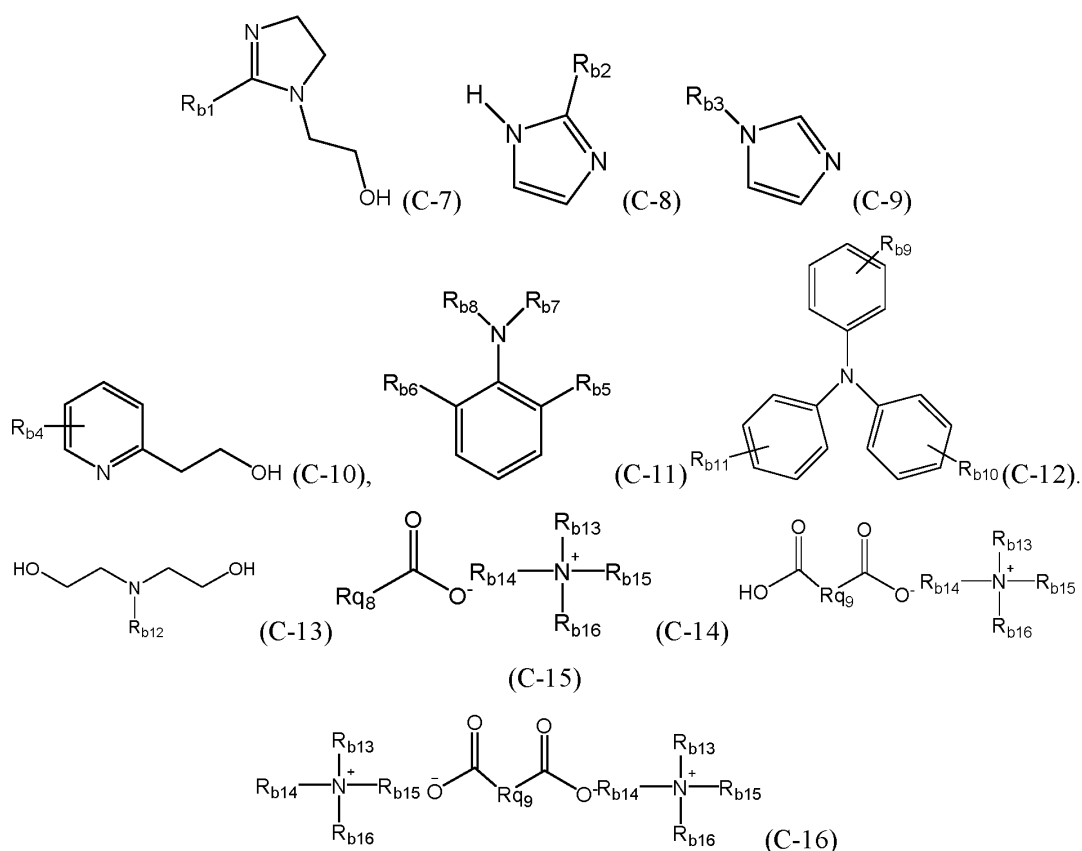
In the acid quencher additive of structure (C-13), R_{b12} is selected from H or a C-1 to C-20 alkyl.

In the acid quencher additive of structure (C-14), R_{q8} is either a C-1 to C-20 alkyl, and R_{b13} is a C-1 to C-8 alkyl, R_{b14} , R_{b15} and R_{b16} are individually selected from H, a C-1 to C-8 unsubstituted alkyl, or a C-1 to C-8 unsubstituted alkyl.

In the acid quencher additive of structure (C-15), R_{q9} is a direct valence bond or a C-1 to C-6 alkylene and R_{b13} is a C-1 to C-8 alkyl, R_{b14} , R_{b15} and R_{b16} are individually selected from H, a C-1 to C-8 unsubstituted alkyl, or a C-1 to C-8 unsubstituted alkyl.

In the acid quencher additive of structure (C-16), R_{q9} is a direct valence bond or a C-1 to C-6 alkylene and R_{b13} is a C-1 to C-8 alkyl, R_{b14} , R_{b15} and R_{b16} are individually selected from H a C-1 to C-8 unsubstituted alkyl, or a C-1 to C-8 unsubstituted alkyl.





[0159] Specific non limiting examples of structures (C-14) (C-15) and (C-16) are trialkylalkylammonium and benzyldialkylammonium salt where these are selected from trimethylammonium, triethylammonium, tripropylammonium, tributylammonium, tripentylammonium, trihexylammonium, triheptylammonium, trioctylammonium, benzyldimethylammonium, benzyldiethylammonium, benzyldipropylammonium, benzyldibutylammonium. and the carboxylate moiety may be selected from formate, acetate, propionate, butyrate, pentanoate, hexanoate, heptanoate, octanoate, cyclohexanecarboxylate, and the like. In one aspect of this embodiment said trialkylammonium salt of an aliphatic carboxylic acid is selected from the salts wherein the trialkylammonium moiety is selected from trimethylammonium, triethylammonium, tripropylammonium, tributylammonium, tripentylammonium, and benzyldimethylammonium.

[0160] In structure (C-14) specific examples of carboxylates are acetate, propionate, butyrate, pentanoate and cyclohexylcarboxylate. Specific non limiting examples are for instance

trimethylammonium acetate, tributylammonium acetate and the like.

[0161] In structures (C-15) these mono trialkylammonium or benzyltrialkyl ammonium salts formed with a dicarboxylic acid are ones formed by oxalic acid, malonic acid, succinic acid or adipic acid. Specific examples non-limiting examples are for instance are mono-(triethylammonium) oxalate, mono-(trimethylammonium) oxalate and the like.

[0162] In structures (C-16) these di carboxylate salts may be ones formed by oxalic acid, malonic acid, succinic acid or adipic acid. Specific non limiting examples are for instance are di-(triethylammonium) oxalate, di-(trimethylammonium) oxalate and the like.

[0163] In one embodiment of the above described positive working photosensitive compositions, said acid quencher is a bis[trialkylammonium] salt of an aliphatic dicarboxylic acid, non-limiting examples of such salts are ones wherein the bis[trialkylammonium] moiety is selected from bis[trimethylammonium], bis[triethylammonium], bis[tripropylammonium], bis[tributylammonium], bis[tripentylammonium], bis[trihexylammonium], bis[triheptylammonium], bis[trioctylammonium], bis-[benzyl dimethylammonium], bis-[benzyl dipropylammonium], bis-[benzyl dibutylammonium] and the like; and wherein the aliphatic dicarboxylate moiety may be chosen from oxalate, malonate, succinate, adipate, heptadionate, octanedioate, nonanedioate, fumarate, maleate, glutaconate, itaconate, and the like. In one aspect of this embodiment said bis[trialkylammonium] salt of an aliphatic dicarboxylic acid is selected from the salts wherein the bis[trialkylammonium] moiety is selected from bis[trimethylammonium], bis[triethylammonium], bis[tripropylammonium], bis[tributylammonium], bis[tripentylammonium], and bis[benzyl dimethylammonium], and the aliphatic dicarboxylate is selected from oxalate, malonate, succinate, adipate, and heptadionate.

[0164] In one embodiment of the above-described positive working photosensitive compositions, said acid quencher is a bis[trialkylammonium] oxalate.

[0165] In one embodiment of the above-described positive working photosensitive compositions, said acid quencher is a bis[trialkylammonium] salt of an aliphatic dicarboxylic acid it is selected from the salts wherein the bis[trialkylammonium] moiety is selected from bis[trimethylammonium], bis[triethylammonium], bis[tripropylammonium], bis[tributylammonium], bis[tripentylammonium], and bis[benzyl dimethylammonium], and the dicarboxylate is oxalate.

Component D: Organic Spin Casting Solvent Component

[0166] In any one of the above described composition said Component D, said organic spin casting is any suitable solvent for dissolving the above-described photoresist compositions including glycol ether derivative such as ethyl cellosolve, methyl cellosolve, propylene glycol monomethyl ether (PGME), diethylene glycol monomethyl ether, diethylene glycol monoethyl ether, dipropylene glycol dimethyl ether, propylene glycol n-propyl ether, or diethylene glycol dimethyl ether; a glycol ether ester derivative such as ethyl cellosolve acetate, methyl cellosolve acetate, or propylene glycol monomethyl ether acetate (PGMEA); carboxylates such as ethyl acetate, n-butyl acetate and amyl acetate; carboxylates of di-basic acids such as diethyloxylate and diethylmalonate; dicarboxylates of glycols such as ethylene glycol diacetate and propylene glycol diacetate; and hydroxy carboxylates such as methyl lactate, ethyl lactate (EL), ethyl glycolate, and ethyl-3-hydroxy propionate; a ketone ester such as methyl pyruvate or ethyl pyruvate; an alkoxy-carboxylic acid ester such as methyl 3-methoxypropionate, ethyl 3-ethoxypropionate, ethyl 2-hydroxy-2-methylpropionate, or methylethoxypropionate; a ketone derivative such as methyl ethyl ketone, acetone, cyclopentanone, cyclohexanone or 2-heptanone; a ketone ether derivative such as diacetone alcohol methyl ether; a ketone alcohol derivative such as acetol or diacetone alcohol; a ketal or acetal like 1,3 dioxalane and diethoxypropane; lactones such as butyrolactone; an amide derivative such as dimethylacetamide or dimethylformamide, anisole, and mixtures thereof. For example, the organic spin casting solvent can be selected from a glycol ether derivative, a glycol ether ester derivative, an alkyl carboxylate, an alkyl carboxylates of di-basic carboxylic acid, an alkyl dicarboxylates, an alkyl ester of a hydroxyalkylcarboxylic acid, a ketone ester, a ketone, a ketone ether, a ketone alcohol, a ketal, an acetal and a lactones, an amide and mixtures thereof.

Optional Component E: Surfactant

[0167] Surfactants which are not fluorinated are typically compounds/polymers containing silicon compounds or long chain alkyls and polyglycolic moiety which can assist in forming good uniform photoresist coatings. Examples of the surfactant that can be used in the present disclosed and claimed subject matter include (I) anionic surfactants, (II) cationic surfactants or (III) nonionic surfactants, and more particularly (I) alkyl sulfonate, alkyl benzene sulfonic acid and alkyl benzene sulfonate, (II) lauryl pyridinium chloride and lauryl methyl ammonium chloride and (III) polyoxyethylene octyl ether, polyoxyethylene lauryl ether, polyoxyethylene acetylenic glycol ether and organic siloxane surfactants (for example, KF-53 and KP341 (Shin-Etsu Chemical)). These surfactants can be used alone or in combination of two or more of these. The content of the

surfactant (Component E) based on Component A is preferably more than 0 weight % up to 10 weight %; more preferably from 0.001 to about 10 weight %.

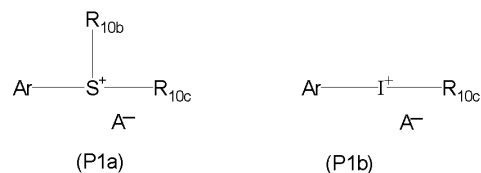
Optional Component F: Additional PAGs

[0168] Optional PAGs may include any of the following provided that these do not contain any fluoroalkyl or perfluoroalkyl moieties:

- (i) onium (not including ammonium) salts of the formula (P1a), (P1b),
- (ii) diazomethane derivatives of the formula (P2),
- (iii) glyoxime derivatives of the formula (P3),
- (iv) bis-sulfone derivatives of the formula (P4),
- (v) sulfonic acid esters of N-hydroxyimide compounds of the formula (P5),
- (vi) β -ketosulfonic acid derivatives,
- (vii) disulfone derivatives,
- (viii) nitrobenzylsulfonate derivatives,
- (ix) sulfonate derivatives,
- (x) benzyloxysulfonylbenzene derivatives of the formula (P6)

These onium salts are described in detail as follows:

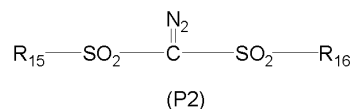
[0169] (i) Onium salts of structures (P1a) or (P1b):



Wherein in structure (P1a) or (P1b), Ar is an unsubstituted or substituted aryl group of 6 to 20 carbon atoms, which does not contain any fluoroalkyl or perfluoroalkyl moieties; R_{10b} and R_{10c} independently represent unsubstituted or substituted straight, branched or cyclic alkyl, alkenyl, aryl groups of 6 to 20 carbon atoms, aralkyl or aryloxyalkyl groups of 7 to 12 carbon atoms, the straight, branched or cyclic alkyl or alkenyl groups optionally containing one or more O atoms but which do not contain any fluoroalkyl or perfluoroalkyl moiety. Also, R_{10b} and R_{10c} , taken together, may form a ring. R_{10b} and R_{10c} each are alkylene groups of 1 to 6 carbon atoms when they form a ring. A^- is an anion of an acid having a pK_a less than 1, which does not contain any fluoroalkyl or perfluoroalkyl moieties such as for example tosylate, benzenesulfonate, 4-fluorobenzenesulfonate, and 1,2,3,4,5-pentafluorobenzenesulfonate, alkylsulfonate ions such as mesylate and

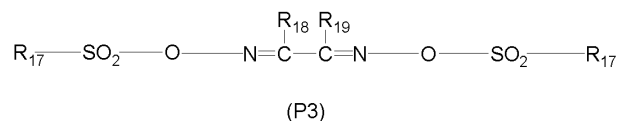
butanesulfonate.

[0170] (ii) diazomethane derivatives of structure (P2),



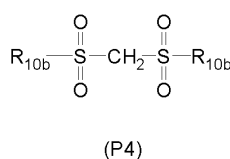
Wherein in Structure (P2), R₁₅ and R₁₆ independently represent unsubstituted or substituted straight, branched or cyclic alkyl optionally containing one or more O atoms, or brominated or chlorinated alkyl groups of 1 to 12 carbon atoms, unsubstituted or substituted aryl or brominated aryl groups or chlorinated aryl group of 6 to 20 carbon atoms, or unsubstituted or substituted aralkyl groups of 7 to 12 carbon atoms, provide that none of these contain any fluoroalkyl or perfluoroalkyl moieties.

[0171] (iii) glyoxime derivatives of Structure (P3),



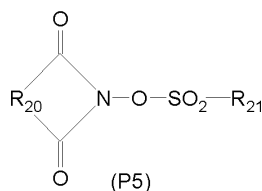
Wherein in structure (P3), R₁₇, R₁₈, and R₁₉ independently represent unsubstituted or substituted straight, branched or cyclic alkyl or halogenated alkyl groups of 1 to 12 carbon atoms, unsubstituted or substituted aryl or brominated or chlorinated aryl groups of 6 to 20 carbon atoms, or unsubstituted or substituted aralkyl groups of 7 to 12 carbon atoms. Also, R₁₈ and R₁₉, taken together, may form a ring. R₁₈ and R₁₉ each are unsubstituted or substituted straight or branched alkylene groups of 1 to 6 carbon atoms when they form a ring, provided that none of these moieties contain fluoroalkyl or perfluoroalkyl moieties.

[0172] (iv) bis-sulfone derivatives of structure (P4),



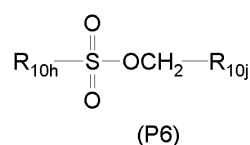
Wherein in Structure (P4) R_{10b} is as defined above.

[0173] (v) sulfonic acid esters of N-hydroxyimide compounds of structure (P5)



Wherein in structure (P5) R_{20} is an arylene group of 6 to 10 carbon atoms, alkylene group of 1 to 6 carbon atoms, or alkenylene group of 2 to 6 carbon atoms wherein some or all of the hydrogen atoms may be replaced by straight or branched alkyl or alkoxy groups of 1 to 4 carbon atoms, nitro, acetyl, or phenyl groups. R_{21} is a straight, branched or cyclic alkyl group of 1 to 8 carbon atoms, alkenyl, alkoxyalkyl, phenyl or naphthyl group wherein some or all of the hydrogen atoms may be replaced by alkyl or alkoxy groups of 1 to 4 carbon atoms, phenyl groups (which may have substituted thereon an alkyl or alkoxy of 1 to 4 carbon atoms, nitro, or acetyl group), hetero-aromatic groups of 3 to 5 carbon atoms, or chlorine atoms, provided that none of these moieties contain fluoroalkyl or perfluoroalkyl moieties.

[0174] (x) benzyloxysulfonylbenzene derivatives of Structure (P6)

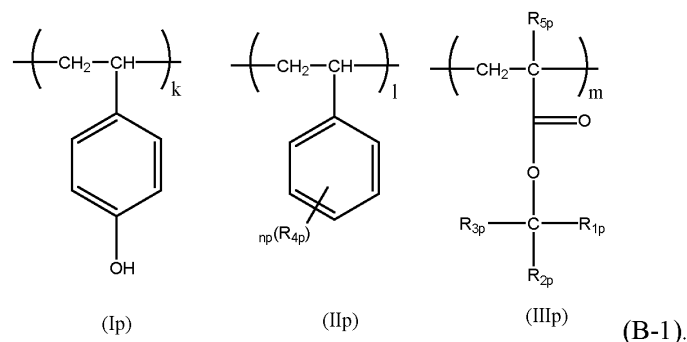


Wherein in Structure (P6), R_{10h} and R_{10j} independently stand for the same thing as R_{10b} .

Compositions: Detailed Descriptions

Detailed Description: Composition 1

[0175] In another aspect of the above described composition wherein said Component B is said above described resin comprising repeat units derived from 4-hydroxystyrene it is a polymer having structure (B-1), which comprises repeat units of structure (Ip), (IIp) and (IIIp), where R_{1p} , R_{2p} , and R_{3p} are individually selected from a C-1 to C-6 alkyl, n_p is 0, 1, 2 or 3, and R_{4p} is a C-1 to C-4 alkyl, and R_{5p} is H or a methyl, and k , l and m are the number of repeat units.



[0176] In one embodiment of said composition, comprising Component B, the polymer of structure (B-1), the mole % of repeat unit of structure (Ip) ranges from about 47.5 mole % to about 71.3

mole %, the mole % of structure (IIp) ranges from about 15.3 mole % to about 22.9 mole % and structure (IIIp) ranges from about 17.2 mole % to about 25.8 mole %, and further that the sum of the mole % values of the repeat unit of structure (Ip), the repeat unit of structure (IIp) and the repeat units of structure (IIIp), adds up to 100 mole %.

[0177] In another embodiment of said composition comprising Component B the polymer of structure (B-1), the mole % of repeat unit of structure (Ip) ranges from about 53.46 mole % to about 65.34 mole %, the mole % of structure (IIp) ranges from about 17.19 mole % to about 21.01 mole % and structure (IIIp) ranges from about 19.35 mole % to about 23.65 mole %, and further that the sum of the mole % values of the repeat unit of structure (Ip), the repeat unit of structure (IIp) the repeat units of structure (IIIp), adds up to 100 mole %.

[0178] In another embodiment of said composition, comprising Component B, the polymer of structure (B-1), the mole % of repeat unit of structure (Ip) ranges from about 55.8 mole % to about 63.0 mole %, the mole % of structure (IIp) ranges from about 18.0 mole % to about 20.2 mole % and structure (IIIp) ranges from about 20.2 mole % to about 22.8 mole %, and further that the sum of the mole % values of the repeat unit of structure (Ip), the repeat unit of structure (IIp) and the repeat units of structure (IIIp) adds up to 100 mole %.

[0179] In another embodiment of said composition, comprising Component B, the polymer of structure (B-1), the mole % of repeat unit of structure (Ip) ranges from about 57.0 mole % to about 61.8 mole %, the mole % of structure (IIp) ranges from about 18.3 mole % to about 19.9 mole % and structure (IIIp) ranges from about 20.6 mole % to about 22.4 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IIp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

[0180] In another embodiment of said composition, comprising Component B, the polymer of structure (B-1), the mole % of repeat unit of structure (Ip) ranges from about 58.2 mole % to about 60.6 mole %, the mole % of structure (IIp) ranges from about 18.7 mole % to about 19.5 mole % and structure (IIIp) ranges from about 21.1 mole % to about 21.9 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IIp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

[0181] In another embodiment of said composition, comprising Component B, the polymer of structure (B-1), the mole % of repeat unit of structure (Ip) ranges from about 58.8 mole % to about 60.0 mole %, the mole % of structure (IIp) ranges from about 18.9 mole % to about 19.3 mole %

and structure (IIIp) ranges from about 21.3 mole % to about 21.7 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IIp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

[0182] In one embodiment of said composition, comprising Component B, the polymer of structure (B-1), In another embodiment of said Component B which is the polymer of structure (B-1), the mole % of repeat unit of structure (Ip) ranges from about 58.0 mole % to about 60.0 mole %, the mole % of structure (IIp) ranges from about 18.5 mole % to about 20.5 mole % and structure (IIIp) ranges from about 21.3 mole % to about 21.7 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IIp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

[0183] In one embodiment of said composition, comprising Component B, the polymer of structure (B-1), the mole % of repeat unit of structure (Ip) is about 59.4 mole %, the mole % of structure (IIp) is about 19.1 mole % and structure (IIIp) is about 21.5 mole % and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IIp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

[0184] In one embodiment of said composition, comprising Component B, the polymer of structure (B-1), the ratio of the moles of the repeat unit of structure (IIIp) in said polymer of structure (B-1) to the moles of component A, said PAG, is from about 68.8 to about 103.2.

[0185] In one embodiment of said composition, comprising Component B, the polymer of structure (B-1), the ratio of the moles of the repeat unit of structure (IIIp) in said polymer of structure (B-1) to the moles of component A, said PAG, is from about 77.5 to about 94.7.

[0186] In another embodiment of said composition, comprising Component B, the polymer of structure (B-1), the ratio of the moles of the repeat unit of structure (IIIp) in said polymer of structure (B-1) to the moles of component A, said PAG, is from about 80.9 to about 91.2.

[0187] In another embodiment of said composition, comprising Component B, the polymer of structure (B-1), the ratio of the moles of the repeat unit of structure (IIIp) in said polymer of structure (B-1) to the moles of component A, said PAG, is from about 82.6 to about 89.5.

[0188] In another embodiment of said composition, comprising Component B, the polymer of structure (B-1), the ratio of the moles of the repeat unit of structure (IIIp) in said polymer of structure (B-1) to the moles of component A, said PAG, is from about 84.3 to about 87.8.

[0189] In another embodiment of said composition, comprising Component B, the polymer of

structure (B-1), the ratio of the moles of the repeat unit of structure (IIIp) in said polymer of structure (B-1) to the moles of component A, said PAG, is from about 85.2 to about 86.9.

[0190] In one embodiment of said composition, comprising Component B, preferably the polymer of structure (B-1), the mole ratio of the moles of component A, said PAG to the moles of component C, said acid quencher is from about 7.8 to about 11.7.

[0191] In another embodiment of said composition, comprising Component B, preferably the polymer of structure (B-1), the mole ratio of the moles of component A, said PAG to the moles of component C, said acid quencher is from about 8.8 to about 10.7.

[0192] In another embodiment of said composition, comprising Component B, preferably the polymer of structure (B-1), the mole ratio of the moles of component A, said PAG to the moles of component C, said acid quencher is from about 9.2 to about 10.3.

[0193] In another embodiment of said composition, comprising Component B, preferably the polymer of structure (B-1), the mole ratio of the moles of component A, said PAG to the moles of component C, said acid quencher is from about 9.4 to about 10.1.

[0194] In another embodiment of said composition, comprising Component B, preferably the polymer of structure (B-1), the mole ratio of the moles of component A, said PAG to the moles of component C, said acid quencher is from about 9.6 to about 9.9.

[0195] In another embodiment of said composition, comprising Component B, preferably the polymer of structure (B-1), the mole ratio of the moles of component A, said PAG to the moles of component C, said acid quencher is from about 9.7 to about 9.8.

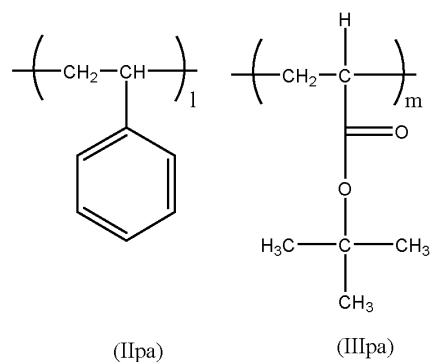
[0196] In another embodiment of said composition, comprising Component B, the polymer of structure (B-1) is one wherein, R_{4p} is methyl and n_p is 1. In another aspect of this embodiment R_{5p} is methyl. In another aspect of this embodiment R_{3p} , R_{1p} and R_{2p} are methyl.

[0197] In another embodiment of said composition, comprising Component B, the polymer of structure (B-1) is one wherein, R_{4p} is methyl and n_p is 1. In another aspect of this embodiment R_{5p} is H. In another aspect of this embodiment R_{3p} , R_{1p} and R_{2p} are methyl.

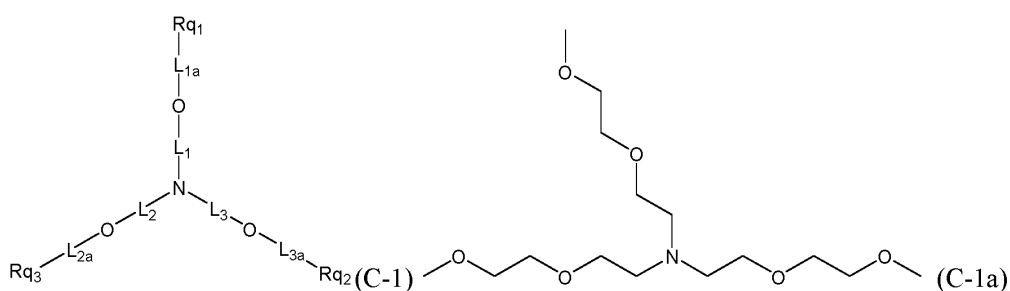
[0198] In another embodiment of said composition, comprising Component B, the polymer of structure (B-1) is one wherein n_p is 0. In another aspect of this embodiment R_{5p} is methyl. In another aspect of this embodiment R_{5p} is H. In another aspect of this embodiment R_{3p} , R_{1p} and R_{2p} are methyl.

[0199] In another embodiment of said composition, comprising Component B, the polymer of

structure (B-1) is one wherein said repeat unit of structure (IIp) has structure (IIpa) and said repeat unit of structure (IIIp) has structure (IIIpa),



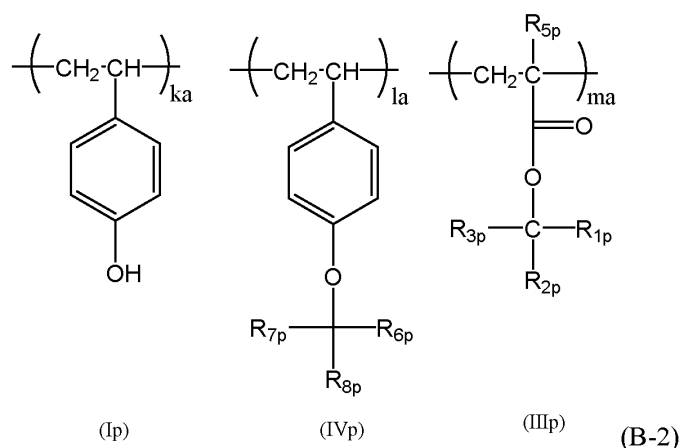
[0200] In another embodiment of said composition, comprising Component B, the polymer of structure (B-1) as described above, component C said acid quencher is an amine. In another aspect of this embodiment said acid quencher is at least one acid quencher having structure (C-1), wherein Rq₁, Rq₂, Rq₃ are independently a C-1 to C-4 alkyl, L₁, L_{1a}, L₂, L_{2a}, L₃, L_{3a} are independently a linear C-2 to C-4 alkylene spacer. In another aspect of this embodiment said acid quencher at least one acid quencher of structure (C-1), wherein Rq₁, Rq₂, Rq₃ are the same C-1 to C-4 alkyl, L₁, L₂ and L₃ are the same linear C-2 to C-4 alkylene spacer and L_{1a}, L_{2a} and L_{3a} are the same linear C-2 to C-4 alkylene spacer. In another aspect of this embodiment said acid quencher has structure (C-1a)



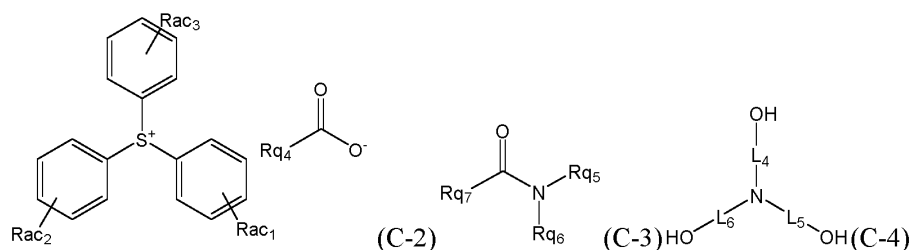
[0201] In another embodiment of said composition, comprising Component B, the polymer of structure (B-1) has an Mw of about 8,000 to about 27,000 and a polydispersity of 1.0 to about 2.5. In another aspect of this embodiment, it has an Mw of about 12,684 to about 13,884 and a polydispersity of about 1.77 to about 2.17.

Detailed Description: Composition 2

[0202] In another aspect of the above described composition wherein said Component B is said above described resin comprising repeat units derived from 4-hydroxystyrene it is a polymer having structure (B-2) which comprises repeat units of structure (Ip) (IVp) and (IIIp), where R_{1p} , R_{2p} , R_{3p} , R_{6p} , R_{7p} and R_{8p} are individually selected from a C-1 to C-6 alkyl, R_{5p} is H or a C-1 to C-4 alkyl, k_a , l_a , and m_a are the number of repeat units,



[0203] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), Component C, said acid quencher is at least one amine. In another aspect of this embodiment said acid quencher is an amine having structure (C-4), wherein L_4 , L_5 and L_6 are independently a linear C-2 to C-4 alkylene spacer. In another aspect of this embodiment, said composition additionally comprises as an acid quencher photodecomposable base an acid quencher which is a triarylsulfonium carboxylate, in one aspect of this embodiment said triarylsulfonium carboxylate has structure (C-2), wherein R_{q4} is a C-1 to C-4 alkyl, and R_{ac1} , R_{ac2} and R_{ac3} are independently selected from H, a C-1 to C-12 alkyl and a C-1 to C-12 alkoxy. In another aspect of this embodiment, said composition additionally comprises an acid quencher which is at least one amide. In another aspect this embodiment, said composition additionally comprises an acid quencher of structure (C-3), wherein R_{q5} , R_{q6} , R_{q7} are independently a C-1 to C-4 alkyl.



[0204] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the mole % of repeat unit of structure (Ip) ranges from about 52.8 mole % to about 79.9 mole %, the mole % of structure (IVp) ranges from about 17.6 mole % to about 26.4 mole % and structure (IIIp) ranges from about 9.6 mole % to about 14.4 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IVp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

[0205] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the mole % of repeat unit of structure (Ip) ranges from about 59.4 mole % to about 72.6 mole %, the mole % of structure (IVp) ranges from about 21.12 mole % to about 24.2 mole % and structure (IIIp) ranges from about 10.8 mole % to about 13.2 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IVp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

[0206] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the mole % of repeat unit of structure (Ip) ranges from about 62.4 mole % to about 70.0 mole %, the mole % of structure (IVp) ranges from about 20.7 mole % to about 23.3 mole % and structure (IIIp) ranges from about 11.3 mole % to about 12.7 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IVp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

[0207] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the mole % of repeat unit of structure (Ip) ranges from about 63.4 mole % to about 68.6 mole %, the mole % of structure (IVp) ranges from about 21.1 mole % to about 22.9 mole % and structure (IIIp) ranges from about 11.5 mole % to about 12.5 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IVp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

[0208] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the mole % of repeat unit of structure (Ip) ranges from about 64.7 mole % to about

67.3 mole %, the mole % of structure (IVp) ranges from about 21.6 mole % to about 22.4 mole % and structure (IIIp) ranges from about 11.8 mole % to about 12.2 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IVp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

[0209] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the mole % of repeat unit of structure (Ip) ranges from about 65.3 mole % to about 66.7 mole %, the mole % of structure (IVp) ranges from about 21.8 mole % to about 22.2 mole % and the mole % of structure (IIIp) ranges from about 11.9 mole % to about 12.1 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IVp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

[0210] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the mole % of repeat unit of structure (Ip) ranges from about 65 mole % to about 67 mole %, the mole % of structure (IVp) ranges from about 21.4 mole % to about 23.4 mole % and structure (IIIp) ranges from about 11.0 mole % to about 13.0 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IVp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

[0211] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the ratio of the total moles of the repeat unit of structures (IVp) and (IIIp) in this polymer, to the moles of component A, said PAG, is from about 38.5 to about 57.8.

[0212] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the ratio of the total moles of the repeat unit of structures (IVp) and (IIIp) in this polymer, to the moles of component A, said PAG, is from about 43.3 to about 53.0.

[0213] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the ratio of the total moles of the repeat unit of structures (IVp) and (IIIp) in this polymer, to the moles of component A, said PAG, is from about 45.3 to about 51.1.

[0214] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the ratio of the total moles of the repeat unit of structures (IVp) and (IIIp) in this polymer, to the moles of component A, said PAG, is from about 46.3 to about 50.1.

[0215] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the ratio of the total moles of the repeat unit of structures (IVp) and (IIIp) in this polymer, to the moles of component A, said PAG, is from about 47.2 to about 49.1.

[0216] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the ratio of the total moles of the repeat unit of structures (IVp) and (IIIp) in this polymer, to the moles of component A, said PAG, is from about 47.7 to about 48.2.

[0217] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the ratio of the total moles of the repeat unit of structures (IVp) and (IIIp) in this polymer, to the moles of component A, said PAG, is about 48.2.

[0218] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-2) is from about 1.84 to about 2.76, the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-2) is from about the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-3) is from about 0.093 to about 0.139, and the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-4) is from about 3.83 to about 5.74.

[0219] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-2) is from about 2.07 to about 2.53, and the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-3) is from about 0.105 to about 0.128, and the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-4) is from about 4.31 to about 5.26.

[0220] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-2) is from about 2.16 to about 2.43, and the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-3) is from about 0.109 to about 0.123, and the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-4) is from about 4.50 to about 5.07.

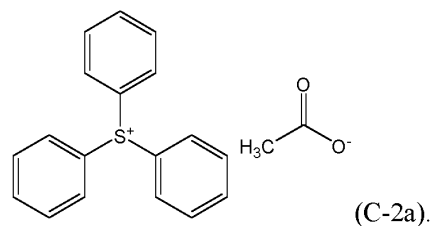
[0221] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-2) is from about 2.20 to about 2.39, and the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-3) is from about 0.111 to about 0.121, and the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-4) is from about 4.60 to about 4.98.

[0222] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-2) is from about 2.25 to about 2.34, and the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-3) is from about 0.114 to about 0.119, and the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-4) is from about 4.69 to about 4.88.

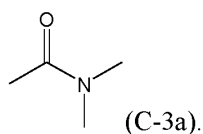
[0223] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-2) is from about 2.27 to about 2.30, and the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-3) is from about 0.115 to about 0.126, and the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-4) is from about 4.73 to about 4.79.

[0224] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-2) is about 2.29, and the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-3) is about 0.116, and the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-4) is about 4.78.

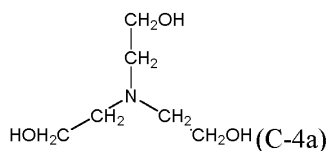
[0225] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), as described above, said acid quencher of structure (C-2) is one where Rac_1 is H and Rac_2 and Rac_3 are both a C-1 to C-12 alkyl. In another embodiment is one where Rac_1 is H and Rac_2 and Rac_3 are both a C-1 to C-12 alkoxy. In another embodiment at least one of Rac_1 , Rac_2 are H and Rac_3 is a C-1 to C-12 alkyl. In another embodiment at least one of Rac_1 , Rac_2 are H and Rac_3 is a C-1 to C-12 alkoxy. In another embodiment Rac_1 , Rac_2 and Rac_3 are a C-1 to C-12 alkyl. In another embodiment Rac_1 , Rac_2 and Rac_3 are a C-1 to C-12 alkoxy. In another embodiment Rac_1 , Rac_2 and Rac_3 are H. In another embodiment Rq_4 is n-butyl. In another embodiment Rq_4 is tert-butyl. In another embodiment Rq_4 is n-propyl. In another embodiment Rq_4 is isopropyl. In another embodiment Rq_4 is ethyl. In another embodiment Rq_4 is methyl. In another embodiment the acid quencher of structure (C-2) more specifically has structure (C-2a).



[0226] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), said acid quencher of structure (C-3) has structure (C-3a),

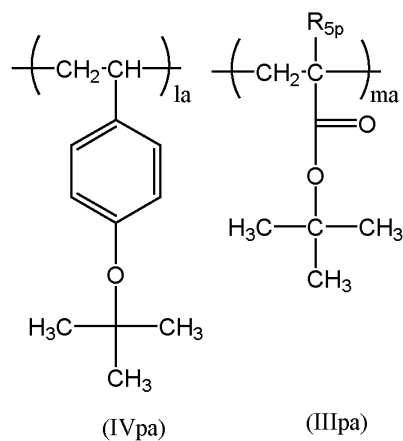


[0227] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), said acid quencher of structure (C-4) has structure (C4a),



[0228] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), this polymer has an Mw of about 18,815 to about 63,659 and a polydispersity of 1.0 to about 2.5.

[0229] In another embodiment of said composition, comprising Component B, the polymer of structure (B-2), is one where said repeat unit of structure (IVp) has structure (IVpa) and said repeat unit of structure (IIIp) has structure (IIIpa),



[0230] In another aspect of the above described composition wherein said Component B is said above described resin comprising repeat units derived from 4-hydroxystyrene this component comprises two different polymers of structures (B-3) and (B-4), where R_{10p} , R_{9p} are individually selected from a C-1 to C-4 alkyl, kb, lb are the number of repeat units for polymer (B-4) and kba and lba are the number of repeat units for polymer (B-4). In one aspect of this embodiment, the mole % of the repeat unit of structure (Vp) in the polymer of structure (B-3) and (B-4) are different, where the mole % the repeat unit of structure (Vp) in the polymer of structure (B-3) ranges from about 35 mole % to about 45 mole %, and the mole % of the repeat unit of structure (Vp) in the polymer structure (B-4) is from about 20 mole % to about 35 mole % and that total mole % of repeat units of structure (Vp) in both polymers of structure (B-3) and (B-4), ranges from about 30 mole % to about 40 mole %. In one aspect of this embodiment said composition comprises as Component C at least one amine an acid quencher.

Detailed Description: Composition 3

[0231] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4).

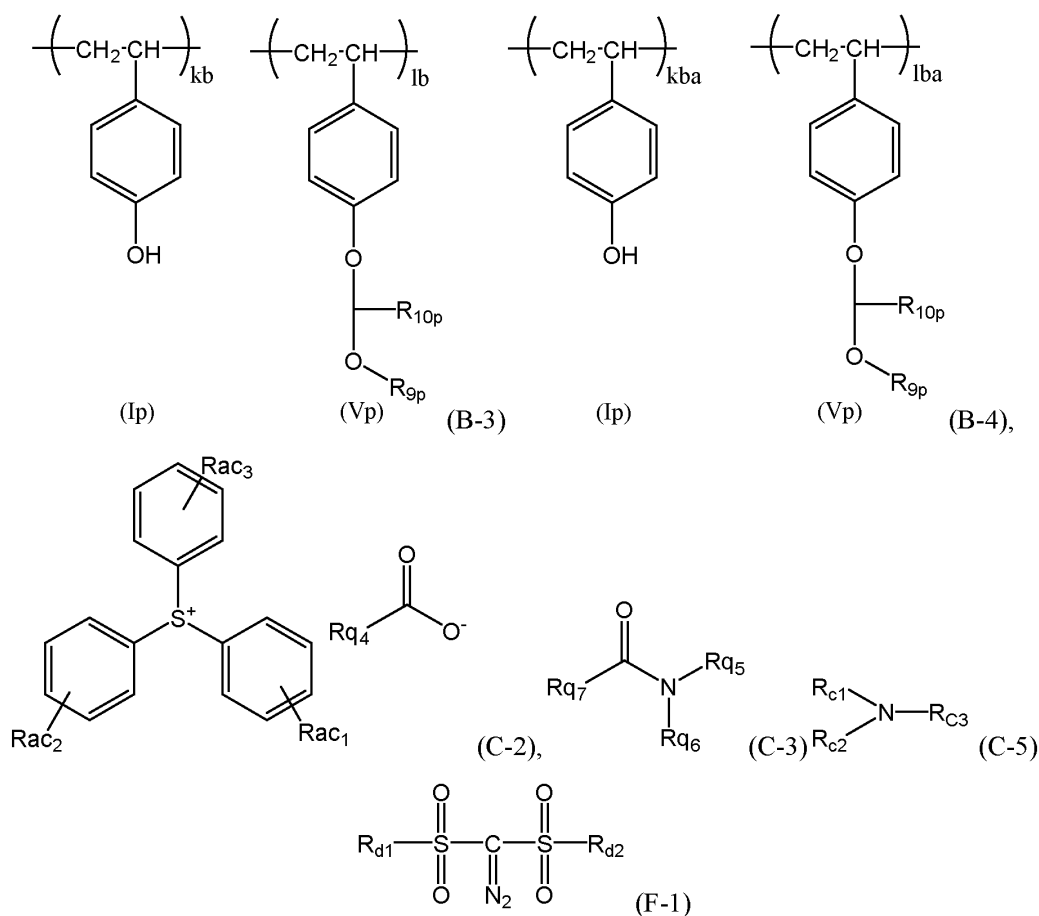
[0232] In another aspect of this embodiment, it further comprises as Component C an amine. In one aspect of this embodiment, it comprises an additional PAG of structure (F-1), where R_{d1} and R_{d2} are individually selected from a C-5 to C-8 alicyclic alkyl.

[0233] In another aspect of this composition said amine has structure (C-5), where R_{c3} is a C-1 to C-4 alkyl and R_{c1} and R_{c2} are independently selected from a C-5 to C-8 cyclic alkyl.

[0234] In another aspect of this composition, Component C said acid quencher further comprises at least one triarylsulfonium carboxylate. In one aspect of this embodiment said triarylsulfonium carboxylate has structure (C-2), where R_{q4} is a C-1 to C-4 alkyl, and R_{ac1} , R_{ac2} and R_{ac3} are independently selected from H, a C-1 to C-12 alkyl and a C-1 to C-12 alkoxy.

[0235] In another aspect of this composition, Component C, said acid quencher further comprises an amide. In one aspect of this embodiment said amide has structure (C-3), where R_{q5} , R_{q6} , R_{q7} are independently a C-1 to C-4 alkyl.

[0236] In another aspect of this composition, Component C, said acid quencher is a mixture of an amine, a triarylsulfonium carboxylate, and an amide. In one aspect of this embodiment these respectively have structures (C-5), (C-2) and (C-3)



[0237] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), said total mole % of repeat units of structure (Vp) in both polymers of structure (B-3) and (B-4), independently, range from about 28.1 mole % to about 42.12 mole %.

[0238] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), said total mole % of repeat units of structure (Vp) in both polymers of structure (B-3) and (B-4), independently, range from about 31.6 mole % to about 38.6 mole %.

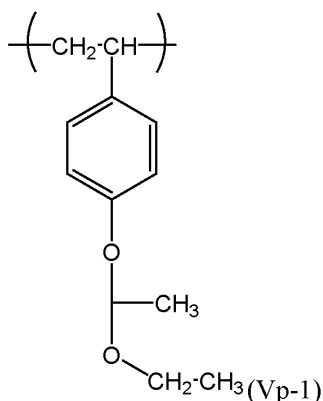
[0239] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), said total mole % of repeat units of structure (Vp) in both polymers of structure (B-3) and (B-4), independently, range from about 33.0 mole % to about 37.2 mole %.

[0240] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), said total mole % of repeat units of structure (Vp) in both polymers of structure (B-3) and (B-4), independently, range from about 33.7 mole % to about 36.5 mole %.

[0241] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), said total mole % of repeat units of structure (Vp) in both polymers of structure (B-3) and (B-4), independently, range from about 34.4 mole % to about 35.8 mole %.

[0242] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), said total mole % of repeat units of structure (Vp) in both polymers of structure (B-3) and (B-4), independently, range from about 34.7 mole % to about 35.5 mole %.

[0243] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), said repeat units of structure (Vp), respectively having number of repeat unit lb and lba in polymers of structures (B-3) and (B-4) have structure (Vp-1)



[0244] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), said polymer of structure (B-3) and (B-4) have an M_w which independently range from about 24,544 to about 16,363 and a polydispersity which independently range from 1 to about 1.35.

[0245] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of component A, said aryl sulfate aryl onium salt PAG to said component F, said PAG of structure (F-1) ranges from about 0.0260 to

about 0.0389.

[0246] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of component A, said aryl sulfate aryl onium salt PAG to said component F, said PAG of structure (F-1) ranges from about 0.0291 to about 0.0357.

[0247] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of component A, said aryl sulfate aryl onium salt PAG to said component F, said PAG of structure (F-1) ranges from about 0.0305 to about 0.0344.

[0248] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of component A, said aryl sulfate aryl onium salt PAG to said component F, said PAG of structure (F-1) ranges from about 0.0311 to about 0.0337.

[0249] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of component A, said aryl sulfate aryl onium salt PAG to said component F, said PAG of structure (F-1) ranges from about 0.0318 to about 0.0331.

[0250] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of component A, said aryl sulfate aryl onium salt PAG to said component F, said PAG of structure (F-1) ranges from about 0.0321 to about 0.0328.

[0251] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component A, said aryl sulfate aryl onium salt PAG ranges from about 398 to about 597.

[0252] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component A, said aryl sulfate aryl onium salt PAG ranges from about 448 to about 547.

[0253] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of repeat units of structure (Vp)

to the mole % of said component A, said aryl sulfate aryl onium salt PAG ranges from about 468 to about 528.

[0254] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component A, said aryl sulfate aryl onium salt PAG from about 478 to about 518.

[0255] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component A, said aryl sulfate aryl onium salt PAG is from about 488 to about 508.

[0256] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component A, said aryl sulfate aryl onium salt PAG is from about 493 to about 503.

[0257] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component F, said PAG of structure (F-1) is from about 12.9 to about 19.4.

[0258] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component F, said PAG of structure (F-1) is from about 14.5 to about 17.8.

[0259] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component F, said PAG of structure (F-1) is from about 15.2 to about 17.1.

[0260] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component F, said PAG of structure (F-1) is from about 15.5 to about 16.8.

[0261] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component F, said PAG of structure (F-1) is from about 15.8 to about 16.5.

[0262] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the moles of repeat units of structure (Vp)

to the mole % of said component F, said PAG of structure (F-1) is from about 16.0 to about 16.3.

[0263] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-2) is from about 2.00 to about 1.34, preferably to about 1.38.

[0264] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-2) is from about 1.84 to about 1.50.

[0265] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-2) is from about 1.77 to about 1.57.

[0266] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-2) is from about 1.74 to about 1.61.

[0267] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-2) is from about 1.71 to about 1.65.

[0268] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-2) is from about 1.69 to about 1.66.

[0269] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-3) is from about 0.00845 to about 0.012675.

[0270] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-3) is from about 0.00951 to about 0.01162.

[0271] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-3) is from about 0.00993 to about

0.03438.

[0272] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-3) is from about 0.03114 to about 0.03373.

[0273] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-3) is from about 0.03179 to about 0.03308.

[0274] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-3) is from about 0.03211 to about 0.0328.

[0275] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-5) is about 1.582 to about 2.373.

[0276] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-5) is about 1.779 to about 2.175.

[0277] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-5) is about 1.859 to about 2.096.

[0278] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-5) is about 1.898 to about 2.0567.

[0279] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-5) is about 1.938 to about 2.0171.

[0280] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-5) is about 1.958 to about 1.997.

[0281] . In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-2), is about 61.9 to about 41.2.

[0282] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-2), is about 56.7 to about 46.4.

[0283] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-2), is about 54.6 to about 48.5.

[0284] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-2), is about 53.6 to about 49.5.

[0285] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-2), is about 52.6 to about 50.5.

[0286] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-2), is about 52.1 to about 51.0.

[0287] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-3), is about 0.260 to about 0.391.

[0288] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-3), is about 0.293 to about 0.358.

[0289] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-3), is about 0.306 to about 0.345.

[0290] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-3), is about 0.313 to about 0.339.

[0291] In another embodiment of said composition, comprising Component B, a mixture of the

polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-3), is about 0.319 to about 0.332.

[0292] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-3), is about 0.322 to about 0.329.

[0293] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-5), is from about 19.28 to about 28.92.

[0294] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-5), is from about 21.69 to about 26.51.

[0295] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-5), is from about 22.65 to about 25.55.

[0296] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-5), is from about 23.14 to about 25.06.

[0297] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-5), is from about 23.62 to about 24.58.

[0298] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-5), is from about 23.62 to about 24.58.

[0299] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the sum of PAG of structure (F-1) and said aryl sulfate aryl onium salt PAG to the sum of moles of an acid quencher of structures (C-2), (C-3) and (C-5) is about 0.399 to about 0.266.

[0300] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the sum of PAG of structure (F-1) and said aryl sulfate aryl onium salt PAG to the sum of moles of an acid quencher of structures (C-2), (C-3) and (C-5) is about 0.366 to about 0.300.

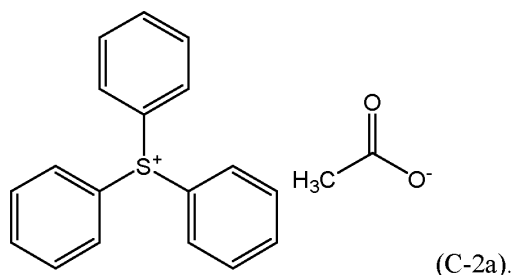
[0301] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the sum of PAG of structure (F-1) and said aryl sulfate aryl onium salt PAG to the sum of moles of an acid quencher of structures (C-2), (C-3) and (C-5) is about 0.352 to about 0.312.

[0302] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the sum of PAG of structure (F-1) and said aryl sulfate aryl onium salt PAG to the sum of moles of an acid quencher of structures (C-2), (C-3) and (C-5) is about 0.346 to about 0.319.

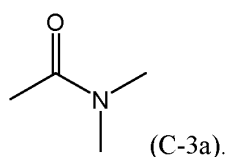
[0303] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the sum of PAG of structure (F-1) and said aryl sulfate aryl onium salt PAG to the sum of moles of an acid quencher of structures (C-2), (C-3) and (C-5) is about 0.338 to about 0.325 or about 0.339 to about 0.326.

[0304] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), the mole ratio of the sum of PAG of structure (F-1) and said aryl sulfate aryl onium salt PAG to the sum of moles of an acid quencher of structures (C-2), (C-3) and (C-5) is about 0.335 to about 0.329.

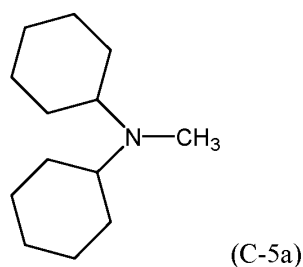
[0305] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), said acid quencher of structure (C-2) is one where R_{ac1} is H and R_{ac2} and R_{ac3} are both a C-1 to C-12 alkyl. In another embodiment is one where R_{ac1} is H and R_{ac2} and R_{ac3} are both a C-1 to C-12 alkoxy. In another embodiment at least one of R_{ac1} , R_{ac2} are H and R_{ac3} is a C-1 to C-12 alkyl. In another embodiment at least one of R_{ac1} , R_{ac2} are H and R_{ac3} is a C-1 to C-12 alkoxy. In another embodiment R_{ac1} , R_{ac2} and R_{ac3} are a C-1 to C-12 alkyl. In another embodiment R_{ac1} , R_{ac2} and R_{ac3} are a C-1 to C-12 alkoxy. In another embodiment R_{ac1} , R_{ac2} and R_{ac3} are H. In another embodiment R_{q4} is n-butyl. In another embodiment R_{q4} is tert-butyl. In another embodiment R_{q4} is n-propyl. In another embodiment R_{q4} is isopropyl. In another embodiment R_{q4} is ethyl. In another embodiment R_{q4} is methyl. In another embodiment said acid quencher of structure (C-2) more specifically has structure (C-2a).



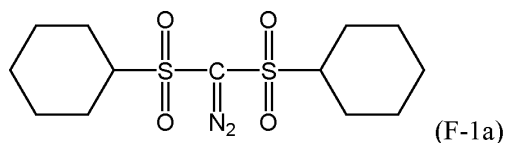
[0306] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), said acid quencher of structure (C-3) has structure (C-3a).



[0307] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), said acid quencher of structure (C-5) has structure (C-5a).



[0308] In another embodiment of said composition, comprising Component B, a mixture of the polymer of structures (B-3) and (B-4), said component F, said PAG of structure (F-1) has structure (F-1a).



Process of a Forming a Positive Image and Use Thereof of Inventive Compositions

[0309] Another aspect of this disclosed and claimed subject matter is the process of forming an image by exposure to radiation, comprising steps ia) to va) with any of the above described and claimed Chemically Amplified Photoresist composition. In this process different types of radiation

may be employed such as 248 nm, 193 nm or EUV.

ia) coating any one of the disclosed and claimed compositions, on a substrate, forming a coated film,

iiia) baking said coated film to form a baked film,

iiia) exposing regions of said baked film through a mask with radiation, forming exposed and unexposed regions,

iva) baking said radiation exposed film of step iiia),

va) developing away the unexposed regions of said radiation exposed and baked film of step iva) forming a positive image on said substrate.

[0310] Another aspect of this disclosed and claimed subject matter is the use of any one of the compositions described herein for coating a substrate, preferably in a photolithographic process.

EXAMPLES

Chemicals and Characterization

[0311] All chemicals unless otherwise indicated were purchased from Sigma-Aldrich, Inc. (3050 Spruce St., St. Louis, MO 63103).

[0312] P622 polymer is a copolymer of 4-hydroxystyrene, styrene and tert-butyl acrylate P(PHS/S/TBA) obtained commercially from TOHO Chemical industry, Japan. It's repeat unit composition is 59.4 mole % PHS, 19.1 mole % S and 21.5 mole % of TBA. It has an M_w of 13,284 and a polydispersity of 1.97.

[0313] C-55 polymer is a copolymer of hydroxystyrene, 4-tert-butoxystyrene, and tert-butyl acrylate, P(PHS/PTBST/TBA) from Gun Ei Chemical Industry Ltd in Japan. It has the following composition: 66.0 mole % PHS, 22 mole % PTBST and 12 mole % of TBA. It has an M_w of 30,759 and a polydispersity of 1.97.

[0314] Poly[p-(1-ethoxyethoxy)styrene-co-p-hydroxy styrene] P(EES/PHS) is a blend of two different commercially available as 30 % solutions in PGMEA available commercially under the name MWP-240HW and MWP-240LW, from Wako Chemical (Japan) where MWP-240HW has a composition of 41.6 mole % p-(1-ethoxyethoxy)styrene (EES) an M_w of 20,707 and polydispersity of 1.14 and MWP-240LW has a composition of 29.8 mole % EES, an M_w of 20,201 and polydispersity of 1.11 and are blended to give a average composition of 35.1 mole % EES, an average M_w of 20,413 and polydispersity of 1.125.

[0315] All synthetic experiments were carried out under N_2 atmosphere. Lithographic experiments

were carried out as described in the text.

[0316] A Canon KrF stepper FPA-3000 EX5 was used to expose the resist films of the examples which was provided at 0.48 numerical aperture. The resist pattern profile cross sections were examined by means of scanning electron microscopy. A Hitachi S-4700 SEM (FIG. 1 to 6) or Hitachi SU8230 SEM (FIG. 7), were used to evaluate resist profiles.

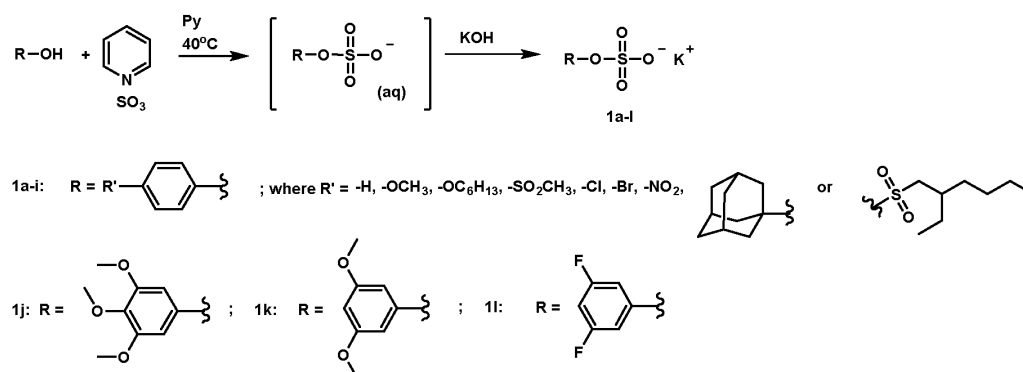
[0317] ^1H NMR (400 MHz) spectra were obtained at room temperature on a Bruker spectrometer, using deuterated chloroform as a solvent, and calibrated at 7.26 ppm or deuterated dimethyl sulfoxide as a solvent and calibrated at 2.50 ppm.

[0318] The molecular weight of polymers was measured with a Gel Permeation Chromatograph. Gel permeation chromatography equipped with 100 Å, 500 Å, 10^3 Å, 10^5 Å and 10^6 Å μ -ultrastyrigel columns using polystyrene standards.

[0319] Lithographic Experiments were done using a TEL Mark 8.

General synthetic procedure for the preparation of potassium phenyl sulfate derivatives

[0320]



Scheme 1

[0321] *Synthesis of potassium phenyl sulfate (1a).* The synthesis of **1b-h** follows the general procedure described herein for **1a**: In a 250-mL round bottom flask equipped with magnetic stirring bar and reflux condenser, phenol (28.23 g; 0.3 mol) and sulfur trioxide pyridine complex pyridine (0.33 mol) were dispersed in anhydrous pyridine (150 mL) and the mixture was stirred at 45 °C overnight. The reaction was then allowed to cool down to ambient temperature and transferred to a flask containing an aqueous solution of potassium hydroxide (270 mL; 5 mol/L). To this mixture, 300 mL iso-propanol was added to induce crystallization. The whitish precipitate was collected by filtration and recrystallized from a mixture of ethanol:water, 3:1 (v:v) to give white crystals of

potassium phenyl sulfate (30.5 g; yield 47.9%). ¹H NMR (DMSO-d₆): 7.28-7.25 (2H, t); 7.17-7.15 (2H, d); 7.05-7.02 (1H, t).

[0322] *Potassium 4-methoxyphenyl sulfate (1b)*. recrystallization from a mixture ethanol:water, 4:1 (v:v), white crystals, yield 61%. ¹H NMR (DMSO-d₆): 7.07-7.04 (2H, d); 6.82-6.81 (2H, d); 3.70 (3H, s).

[0323] *Potassium 4-hexyloxyphenyl sulfate (1c)*. recrystallization from a mixture ethanol:water, 4:1 (v:v), white crystals, yield 53%. ¹H NMR (DMSO-d₆): 7.05-7.02 (2H, d); 6.81-6.79 (2H, d); 3.91-3.88 (2H, t); 1.71-1.65 (2H, m); 1.42-1.37 (2H, m); 1.32-1.28 (4H, s); 0.89-0.85 (3H, t).

[0324] *Potassium 4-methylsulfonylphenyl sulfate (1d)*. recrystallization from a mixture ethanol:water, 4:1 (v:v), white crystals, yield 55.1%. ¹H NMR (DMSO-d₆): 7.85-7.82 (2H, d); 7.41-7.38 (2H, d); 3.16 (3H, s).

[0325] *Potassium 4-chlorophenyl sulfate (1e)*. recrystallization from a mixture ethanol:water, 4:1 (v:v), white crystals, yield 58.4%. ¹H NMR (DMSO-d₆): 7.32-7.30 (2H, d); 7.19-7.17 (2H, d).

[0326] *Potassium 4-bromophenyl sulfate (1f)*. recrystallization from a mixture ethanol:water, 4:1 (v:v), white crystals, yield 54.3%. ¹H NMR (DMSO-d₆): 7.45-7.42 (2H, d); 7.14-7.12 (2H, d).

[0327] *Potassium 4-nitrophenyl sulfate (1g)*. recrystallization from a mixture ethanol:water, 4:1 (v:v), slight yellow crystals, yield 59.8%. ¹H NMR (DMSO-d₆): 8.20-8.19 (2H, d); 7.40-7.38 (2H, d).

[0328] *Potassium 4-(adamantan-1-yl)phenyl sulfate (1h)*. recrystallization from a mixture ethanol:water, 4:1 (v:v), white crystals, yield 52%. ¹H NMR (DMSO-d₆): 7.24-7.22 (2H, d); 7.08-7.07 (2H, d); 2.05-2.03 (3H, m); 1.84-1.83 (6H, m); 1.75-1.70 (6H, m).

[0329] *Potassium 4-((2-ethylhexyl)sulfonyl)phenyl sulfate (1i)*. recrystallization from a mixture ethanol:water, 4:1 (v:v), white crystals, yield 51%. ¹H NMR (DMSO-d₆): 7.82-7.80 (2H, d); 7.40-7.38 (2H, d); 3.17-3.09 (2H, m); 1.75-1.70 (1, m); 1.39-1.24 (4H, m); 1.20-1.1 (4H, m); 0.83-0.80 (3H, t); 0.76-0.73 (3H, t).

[0330] *Potassium 3,4,5-trimethoxyphenyl sulfate (1j)*. recrystallization from a mixture ethanol:water, 1:1 (v:v), white crystals, yield 91%. ¹H NMR (DMSO-d₆): 6.51 (2H, s); 3.72 (6H, s); 3.61 (3H, s).

[0331] *Potassium 3,5-dimethoxyphenyl sulfate (1k)*. recrystallization from a mixture ethanol:water, 3:2 (v:v), white crystals, yield 89%. ¹H NMR (DMSO-d₆): 6.37 (2H, s); 6.19 (1H, s); 3.68 (6H, s).

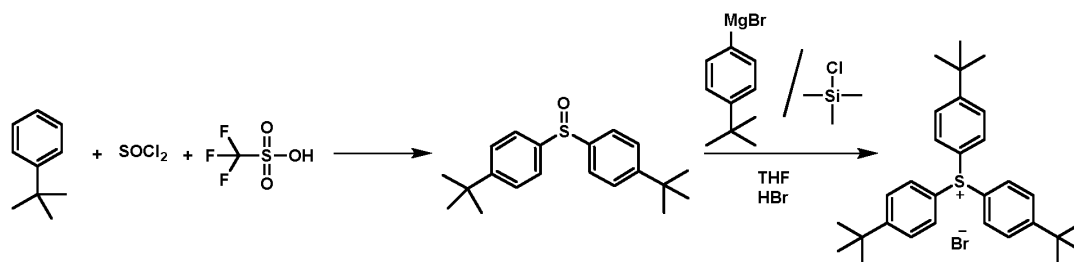
[0332] *Potassium 3,5-difluorophenyl sulfate (1l)*. recrystallization from a mixture ethanol:water,

4:3 (v:v), white crystals, yield 88%. ^1H NMR (DMSO- d_6): 6.92-6.86 (3H, m).

[0333]

Synthesis of tris(4-*tert*-butylphenyl)sulfonium bromide (2)

[0334]



Scheme 2

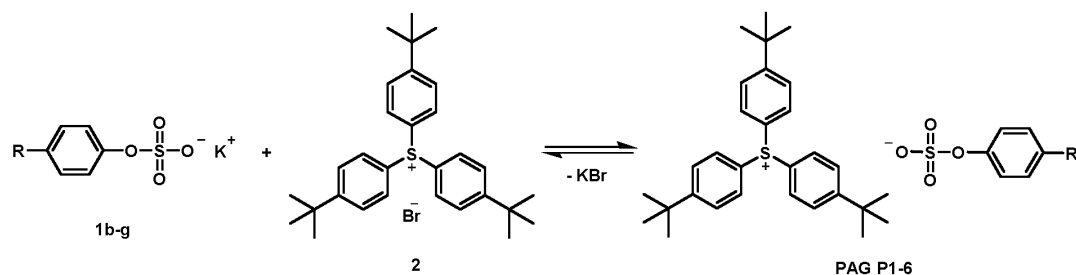
[0335] *Bis(4-tert-butylphenyl)sulfoxide*. To thionyl chloride (25 mL; 0.34 mol) was added *tert*-butylbenzene (206 mL; 1.326 mol) in a 500 mL Schlenk flask under argon. The flask was then cooled to 0 °C and trifluoromethane sulfonic acid (130mL; 1.462 mol) was added dropwise. HCl is generated and vented through the stop cock of the Schlenk flask. After 1 hour, the reaction was allowed to warm up to room temperature and the stirring continued for another hour. The reaction mixture was quenched by pouring into ice and neutralized with NaHCO_3 . The sulfoxide formed was further extracted with dichloromethane, the organic phase was washed with additional water, separated, dried over sodium sulfate, filtered over Celite, and evaporated under high vacuum to afford a white solid. The solid was dispersed in heptane, to remove the excess of *tert*-butylbenzene, filtered off and further recrystallized from methanol to afford white crystals (85 g; yield 79.5%). ^1H NMR (CDCl_3): 7.57-7.55 (4H, d); 7.48-7.46 (4H, d); 1.32 (18H, s).

[0336] *Tris(4-tert-butylphenyl)sulfonium bromide (2)*. Magnesium turnings (11.78 g; 0.485 mol) were dispersed in anhydrous tetrahydrofuran (35 mL) in an oven-dry flask equipped with a magnetic stirring bar, reflux condenser, and addition funnel. Iodine (several crystals) was added, and the mixture stirred for several minutes (until the color dissipated). A solution of 1-bromo-4-*tert*-butylbenzene (86.7 mL; 0.5 mol) in anhydrous tetrahydrofuran (150 mL) was added dropwise and the mixture gently heated to 67 °C to initiate the reaction. After the completion of addition, the dark brown mixture obtained was further stirred for additional 3 hours, maintaining a gentle reflux. Afterwards, the reaction mixture was cooled down to room temperature. To the cooled solution of the Grignard reagent mixture, a solution of bis(4-*tert*-butylphenyl)sulfoxide (31.45 g; 0.1 mol) in

anhydrous tetrahydrofuran (250 mL) was added. The mixture was cooled down with an ice bath and then chlorotrimethylsilane (64 mL; 0.5 mol) was added dropwise. After being stirred for 30 min, the reaction was allowed to reach room temperature and quenched by addition of an aqueous hydrobromic acid 47%. Dichloromethane was added to the mixture to extract the organics. The organic phase was further washed with brine, dried over anhydrous sodium sulfate, and concentrated to dryness. Purification of the crude mixture by recrystallization from methanol afforded tris(4-*tert*-butylphenyl)sulfonium bromide as white crystals (49 g; yield 95.8%). ¹H NMR (CDCl₃): 7.79-7.76 (6H, d); 7.67-7.65 (6H, d); 1.32 (27 H, s).

General synthetic procedure for the preparation of PAG P1-6 with tris(4-*tert*-butylphenyl)sulfonium as cation

[0337]



R = -OCH₃, -OC₆H₁₃, -SO₂CH₃, -Cl, -Br, -NO₂

Scheme 3

[0338] *Synthesis of tris(4-tert-butylphenyl)sulfonium 4-methoxyphenyl sulfate (PAG P1).* The synthesis of **PAG P2-6** follows the general procedure described herein for **PAG P1**: In a 250-mL round bottom flask equipped with magnetic stirring bar, potassium 4-methoxyphenyl sulfate (**1b**) (3.78 g; 15.6 mmol) was dispersed in dichloromethane (50 mL). To the suspension, a solution of tris(4-*tert*-butylphenyl)sulfonium bromide (**2**) (6.14 g; 12 mmol) in dichloromethane (100 mL) was added. To the reaction mixture, water was added until no more solid could be observed. The slightly turbid solution was further stirred under light protection for additional 3 hours. The organic phase was washed with water, separated, dried over sodium sulfate, and concentrated under vacuum. The obtained residue was further purified with a CombiFlash instrument on silica gel using dichloromethane:methanol mixture, 95:5 (v:v) as eluent. White crystals of tris(4-*tert*-butylphenyl)sulfonium 4-methoxyphenyl sulfate (**PAG P1**) were obtained from methyl *tert*-butyl ketone (6.7 g; yield 88%). ¹H NMR (CDCl₃): 7.68-7.62 (12H, m); 7.33-7.32 (2H, d); 6.77-6.75 (2H,

d); 3.73 (3H, s); 1.32 (27 H, s).

[0339] *Tris(4-tert-butylphenyl)sulfonium 4-hexyloxyphenyl sulfate (PAG P2)*. purification silica gel eluting on dichloromethane:methanol, 95:5 (v:v), crystallization methyl *tert*-butyl ketone, white crystals, yield 87%. ¹H NMR (CDCl₃): 7.68-7.62 (12H, m); 7.31-7.29 (2H, d); 6.75-6.73 (2H, d); 3.87-3.85 (2H, t); 1.73-1.69 (2H, m); 1.44-1.40 (2H, m); 1.34-1.30 (31 H, m); 0.9-0.87 (3H, t).

[0340] *Tris(4-tert-butylphenyl)sulfonium 4-methylsulfonylphenyl sulfate (PAG P3)*. purification silica gel eluting on dichloromethane:methanol, 95:5 (v:v), crystallization methyl *tert*-butyl ketone, white crystals, yield 70%. ¹H NMR (CDCl₃): 7.81-7.79 (2H, d); 7.68-7.65 (6H, d); 7.62-7.60 (6H, d); 7.57-7.55 (2H, d); 2.99 (3H, s); 1.32 (27 H, s).

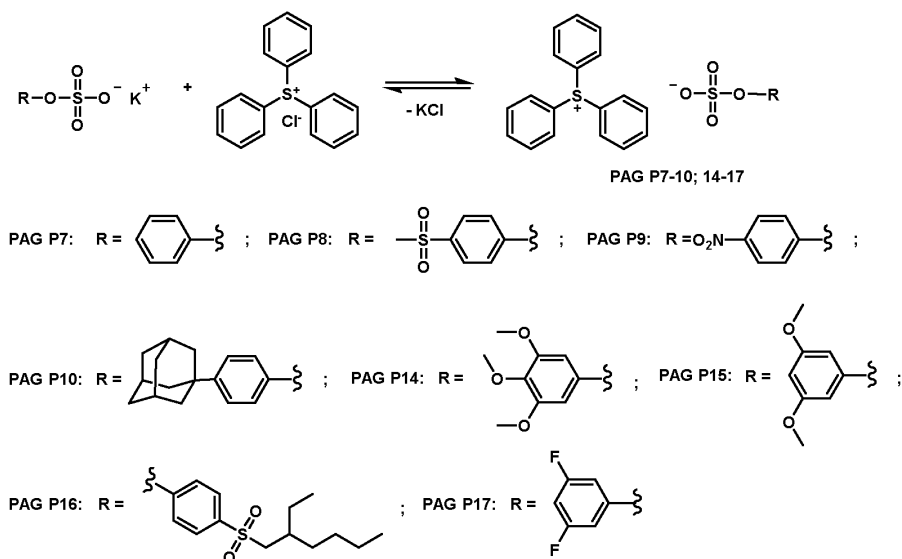
[0341] *Tris(4-tert-butylphenyl)sulfonium 4-chlorophenyl sulfate (PAG P4)*. purification silica gel eluting on dichloromethane:methanol, 95:5 (v:v), crystallization methyl *tert*-butyl ketone, white crystals, yield 71.4%. ¹H NMR (CDCl₃): 7.65 (12H, s); 7.34-7.33 (2H, d); 7.17-7.16 (2H, d); 1.32 (27 H, s).

[0342] *Tris(4-tert-butylphenyl)sulfonium 4-bromophenyl sulfate (PAG P5)*. purification silica gel eluting on dichloromethane:methanol, 95:5 (v:v), crystallization methyl *tert*-butyl ketone, white crystals, yield 71%. ¹H NMR (DMSO-d₆): 7.81-7.79 (4H, d); 7.75-7.73 (4H, d); 7.44-7.42 (2H, d); 7.13-7.11 (2H, d); 1.31 (27 H, s).

[0343] *Tris(4-tert-butylphenyl)sulfonium 4-nitrophenyl sulfate (PAG P6)*. purification silica gel eluting on dichloromethane:methanol, 95:5 (v:v), crystallization methyl *tert*-butyl ketone, light yellow crystals, yield 87%. ¹H NMR (CDCl₃): 8.12-8.10 (2H, d); 7.68-7.62 (12H, m); 7.50-7.48 (2H, d); 1.32 (27 H, s).

**General synthetic procedures for the preparation of PAG P7-10 with triphenyl sulfonium
TPS as cation**

[0344]



Scheme 4

Synthesis of triphenyl sulfonium phenyl sulfate (PAG P7).

[0345] The synthesis of **PAG P8-10** and **P14-17** follows the general procedure described herein for **PAG P7**: In a 250-mL round bottom flask equipped with magnetic stirring bar, potassium phenyl sulfate (**1a**) (4.26 g; 20 mmol) was dissolved in water (75 mL). To the clear solution, triphenyl sulfonium chloride (5 g; 17 mmol) in water (75 mL) was added and the reaction mixture was stirred under light protection for additional 3 hours. Ethyl acetate was added to the resulting suspension. The organic phase was thoroughly washed with water, separated, dried over sodium sulfate, and concentrated under vacuum. To the obtained residue, methyl *tert*-butyl ketone was added to induce crystallization. White crystals of triphenyl sulfonium phenyl sulfate (**PAG P7**) were collected by filtration and further dried under vacuum (6.7 g; yield 92%). ¹H NMR (DMSO-*d*₆): 7.88-7.85 (3H, m); 7.83-7.77 (12H, m); 7.27-7.24 (2H, t); 7.17-7.15 (2H, d); 7.04-7.01 (1H, t).

[0346] *Triphenyl sulfonium 4-methylsulfonylphenyl sulfate (PAG P8)*. crystallization from methyl *tert*-butyl ketone, white crystals, yield 87%. ¹H NMR (DMSO-*d*₆): 7.88-7.77 (17H, m); 7.41-7.38 (2H, d); 3.16 (3H, s).

[0347] *Triphenyl sulfonium 4-nitrophenyl sulfate (PAG P9)*. slight yellow thick viscous liquid,

yield 85%. ^1H NMR (DMSO- d_6): 8.20-8.17 (2H, d); 7.88-7.85 (3H, m); 7.83-7.77 (12H, m); 7.41-7.37 (2H, d).

[0348] *Triphenyl sulfonium 4-(adamantan-1-yl)phenyl sulfate (PAG P10)*. crystallization from methyl *tert*-butyl ketone, white crystals, yield 82%. ^1H NMR (DMSO- d_6): 7.88-7.85 (3H, m); 7.83-7.77 (12H, m); 7.24-7.22 (2H, d); 7.08-7.07 (2H, d); 2.05-2.03 (3H, m); 1.84-1.83 (6H, m); 1.73-1.71 (6H, m).

[0349] *Triphenyl sulfonium 3,4,5-trimethoxyphenyl sulfate (PAG P14)*. white solid, yield 88%. ^1H NMR (DMSO- d_6): 7.88-7.85 (3H, m); 7.83-7.77 (12H, m); 6.51 (2H, s); 3.70 (6H, s); 3.60 (3H, s).

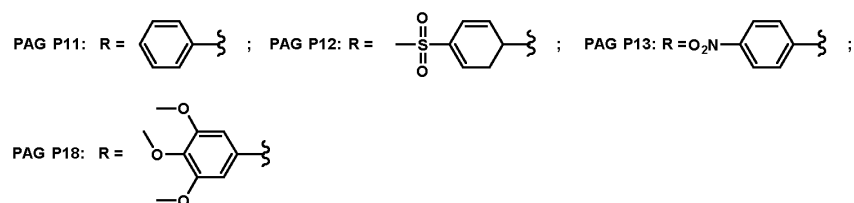
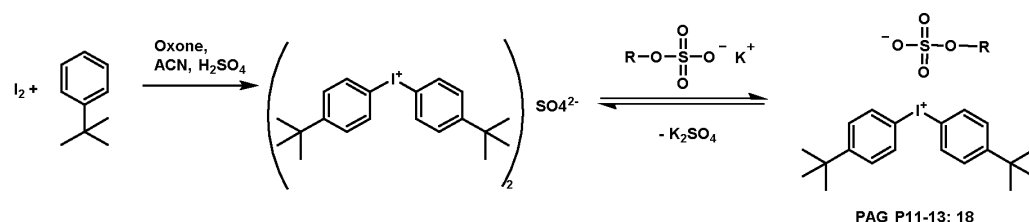
[0350] *Triphenyl sulfonium 3,5-dimethoxyphenyl sulfate (PAG P15)*. white solid, yield 87%. ^1H NMR (DMSO- d_6): 7.88-7.85 (3H, m); 7.83-7.77 (12H, m); 6.37 (2H, s); 6.19 (1H, s); 3.68 (3H, s).

[0351] *Triphenyl sulfonium 4-((2-ethylhexyl)sulfonyl)phenyl sulfate (PAG P16)*. colorless thick viscous liquid, yield 96. ^1H NMR (DMSO- d_6): 7.88-7.85 (3H, m); 7.83-7.77 (12H, m); 7.40-7.38 (2H, d); 3.17-3.09 (2H, m); 1.75-1.70 (1, m); 1.39-1.24 (4H, m); 1.20-1.1 (4H, m); 0.83-0.80 (3H, t); 0.76-0.73 (3H, t).

[0352] *Triphenyl sulfonium 3,5-difluorophenyl sulfate (PAG P17)*. white solid, yield 87%. ^1H NMR (DMSO- d_6): 7.88-7.85 (3H, m); 7.83-7.77 (12H, m); 6.90-6.86 (3H, m).

General synthetic procedure for the preparation of PAG P11-13 with di(4-*tert*-butylphenyl)iodonium DTBPIO as cation

[0353]



Scheme 5

Synthesis of di(4-*tert*-butylphenyl)iodonium phenyl sulfate (PAG P11).

[0354] The synthesis of PAG P12,13 follows the general procedure described herein for PAG P11: Oxone (12.3 g; 40 mmol) was added to the suspension of iodine (2.54 g; 10 mmol), of 4-*tert*-butylbenzene (6.8 mL; 44 mmol) in acetonitrile (40 mL). To the reaction mixture cooled on an ice bath, concentrated sulfuric acid (8 mL; 150 mmol) was added dropwise (exothermic reaction), and the reaction mixture was further stirred overnight at room temperature. The color went from reddish to light yellow. Under light protection, the obtained mixture containing di(4-*tert*-butylphenyl)iodonium sulfate was added to a solution of potassium phenyl sulfate (**1a**) (8.5 g; 40 mmol) in water (300 mL). Immediately, a fine precipitate was formed. Dichloromethane was added to the suspension and stirred for 2 hours. The organic phase was separated, dried over magnesium sulfate, filtered off over a Celite bed, and concentrated under vacuum. The thick brownish solid residue was taken with methyl *tert*-butyl ketone to induce crystallization. White crystals of di(4-*tert*-butylphenyl)iodonium phenyl sulfate (**PAG P11**) were (DMSO- d_6): 8.16-8.14 (4H, d); 7.84-7.83 (2H, d); 7.55-7.54 (4H, d); 7.41-7.39 (2H, d); 3.16 (collected by filtration and further dried under vacuum (7.2 g; yield 85%). ^1H NMR (DMSO- d_6): 8.17-8.15 (4H, d); 7.46-7.54 (4H, d); 7.27-7.24 (2H, t); 7.17-7.15 (2H, d); 7.04-7.01 (1H, t); 1.25 (18H, s).

Di(4-tert-butylphenyl)iodonium 4-methylsulfonylphenyl sulfate (PAG P12). crystallization from methyl *tert*-butyl ketone, white crystals, yield 84.5%. ^1H NMR 3H, t); 1.25 (18H, s).

[0355] *Di(4-tert-butylphenyl)iodonium 4-nitrophenyl sulfate (PAG P13)*. crystallization from methyl *tert*-butyl ketone, white crystals, yield 79.6%. ^1H NMR (DMSO- d_6): 8.21-8.18 (2H, d); 8.17-8.14 (4H, d); 7.56-7.53 (4H, d); 7.41-7.38 (2H, d); 1.25 (18H, s).

[0356] *Di(4-tert-butylphenyl)iodonium 3,4,5-trimethoxyphenyl sulfate (PAG P18)*. crystallization from methyl *tert*-butyl ketone, white crystals, yield 64%. ^1H NMR (DMSO- d_6): 8.16-8.14 (4H, d); 7.55-7.54 (4H, d); 6.50 (2H, s); 3.71 (6H, s); 3.60 (3H, s); 1.26 (18H, s).

Lithographic performance in P(PHS/S/TBA) resin. A comparison of formulations containing aryl sulfate based onium salt PAGs to those containing a PAGs which produce photoacid which contains perfluoroalkyl moieties.

[0357] FIG. 1 and FIG. 2 respectively show Tables 2A, and 2B which summarize the initial results of the first screening experiments for formulation to replace fluorinated alkyl containing PAGs with the non perfluoroalkyl containing PAGs which are onium salts of an aryl hydrogen sulfate when using a P(PHS/S/TBA) resin where the molar ratio of PAG to acid quencher has not been optimized for the performance of the aryl onium aryl sulfate PAGs.

[0358] FIG. 3 and FIG. 4 respectively show Tables 3A and 3B which summarize the results of the second screening experiments for formulation to replace fluorinated alkyl containing PAGs with the perfluoroalkyl PAGs which are onium salts of an aryl hydrogen sulfate when using a P(PHS/S/TBA) resin where the molar ratio of PAG to acid quencher has been optimized for the performance of the aryl onium aryl sulfate PAGs. This has resulted in an improvement of the sensitivity approach that of the PFAS PAG mixture, approaching that of this mixture and maintaining the resolution and lithographic performance of the comparative formulation containing the mixture of PFAS iodonium salts. Because the PFAS mixture using in the comparative examples was based on a mixture of iodonium salts, while the novel aryl sulfates PAG formulation were based on sulfonium chromophores that may have a lower quantum yield in the P(PHS/S/TBA) resin a third screening was done employing PAGs based on iodonium salts of aryl sulfates.

[0359] FIG. 5 and FIG. 6 respectively show Tables 4A and 4B which summarize the results of the third screening experiments for formulation to replace perfluorinated containing PAGs with the non perfluoroalkyl containing aryl sulfate PAGs when using a P(PHS/S/TBA) in which the optimized PAG to acid quencher molar ratio was maintained and the novel formulations containing aryl sulfate PAGs based on iodonium salts. These novel formulations unexpectedly have in many instances better lithographic sensitivity or at the least maintain the similar lithographic sensitivity and lithographic resolution performance. Additionally, another unexpected result is that a single iodonium salt PAG based on an aryl sulfate can replace in these formulations a more complex mixture of two different PFAS containing PAGs which simultaneously solved the problem of PFAS content and accomplished this with a simpler formulation.

FIG. 7 shows Table 5 which summarizes the results of an initial screening using the P(PHS/PTBST/TBA) resin comparing a formulation containing TPS-Nona (Comparative Example 4) to PAG P7 which is triphenylsulfonium phenyl sulfate (Example 20). These initial results without optimization of the quencher additives unexpectedly show that the formulation containing PAG P7 already has a resolution approaching that of the formulation containing TPS-Nona.

[0360] FIG. 8 and FIG. 9 respectively show Tables 6A and 6B which summarize the results of the screening experiments using the in P(EPP/PHS) resin in which Comparative Example 5 containing triphenylsulfonium triflate has this PFAS containing PAG replaced in different formulations with either PAG P1, PAG P2, PAG P3, PAG P4, PAG P5 or PAG P6. The lithographic results using these aryl sulfate based onium salt PAG show that these impart similar sensitivity, resolution,

defocus latitude and exposure latitude to that obtained with Comparative Example 5 containing triphenyl sulfonium triflate.

[0361] FIG. 10 shows Table 7 which summarizes the results of dose-to print values using the P(PHS/S/TBA) resin.

[0362] The above screening with a range of different chemically amplified resins containing either high activation acid cleavable group [tert-butyl esters and ethers): P(PHS/S/TBA) & P(HS/PTBST/TBA)] or low activation energy acid cleavable groups [acetal: P(EPP/PHS)] show that that onium salt PAGs based on the non-PFAS aryl sulfates can be used to replace currently used onium salt PAGs containing PFAS moieties solving the problem of the presence of undesirable PFAS materials.

Comparative Photoresist Example 1

[0363] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.050 parts of bis(4-(*tert*-butyl)phenyl)iodonium nanoflate (Garo In-K MP Gokyo Food & Chemical, Japan),, 0.600 parts of bis(4-(*tert*-butyl)phenyl)iodonium bis((perfluorobutyl)sulfonyl)amide (ZK-0518 MP Gokyo Food & Chemical, Japan) as a photo acid generator, 0.276 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 µm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer to give 1µm trench pattern at 190 mJ/cm².

Photoresist Example 1

[0364] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.338 parts of PAG P1 as a photo acid generator, 0.276 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140°C for 90 seconds to form a photosensitive layer with 8.5 µm film

thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. 1 μm trench pattern was not opened under 350 mJ/cm².

Photoresist Example 2

[0365] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.487 parts of PAG P2 as a photo acid generator, 0.276 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 μm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. 1 μm trench pattern was not opened under 350 mJ/cm².

Photoresist Example 3

[0366] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.440 parts of PAG P3 as a photo acid generator, 0.276 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 μm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. 1 μm trench pattern was not opened under 350 mJ/cm².

Photoresist Example 4

[0367] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.347

parts of PAG P4 as a photo acid generator, 0.276 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 µm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. 1 µm trench pattern was not opened under 350 mJ/cm².

Photoresist Example 5

[0368] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.442 parts of PAG P5 as a photo acid generator, 0.276 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 µm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. 1 µm trench pattern was not opened under 350 mJ/cm².

Photoresist Example 6

[0369] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.365 parts of PAG P6 as a photo acid generator, 0.276 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 µm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure,

the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. 1 µm trench pattern was not opened under 350 mJ/cm².

Comparative Photoresist Example 2

[0370] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.335 parts of Garo In-K and 0.600 parts of ZK-0518 as photo acid generators, 0.276 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 µm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. The photosensitive layer had a trench pattern of 1 µm, a sensitivity of 168 mJ/cm² and showed fine pattern profile.

Photoresist Example 7

[0371] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.335 parts of PAG P1 as a photo acid generator, 0.070 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 µm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. The photosensitive layer had a trench pattern of 1 µm, a sensitivity of 194 mJ/cm² and showed fine pattern profile.

Photoresist Example 8

[0372] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.484 parts of PAG P2 as a photo acid generator, 0.070 parts of TMEEA as an acid quencher, 0.15 parts

of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 µm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. The photosensitive layer had a trench pattern of 1 µm, a sensitivity of 186 mJ/cm² and showed fine pattern profile.

Photoresist Example 9

[0373] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.437 parts of PAG P3 as a photo acid generator, 0.070 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 µm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. The photosensitive layer had a trench pattern of 1 µm, a sensitivity of 191 mJ/cm² and showed fine pattern profile.

Photoresist Example 10

[0374] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.344 parts of PAG P4 as a photo acid generator, 0.070 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 µm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH

and then rinsed with water to obtain a positive-type pattern on the silicon wafer. The photosensitive layer had a trench pattern of 1 μm , a sensitivity of 180 mJ/cm^2 and showed fine pattern profile.

Photoresist Example 11

[0375] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.439 parts of PAG P5 as a photo acid generator, 0.070 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 μm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. The photosensitive layer had a trench pattern of 1 μm , a sensitivity of 181 mJ/cm^2 and showed fine pattern profile.

Photoresist Example 12

[0376] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.362 parts of PAG P6 as a photo acid generator, 0.070 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 μm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. The photosensitive layer had a trench pattern of 1 μm , a sensitivity of 267 mJ/cm^2 and showed fine pattern profile.

Comparative Photoresist Example 3

[0377] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.335 parts of Garo In-K and 0.600 parts of ZK-0518 as photo acid generators, 0.276 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL

ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 µm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive type-pattern on the silicon wafer. The photosensitive layer had a trench pattern of 1µm, a sensitivity of 168 mJ/cm² and showed fine pattern profile.

Photoresist Example 13

[0378] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 0.916 parts of PAG P7 as a photo acid generator, 0.070 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 µm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. The photosensitive layer had a trench pattern of 1µm, a sensitivity of 115 mJ/cm² and showed fine pattern profile.

Photoresist Example 14

[0379] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.083 parts of PAG P8 as a photo acid generator, 0.070 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 µm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. The photosensitive

layer had a trench pattern of 1 μm , a sensitivity of 111 mJ/cm^2 and showed fine pattern profile.

Photoresist Example 15

[0380] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.012 parts of PAG P9 as a photo acid generator, 0.070 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 μm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. The photosensitive layer had a trench pattern of 1 μm , a sensitivity of 155 mJ/cm^2 and showed fine pattern profile.

Photoresist Example 16

[0381] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.203 parts of PAG P10 as a photo acid generator, 0.070 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 μm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. The photosensitive layer had a trench pattern of 1 μm , a sensitivity of 110 mJ/cm^2 and showed fine pattern profile.

Photoresist Example 17

[0382] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.123 parts of PAG P14 as a photo acid generator, 0.070 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon

wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 µm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. The photosensitive layer had a trench pattern of 1 µm, a sensitivity of 113 mJ/cm² and showed fine pattern profile.

[0383]

Photoresist Example 18

[0384] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.200 parts of PAG P11 as a photo acid generator, 0.070 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 µm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. The photosensitive layer had a trench pattern of 1 µm, a sensitivity of 79 mJ/cm² and showed fine pattern profile.

Photoresist Example 19

[0385] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.368 parts of PAG P12 as a photo acid generator, 0.070 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 µm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. The photosensitive

layer had a trench pattern of 1 μm , a sensitivity of 44 mJ/cm^2 and showed fine pattern profile.

Photoresist Example 20

[0386] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 1.297 parts of PAG P13 as a photo acid generator, 0.070 parts of TMEEA as an acid quencher, 0.15 parts of R-2011 as a surfactant, propylene glycol monomethyl ether (PGME) and ethyl lactate (EL) as a solvent. Solid content of the resist solution was 33.0% and PGME/EL ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 8.5 μm film thickness. The photosensitive layer was exposed through a mask by irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5, NA=0.55, Sigma=0.80). After exposure, the photosensitive layer was post baked at 110 °C for 80 seconds, developed with 2.38% TMAH and then rinsed with water to obtain a positive-type pattern on the silicon wafer. The photosensitive layer had a trench pattern of 1 μm , a sensitivity of 82 mJ/cm^2 and showed fine pattern profile.

Lithographic performance in P(PHS/PTBST/TBA) resin. A comparison of formulations containing an aryl sulfate based onium salt PAGs to those containing a PAGs which produce photoacids which contain perfluoroalkyl moieties

[0387] FIG. 7 shows Table 4 which summarizes the results of lithographic experiments done with P(PHS/PTBST/TBA) resin comparing aryl sulfate based onium salt to PAGs which photorelease perfluoroalkyl containing super acids.

Comparative Photoresist Example 4

[0388] A resist solution was prepared by using 12.06 g of C-55 (Gun Ei Chemical Industry Ltd) P(PHS/PTBST/TBA) polymer, 0.34 g of triphenyl sulfonium nonaflate (Toyo Gosei Co Ltd, TPS-Nona), 0.02 g of TEOLA (Wako Chemicals), 0.09 g of TPSA (Takamoto Oil and Fats), 0.48 g of DMAC, 0.005 g of MegafacTM (DIC Color & Comfort) in 61 g of PGMEA and 26.1 g of PGME. The above-described resist solution was spin-coated on a substrate for semiconductor and baked on a direct hot plate at 120°C for 90 seconds to form a 0.40 μm thick resist coating. This resist coating was selectively exposed through a mask using 248 nm KrF excimer laser light, post baked on a direct hot plate at 130°C for 90 seconds, then paddle-developed for 60 seconds in an alkaline developer solution (a 2.38 wt % aqueous solution of TMAH) to obtain a positive, line-and-space pattern on the silicon wafer. Observation of line width and cross-sectional profile of the positive pattern under a scanning type electronic microscope revealed that it was a pattern of 0.18 μm or

less with good pattern profile at an exposure amount of 49 mJ/cm².

Photoresist Example 21

[0389] A resist solution was prepared by using 12.13 g of P622 polymer (P(PHS/PTBST/TBA)), 0.28 g of triphenyl sulfonium phenyl sulfate (PAG P7), 0.02 g of Triethanolamine (TEOLA), 0.09 g of triphenyl sulfonium Acetate (TPSA), 0.48 g of Dimethyl acetamide (DMAC), 0.005 g of Megafac (Surfactant made by DIC) in 61 g of PGMEA and 26.1 g of PGME. The above-described resist solution was spin-coated on a substrate for semiconductor and baked on a direct hot plate at 120°C for 90 seconds to form a 0.40 μm thick resist coating. This resist coating was selectively exposed through a mask using 248 nm KrF excimer laser light, subjected to post exposure baking (PEB) on a direct hot plate at 130°C for 90 seconds, then paddle-developed for 60 seconds in an alkaline developer solution (a 2.38 wt % aqueous solution of tetramethylammonium hydroxide (TMAH)) to obtain a positive, line-and-space pattern on the silicon wafer. Observation of line width and cross-sectional profile of the positive pattern under a scanning type electronic microscope revealed that it was a pattern of 0.18 μm or less with good pattern profile at an exposure amount of 44 mJ/cm².

Lithographic performance in poly[p-(1-ethoxyethoxy)styrene-co-p-hydroxy styrene] resin. A comparison of aryl sulfate based onium salt PAGs to PAGs which produce photoacids which contain perfluoroalkyl moieties

[0390] FIG.8 and 9 respectively shows Tables 5A and 5B which summarizes the results of lithographic experiments done with poly[p-(1-ethoxyethoxy)styrene-co-p-hydroxy styrene]resin comparing aryl sulfate based onium salt to PAGs which photorelease perfluoroalkyl containing super acids.

Comparative Photoresist Example 5

[0391] 0.2 g (0.485 mmol) of triphenyl sulfonium triflate (Toyo Gosei, TPS Tf), 5.0 g (0.0149 mole) of biscyclohexylsulfonyl diazomethane (WPAG-145 from Wako, BCHSD), 0.0479 g (0.000245 moles) N,N-dicyclohexyl amine (Wako, DCHMA), 0.093 g (0.00028998 mole) triphenylsulfonium acetate (Takemoto, TPSA), 4 g (45.9 mmole) dimethylacetamide (Wako, DMA) and 0.06 g of KP341 (surfactant made by Shinetsu) per 100 g of poly[p-(1-ethoxyethoxy)styrene-co-p-hydroxy styrene] (P(EEOST/HS)) and adjusting the content of the solid components to 15.5 weight % using PGMEA. The above-described resist solution was spin-coated on a substrate for semiconductor and baked on a direct hot plate at 90°C for 60 seconds to form a 0.690 μm thick resist coating. This

resist coating was selectively exposed through a mask using 248 nm KrF excimer laser light, subjected to post exposure baking on a direct hot plate at 110°C for 90 seconds, then paddle-developed for 60 seconds in an alkaline developer solution (a 2.38 wt % aqueous solution of TMAH) to obtain a positive, line-and-space pattern on the silicon wafer. Observation of line width and cross-sectional profile of the positive pattern under a scanning type electronic microscope revealed that it was a pattern of 0.25 nm or less with good pattern profile at an exposure amount is around 18.8 mJ/cm².

Photoresist Example 22 to 27

[0392] 0.485 mmol of PAG P1 to P6 in each separate solution to each was added 5 g (0.01495 moles) of biscyclohexylsulfonyl diazomethane (BCHSD) (WPAG-145 from Wako Pure Chemical Industries, Ltd), 0.0479 g (0.000245 moles) N,N-dicyclohexyl amine (Wako, DCHMA, 0.093 g (0.00028998 mole) triphenylsulfonium acetate (Takemoto, TPSA), 4 g (45.9 mmole) dimethylacetamide (Wako, DMA) and 0.06 g of KP341 (surfactant made by Shinetsu) per 100 g of poly[p-(1-ethoxyethoxy)styrene-co-p-hydroxy styrene] (P(EEOST/HS)) and adjusting the content of the solid components to 15.5 weight % using PGMEA. The above-described resist solution was spin-coated on a substrate for semiconductor and baked on a direct hot plate at 90°C for 60 seconds to form a 0.690 μm thick resist coating. This resist coating was selectively exposed through a mask using 248 nm KrF excimer laser light, subjected to post exposure baking on a direct hot plate at 110°C for 90 seconds, then paddle-developed for 60 seconds in an alkaline developer solution (a 2.38 wt % aqueous solution of TMAH) to obtain a positive, line-and-space pattern on the silicon wafer. Observation of line width and cross-sectional profile of the positive pattern under a scanning type electronic microscope revealed that it was a pattern of 0.25 nm or less with good pattern profile at an exposure amount is around 21 mJ/cm².

[0393] Lithographic performance in P(PHS/S/TBA) resin. Dose-to-print values for formulations containing aryl sulfate based onium salt PAGs.

Photoresist example 28

[0394] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 0.656 parts of PAG P18 as a photo acid generator, 0.15 parts of TEGO gride 100 as a surfactant, propylene glycol monomethyl ether (PGME) and Propylene Glycol 1-Monomethyl Ether 2-Acetate (PGMEA) as a solvent. Solid content of the resist solution was 12.0% and PGME/PGMEA ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated

on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 1.0 µm film thickness. The photosensitive layer was exposed with 0.10~1250 mJ/cm² of irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5) without a photomask. After exposure, the photosensitive layer was post baked at 130 °C for 60 seconds, developed with 2.38% TMAH and then rinsed with water. Finally, dose to print value was obtained with 3.4 mJ/cm² from the film thickness measurement.

Photoresist example 29

[0395] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 0.497 parts of PAG P15 as a photo acid generator, 0.15 parts of TEGO gride 100 as a surfactant, propylene glycol monomethyl ether (PGME) and Propylene Glycol 1-Monomethyl Ether 2-Acetate (PGMEA) as a solvent. Solid content of the resist solution was 12.0% and PGME/PGMEA ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 1.0 µm film thickness. The photosensitive layer was exposed with 0.10~1250 mJ/cm² of irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5) without a photomask. After exposure, the photosensitive layer was post baked at 130 °C for 60 seconds, developed with 2.38% TMAH and then rinsed with water. Finally, dose to print value was obtained with 4.1 mJ/cm² from the film thickness measurement.

Photoresist example 30

[0396] A resist solution was prepared by using 100 parts of P622 polymer (P(PHS/S/TBA)), 0.612 parts of PAG P16 as a photo acid generator, 0.15 parts of TEGO gride 100 as a surfactant, propylene glycol monomethyl ether (PGME) and Propylene Glycol 1-Monomethyl Ether 2-Acetate (PGMEA) as a solvent. Solid content of the resist solution was 12.0% and PGME/PGMEA ratio was 70/30. The mixture was mixed with stirring to obtain a resist solution. The resist solution was spin-coated on a silicon wafer and was baked at 140 °C for 90 seconds to form a photosensitive layer with 1.0 µm film thickness. The photosensitive layer was exposed with 0.10~1250 mJ/cm² of irradiation of KrF stepper having a wavelength of 248 nm (Canon FPA-3000EX5) without a photomask. After exposure, the photosensitive layer was post baked at 130 °C for 60 seconds, developed with 2.38% TMAH and then rinsed with water. Finally, dose to print value was obtained with 4.5 mJ/cm² from the film thickness measurement.

CLAIMS

1. A Chemically amplified photoresist composition which comprises:

Component A: at least one aryl sulfate aryl onium salt PAG (PAG), wherein in said aryl sulfate moiety its aryl moiety is either unsubstituted or substituted with at least one substituent selected from the group consisting of an alkyl, an alkoxy, aryl, -CN, -NO₂, -S(=O)₂-alkyl, -S(=O)₂-aryl, -F, -Cl, and -Br, a linear alkoxy moiety comprising within its chain at least one (-CH₂-O-CH₂-) alkyl ether functionality, but which does not contain any (-CH₂-O-CH₂-O-) moieties, and in said aryl onium salt its aryl moieties are either unsubstituted or have at least one aryl moiety substituted with at least one substituent selected from the group consisting of an alkyl, and an alkoxy,

Component B: a resin essentially insoluble in aqueous 0.26 N TMAH at room temperature comprising at least one type of repeat unit which contains a base solubilizing moiety masked by an acid labile group, where the catalytic cleaving of this acid labile group by an acid, formed by radiation induced fragmentation of Component A, unmasks the base solubilizing moiety and renders the resin soluble in aqueous 0.26 N TMAH at room temperature,

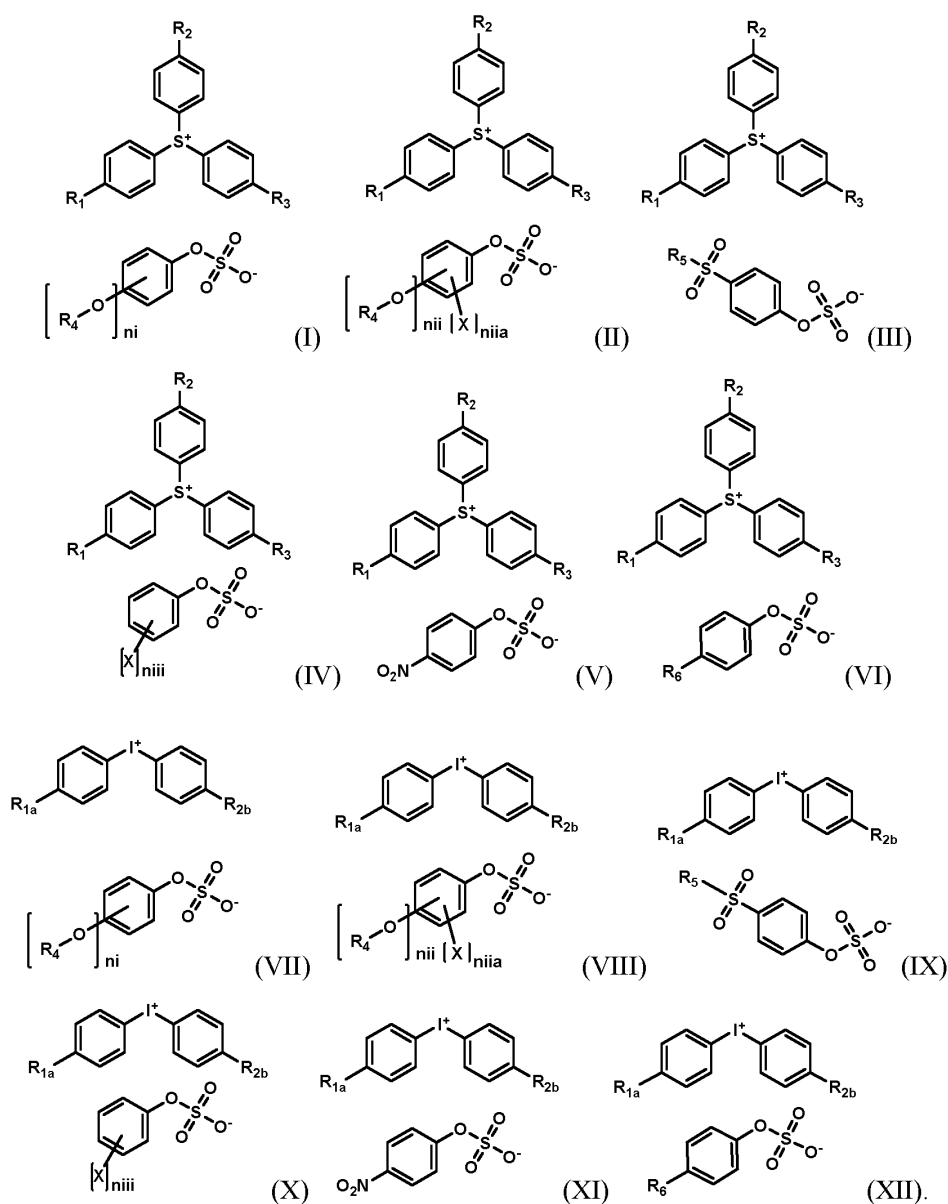
Component C: at least one acid quencher additive having a pK_a higher than -0.5 and a boiling point of at least 150°C at 1 atmosphere,

Component D: an organic spin casting solvent, wherein further

said composition is free of any perfluoroalkyl, fluoroalkyl moieties or mixtures thereof.

2. The composition of claim 1, where said composition is free of any alkyl sulfate onium salt PAGs or substituted alkyl sulfate onium salt PAGs.

3. The composition of claim 1 or 2, where said composition is one where said aryl sulfate aryl onium salt PAG (PAG) is selected from the group consisting of ones having structure (I), (II), (III), (IV), (V), (VI), (VII), (VIII), (IX), (X), (XI) and (XII), wherein in these structures, R₁, R₂, R₃, R_{1a}, R_{2b}, are independently selected from hydrogen, a C-1 to C-12 alkyl, or a C-1 to C-12 alkoxy, R₄ is independently selected from the group consisting of a C-1 to C-12 alkyl, an alkyl moiety comprising an alkyl ether moiety having structure -R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}, where R_{eth} is a C-1 to C-4 alkylene, R_{eth1} is a linear C-2 to C-4 alkylene, neth is an integer ranging from 1 to 6, and R_{eth3} is a C-1 to C-4 alkyl, R₅ is independently selected from a C-1 to C-12 alkyl, a unsubstituted aryl or a substituted aryl, R₆ is independently selected from H or a C-1 to C-12 alkyl, X is independently a halide selected from the group consisting of F, Cl and Br and n_i, and n_{iii}, are independently a integer from 1 to 5, n_{ii} and n_{iiia} are integers from 1 to 4, where the sum of n_{ii} and n_{iiia} ranges from 2 to 5,



4. The composition of any one of claims 1 to 3, wherein Component B, said resin essentially insoluble in aqueous 0.26 N TMAH at room temperature, comprises repeat units derived from 4-hydroxystyrene in addition to at least one type of repeat unit which contains a base solubilizing moiety masked by an acid labile group, where the catalytic cleaving of this acid labile group by an acid formed by radiation induced fragmentation of Component A, unmask the base solubilizing

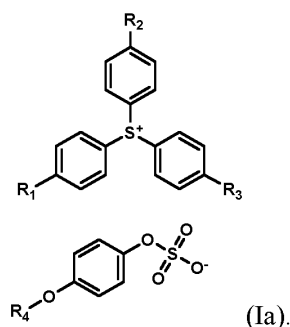
group and renders the resin soluble in aqueous 0.26 N TMAH at room temperature and further, where it does not contain any repeat units comprising moieties which impart a high absorbance at 248 nm greater than 0.8 Absorbance Unit (AU)/micron to a coated film of said resin.

5. The composition of any one of claims 1 to 3, wherein Component B, said resin essentially insoluble in aqueous 0.26 N TMAH at room temperature, does not contain any repeat units comprising moieties which impart a high absorbance at 193 nm greater than 0.8 Absorbance Unit (AU)/micron to a coated film of said resin, and comprises a base solubilizing moiety masked by an acid labile group, which is derived from an acrylate or methacrylate repeat unit wherein in these, the carboxylic acid moiety is masked by said acid labile group where the catalytic cleaving of said acid labile group by an acid, formed by the radiation induced fragmentation of Component A, unmask the base solubilizing group and renders this resin soluble in aqueous 0.26 N TMAH at room temperature.

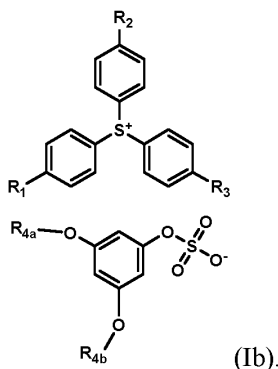
6. The composition of any one of claims 1 to 3, wherein Component B, said resin essentially insoluble in aqueous 0.26 N TMAH at room temperature, is a EUV resin which has an absorbance at 13.5 nm from about 0.4 AU/micron to about 0.5 AU/micron and that comprises at least one base solubilizing moiety masked by an acid labile group, which is derived from a phenolic repeat unit, an acrylate repeat unit, a methacrylate repeat unit or a mixture of these, wherein the carboxylic acid moiety and/or the phenolic moiety of these are masked by said acid labile group where the catalytic cleaving of said acid labile group by an acid, formed by the radiation induced fragmentation of Component A, unmask the base solubilizing group and renders this resin soluble in aqueous 0.26 N TMAH at room temperature.

7. The composition of any one of claims 1 to 6, wherein said aryl sulfate PAG has structure (I) as defined in claim 3.

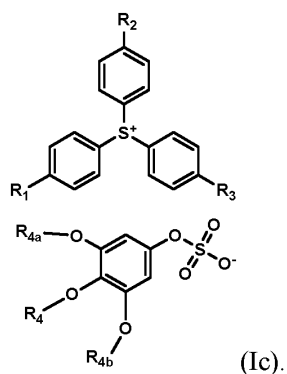
8. The composition of claim 7, wherein said aryl sulfate aryl onium salt PAG has structure (Ia),



9. The composition of claim 7, where said aryl sulfate aryl onium salt PAG has structure (Ib), R_{4a} and R_{4b} are independently selected from the group consisting of a C-1 to C-12 alkyl, an alkyl moiety comprising an alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, where R_{eth} is a C-1 to C-4 alkylene, R_{eth1} is a linear C-2 to C-4 alkylene, $neth$ is an integer ranging from 1 to 6, and R_{eth3} is a C-1 to C-4 alkyl,



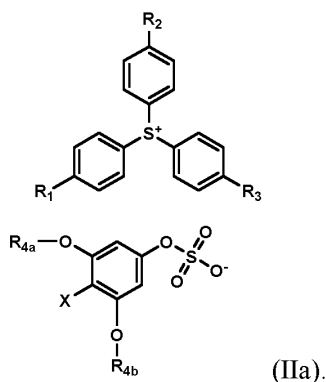
10. The composition of claim 7, where said aryl sulfate aryl onium salt PAG has structure (Ic), where R_4 , R_{4a} and R_{4b} are independently selected from the group consisting of a C-1 to C-12 alkyl and an alkyl moiety comprising an alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, where R_{eth} is a C-1 to C-4 alkylene, R_{eth1} is a linear C-2 to C-4 alkylene, $neth$ is an integer ranging from 1 to 6, and R_{eth3} is a C-1 to C-4 alkyl,



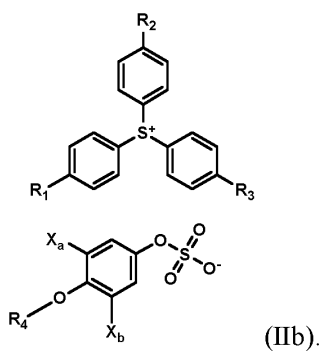
11. The composition of any one of claims 1 to 6, where said aryl sulfate aryl onium salt PAG has structure (II) as defined in claim 3.

12. The composition of claim 11, wherein said aryl sulfate aryl onium salt PAG has structure (IIa), where R_{4a} and R_{4b} are independently selected from the group consisting of a C-1 to C-12 alkyl, an alkyl moiety comprising an alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, where

R_{eth} is a C-1 to C-4 alkylene, R_{eth1} is a linear C-2 to C-4 alkylene, n_{eth} is an integer ranging from 1 to 6, and R_{eth3} is a C-1 to C-4 alkyl,

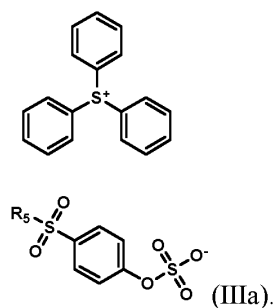


13. The composition of claim 11, wherein said aryl sulfate aryl onium salt PAG has structure (IIb), where X_a and X_b are independently a halide selected from the group consisting of F, Cl and Br,

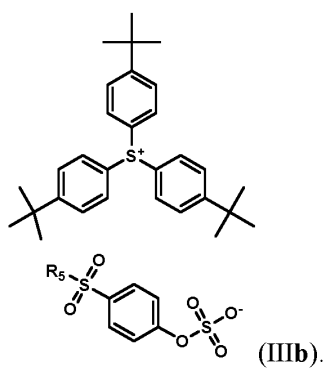


14. The composition of any one of claims 1 to 6, wherein said aryl sulfate aryl onium salt PAG has structure (III) as defined in claim 3.

15. The composition of claim 14, wherein said aryl sulfate aryl onium salt PAG has structure (IIIa),

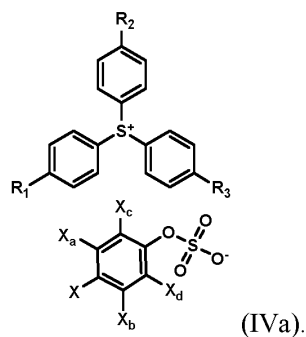


16. The composition of claim 14, wherein said aryl sulfate aryl onium salt PAG has structure (IIIb),

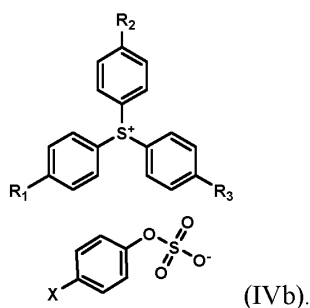


17. The composition of any one of claims 1 to 6, wherein said aryl sulfate aryl onium salt PAG has structure (IV) as defined in claim 3.

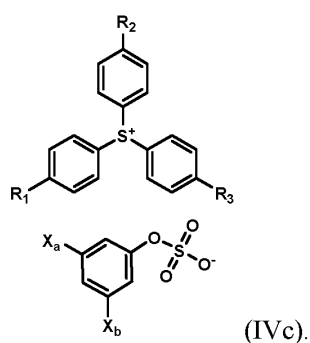
18. The composition of claim 17, wherein said aryl sulfate aryl onium salt PAG has structure (IVa), where X_a , X_b , X_c , X_d are independently a halide selected from the group consisting of F, Cl and Br



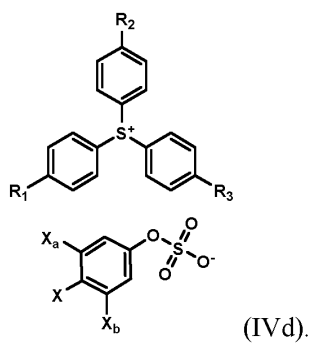
19. The composition of claim 17, wherein said aryl sulfate aryl onium salt PAG has structure (IVb),



20. The composition of claim 17, wherein said aryl sulfate aryl onium salt PAG has structure (IVc), where X_a , X_b are independently a halide selected from the group consisting of F, Cl and Br

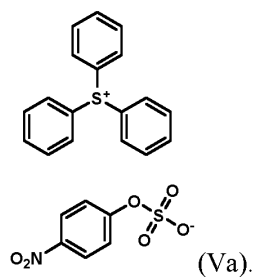


21. The composition of claim 17, wherein said aryl sulfate aryl onium salt PAG has structure (IVd), where X_a , X_b are independently a halide selected from the group consisting of F, Cl and Br

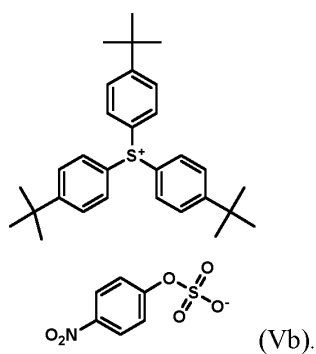


22. The composition of any one of claims 1 to 6, wherein said aryl sulfate aryl onium salt PAG has structure (V) as defined in claim 3.

23. The composition of claim 22, wherein said aryl sulfate aryl onium salt PAG has structure (Va)

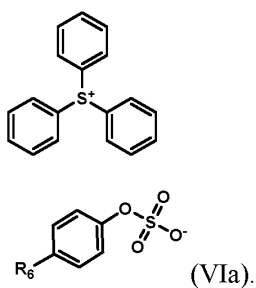


24. The composition of claim 22, wherein said aryl sulfate aryl onium salt PAG has structure (Vb)

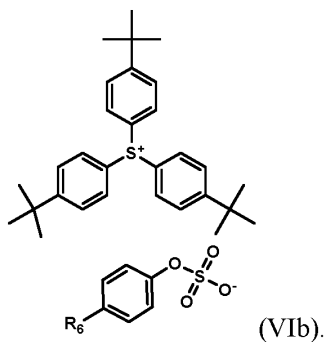


25. The composition of any one of claims 1 to 6, wherein said aryl sulfate aryl onium salt PAG has structure (VI) as defined in claim 3.

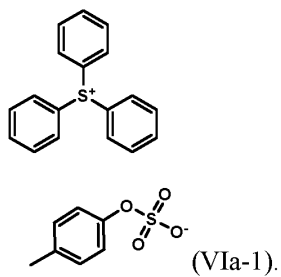
26. The composition of claim 25, wherein said aryl sulfate aryl onium salt PAG has structure (VIa),



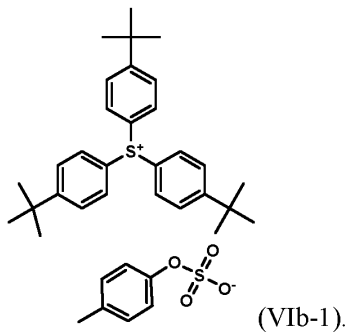
27. The composition of claim 25, wherein said aryl sulfate aryl onium salt PAG has structure (VIb),



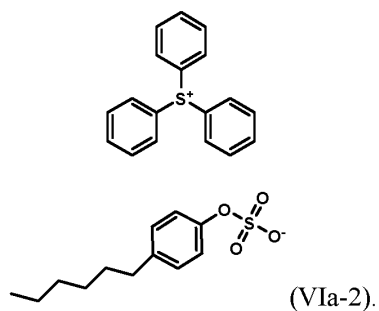
28. The composition of claim 25, wherein said aryl sulfate aryl onium salt PAG has structure has structure (VIa-1),



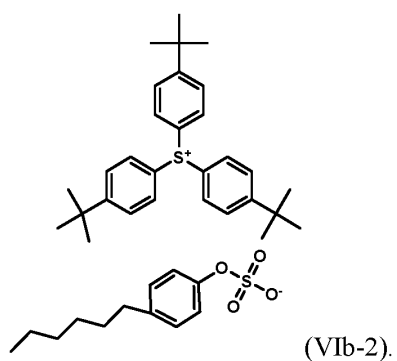
29. The composition of claim 25, wherein said aryl sulfate aryl onium salt PAG has structure (VIb-1),



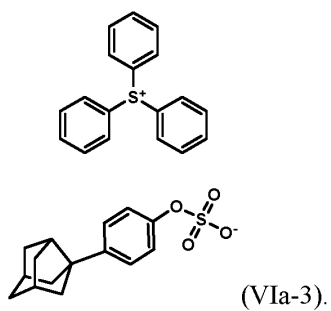
30. The composition of claim 25, wherein said aryl sulfate aryl onium salt PAG has structure (VIa-2),



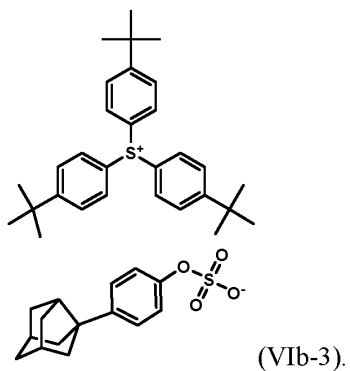
31. The composition of claim 25, wherein said aryl sulfate aryl onium salt PAG has structure (VIb-2),



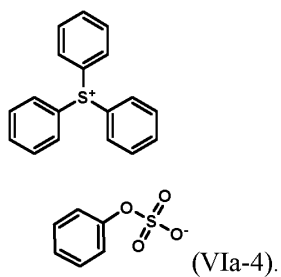
32. The composition of claim 25, wherein said aryl sulfate aryl onium salt PAG has structure (VIa-3),



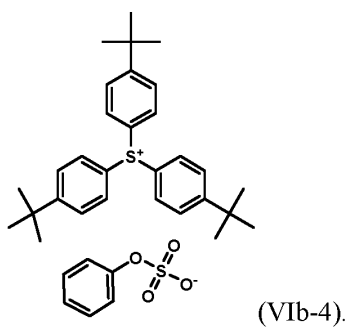
33. The composition of claim 25, wherein said aryl sulfate aryl onium salt PAG has structure (VIb-3),



34. The composition of claim 25, wherein said aryl sulfate aryl onium salt PAG has structure (VIa-4),

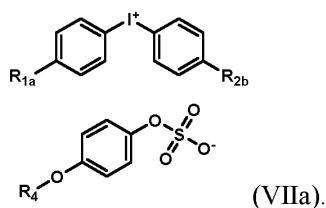


35. The composition of claim 25, wherein said aryl sulfate aryl onium salt PAG has structure (VIb-4),

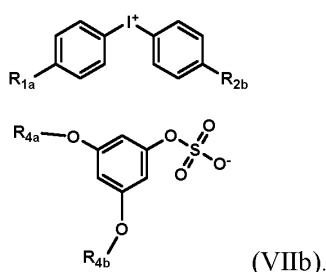


36. The composition of any one of claims 1 to 6, wherein said aryl sulfate aryl onium salt PAG has structure (VII) as defined in claim 3.

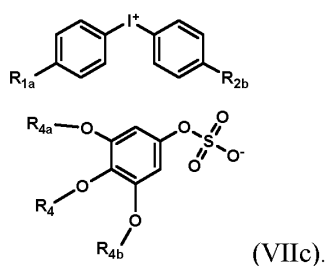
37. The composition of claim 36, wherein said aryl sulfate aryl onium salt PAG has structure (VIIa)



38. The composition of claim 36, where said aryl sulfate aryl onium salt PAG has structure (VIIb), where R_{4a} and R_{4b} are independently selected from the group consisting of a C-1 to C-12 alkyl, an alkyl moiety comprising an alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, where R_{eth} is a C-1 to C-4 alkylene, R_{eth1} is a linear C-2 to C-4 alkylene, $neth$ is an integer ranging from 1 to 6, and R_{eth3} is a C-1 to C-4 alkyl,



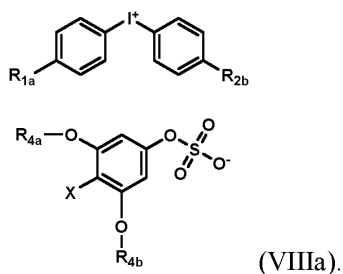
39. The composition of claim 36, where said aryl sulfate aryl onium salt PAG has structure (VIIc), where R_4 , R_{4a} and R_{4b} are independently selected from the group consisting of a C-1 to C-12 alkyl, an alkyl moiety comprising an alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$, where R_{eth} is a C-1 to C-4 alkylene, R_{eth1} is a linear C-2 to C-4 alkylene, $neth$ is an integer ranging from 1 to 6, and R_{eth3} is a C-1 to C-4 alkyl,



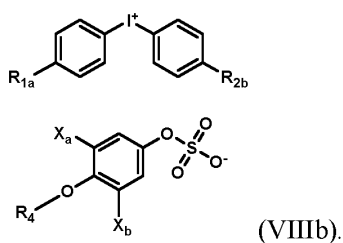
40. The composition of any one of claims 1 to 6, where said aryl sulfate aryl onium salt PAG has structure (VIII) as defined in claim 3.

41. The composition of claim 40, wherein said aryl sulfate aryl onium salt PAG has structure (VIIIa), where R_{4a} and R_{4b} are independently selected from the group consisting of a C-1 to C-12 alkyl, an alkyl moiety comprising an alkyl ether moiety having structure $-R_{eth}-O-(R_{eth1}-O)_{neth}-R_{eth3}$,

where R_{eth} is a C-1 to C-4 alkylene, R_{eth1} is a linear C-2 to C-4 alkylene, n_{eth} is an integer ranging from 1 to 6, and R_{eth3} is a C-1 to C-4 alkyl,

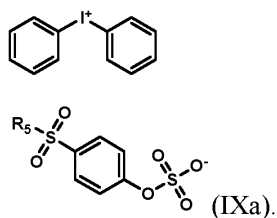


42. The composition of claim 40, wherein said aryl sulfate aryl onium salt PAG has structure (VIIIb), where X_a , X_b are independently a halide selected from the group consisting of F, Cl and Br

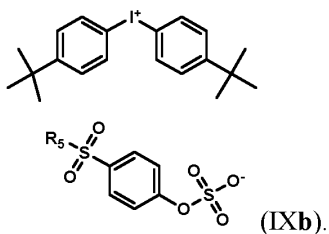


43. The composition of any one of claims 1 to 6, wherein said aryl sulfate aryl onium salt PAG has structure (IX) as defined in claim 3.

44. The composition of claim 43, wherein said aryl sulfate aryl onium salt PAG has structure (IXa),

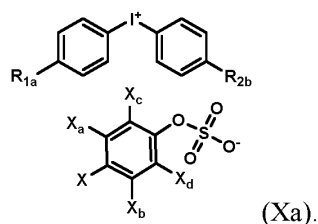


45. The composition of claim 43, wherein said aryl sulfate aryl onium salt PAG has structure (IXb),

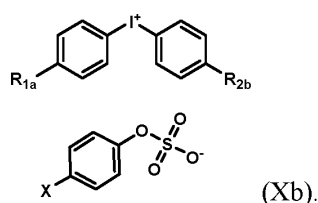


46. The composition of any one of claims 1 to 6, wherein said aryl sulfate aryl onium salt PAG has structure (X) as defined in claim 3.

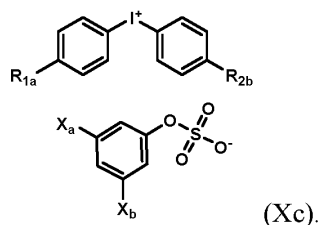
47. The composition of claim 46, wherein said aryl sulfate aryl onium salt PAG has structure (Xa), where X_a , X_b , X_c , X_d are independently a halide selected from the group consisting of F, Cl and Br



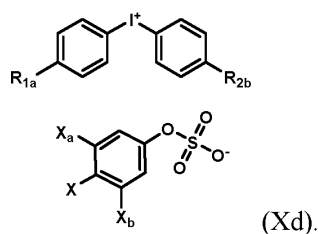
48. The composition of claim 46, wherein said aryl sulfate aryl onium salt PAG has structure (Xb),



49. The composition of claim 46, wherein said aryl sulfate aryl onium salt PAG has structure (Xc), where X_a , X_b are independently a halide selected from the group consisting of F, Cl and Br

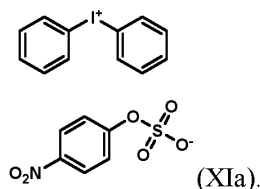


50. The composition of claim 46, wherein said aryl sulfate aryl onium salt PAG has structure (Xd), where X_a , X_b are independently a halide selected from the group consisting of F, Cl and Br

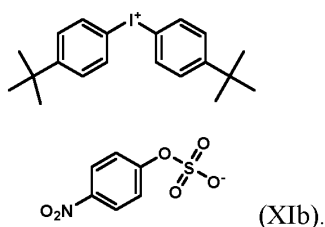


51. The composition of any one of claims 1 to 6, wherein said aryl sulfate aryl onium salt PAG has structure (XI) as defined in claim 3.

52. The composition of claim 51, wherein said aryl sulfate aryl onium salt PAG has structure (XIa)

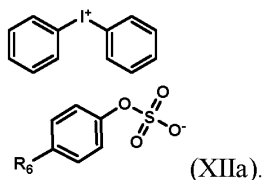


53. The composition of claim 51, wherein said aryl sulfate aryl onium salt PAG has structure (XIb)

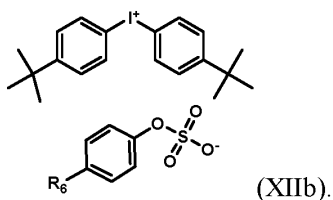


54. The composition of any one of claims 1 to 6, wherein said aryl sulfate aryl onium salt PAG has structure (XII) as defined in claim 3.

55. The composition of claim 54, wherein said aryl sulfate aryl onium salt PAG has structure (XIIa),

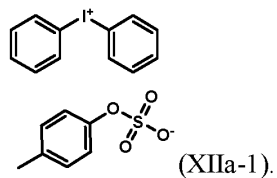


56. The composition of claim 54, wherein said aryl sulfate aryl onium salt PAG has structure (XIIb),

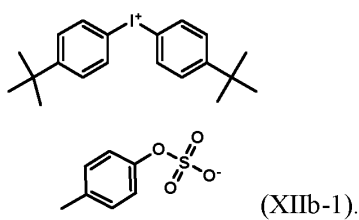


57. The composition of claim 54, wherein said aryl sulfate aryl onium salt PAG has structure

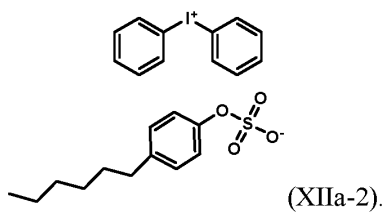
(XIIa-1),



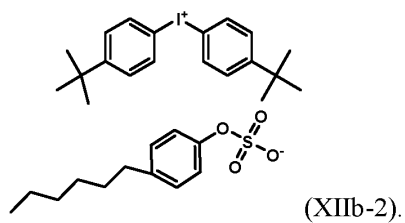
58. The composition of claim 54, wherein said aryl sulfate aryl onium salt PAG has structure (XIIb-1),



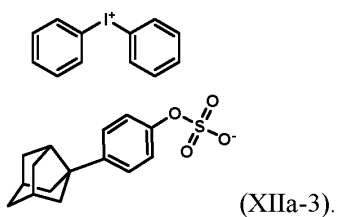
59. The composition of claim 54, wherein said aryl sulfate aryl onium salt PAG has structure (XIIa-2),



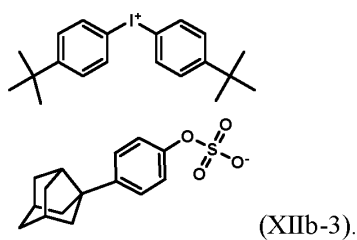
60. The composition of claim 54, wherein said aryl sulfate aryl onium salt PAG has structure (XIIb-2),



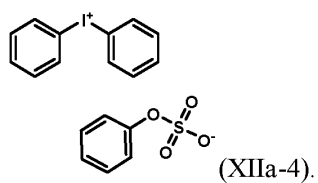
61. The composition of claim 54, wherein said aryl sulfate aryl onium salt PAG has structure (XIIa-3),



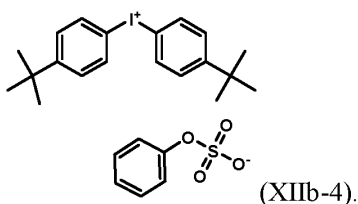
62. The composition of claim 54, wherein said aryl sulfate aryl onium salt PAG has structure (XIIb-3),



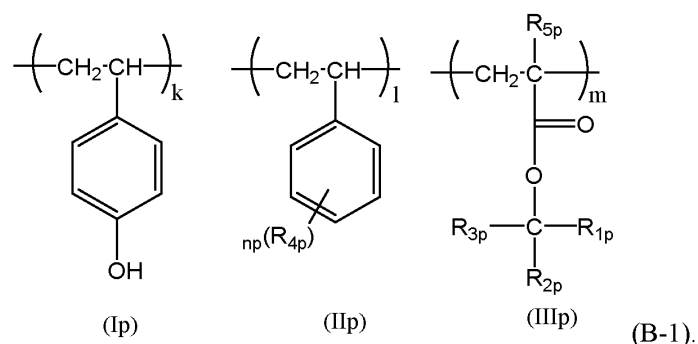
63. The composition of claim 54, wherein said aryl sulfate aryl onium salt PAG has structure (XIIa-4),



64. The composition of claim 54, wherein said aryl sulfate aryl onium salt PAG has structure (XIIb-4),



65. The composition of any one of claim 1 to 4 and 7 to 64, wherein component B is a polymer having structure (B-1), which comprises repeat units of structure (Ip), (IIp) and (IIIp), where R_{1p} , R_{2p} , and R_{3p} are individually selected from a C-1 to C-6 alkyl, n_p is 0, 1, 2 or 3, and R_{4p} is a C-1 to C-4 alkyl, and R_{5p} is H or a methyl, and k , l and m are the number of repeat units,



66. The composition of any one of claim 1 to 4 and 7 to 65, wherein component B is a polymer having structure (B-1) as defined in claim 65, and in the polymer having structure (B-1), the mole % of repeat unit of structure (Ip) ranges from about 47.5 mole % to about 71.3 mole %, the mole % of structure (IIp) ranges from about 15.3 mole % to about 22.9 mole % and structure (IIIp) ranges from about 17.2 mole % to about 25.8 mole %, and further that the sum of the mole % values of the repeat unit of structure (Ip), the repeat unit of structure (IIp) and the repeat units of structure (IIIp), adds up to 100 mole %.

67. The composition of any one of claim 1 to 4 and 7 to 66, wherein component B is a polymer having structure (B-1) as defined in claim 65, and in the polymer of structure (B-1) the mole % of repeat unit of structure (Ip) ranges from about 53.46 mole % to about 65.34 mole %, the mole % of structure (IIp) ranges from about 17.19 mole % to about 21.01 mole % and structure (IIIp) ranges from about 19.35 mole % to about 23.65 mole %, and further that the sum of the mole % values of the repeat unit of structure (Ip), the repeat unit of structure (IIp) and the repeat units of structure (IIIp), adds up to 100 mole %.

68. The composition of any one of claim 1 to 4 and 7 to 67, wherein component B is a polymer having structure (B-1) as defined in claim 65, and in the polymer of structure (B-1) the mole % of repeat unit of structure (Ip) ranges from about 55.8 mole % to about 63.0 mole %, the mole % of structure (IIp) ranges from about 18.0 mole % to about 20.2 mole % and structure (IIIp) ranges from about 20.2 mole % to about 22.8 mole %, and further that the sum of the mole % values of the repeat unit of structure (Ip), the repeat unit of structure (IIp) and the repeat units of structure (IIIp), adds up to 100 mole %.

69. The composition of any one of claim 1 to 4 and 7 to 68, wherein component B is a polymer having structure (B-1) as defined in claim 65, and in the polymer of structure (B-1) the mole % of repeat unit of structure (Ip) ranges from about 57.0 mole % to about 61.8 mole %, the mole % of

structure (IIp) ranges from about 18.3 mole % to about 19.9 mole % and structure (IIIp) ranges from about 20.6 mole % to about 22.4 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IIp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

70. The composition of any one of claim 1 to 4 and 7 to 69, wherein component B is a polymer having structure (B-1) as defined in claim 65, and in the polymer of structure (B-1) the mole % of repeat unit of structure (Ip) ranges from about 58.2 mole % to about 60.6 mole %, the mole % of structure (IIp) ranges from about 18.7 mole % to about 19.5 mole % and structure (IIIp) ranges from about 21.1 mole % to about 21.9 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IIp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

71. The composition of any one of claim 1 to 4 and 7 to 70, wherein component B is a polymer having structure (B-1) as defined in claim 65, and in the polymer of structure (B-1) the mole % of repeat unit of structure (Ip) ranges from about 58.8 mole % to about 60.0 mole %, the mole % of structure (IIp) ranges from about 18.9 mole % to about 19.3 mole % and structure (IIIp) ranges from about 21.3 mole % to about 21.7 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IIp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

72. The composition of any one of claim 1 to 4 and 7 to 64, wherein component B is a polymer having structure (B-1) as defined in claim 65, and in the polymer of structure (B-1) the mole % of repeat unit of structure (Ip) ranges from about 58.0 mole % to about 60.0 mole %, the mole % of structure (IIp) ranges from about 18.5 mole % to about 20.5 mole % and structure (IIIp) ranges from about 21.3 mole % to about 21.7 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IIp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

73. The composition of any one of claim 1 to 4 and 7 to 72, wherein component B is a polymer having structure (B-1) as defined in claim 65, and in the polymer of structure (B-1) the mole % of repeat unit of structure (Ip) is about 59.4 mole %, the mole % of structure (IIp) is about 19.1 mole % and structure (IIIp) is about 21.5 mole % and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IIp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

74. The composition of any one of claim 1 to 4 and 7 to 73, wherein component B is a polymer having structure (B-1) as defined in claim 65, and the ratio of the moles of the repeat unit of structure (IIIp) in said polymer of structure (B-1) to the moles of component A, said PAG, is from about 68.8 to about 103.2.

75. The composition of any one of claim 1 to 4 and 7 to 74, wherein component B is a polymer having structure (B-1) as defined in claim 65, and the ratio of the moles of the repeat unit of structure (IIIp) in said polymer of structure (B-1) to the moles of component A, said PAG, is from about 77.5 to about 94.7.

76. The composition of any one of claim 1 to 4 and 7 to 75, wherein component B is a polymer having structure (B-1) as defined in claim 65, and the ratio of the moles of the repeat unit of structure (IIIp) in said polymer of structure (B-1) to the moles of component A, said PAG, is from about 80.9 to about 91.2.

77. The composition of any one of claim 1 to 4 and 7 to 76, wherein component B is a polymer having structure (B-1) as defined in claim 65, and the ratio of the moles of the repeat unit of structure (IIIp) in said polymer of structure (B-1) to the moles of component A, said PAG, is from about 82.6 to about 89.5.

78. The composition of any one of claim 1 to 4 and 7 to 77, wherein component B is a polymer having structure (B-1) as defined in claim 65, and the ratio of the moles of the repeat unit of structure (IIIp) in said polymer of structure (B-1) to the moles of component A, said PAG, is from about 84.3 to about 87.8.

79. The composition of any one of claim 1 to 4 and 7 to 78, wherein component B is a polymer having structure (B-1) as defined in claim 65, and the ratio of the moles of the repeat unit of structure (IIIp) in said polymer of structure (B-1) to the moles of component A, said PAG, is from about 85.2 to about 86.9.

80. The composition of any one of claim 1 to 4 and 7 to 79, wherein the mole ratio of the moles of component A, said PAG to the moles of component C, said acid quencher is from about 7.8 to about 11.7.

81. The composition of any one of claim 1 to 4 and 7 to 80, wherein the mole ratio of the moles of component A, said PAG to the moles of component C, said acid quencher is from about 8.8 to about 10.7.

82. The composition of any one of claim 1 to 4 and 7 to 81, wherein the mole ratio of the moles

of component A, said PAG to the moles of component C, said acid quencher is from about 9.2 to about 10.3.

83. The composition of any one of claim 1 to 4 and 7 to 82, wherein the mole ratio of the moles of component A, said PAG to the moles of component C, said acid quencher is from about 9.4 to about 10.1.

84. The composition of any one of claim 1 to 4 and 7 to 83, wherein the mole ratio of the moles of component A, said PAG to the moles of component C, said acid quencher is from about 9.6 to about 9.9.

85. The composition of any one of claim 1 to 4 and 7 to 84, wherein the mole ratio of the moles of component A, said PAG to the moles of component C, said acid quencher is from about 9.7 to about 9.8.

86. The composition of any one of claim 1 to 4 and 7 to 85, wherein said component B is a polymer having structure (B-1) as defined in claim 65, wherein, R_{4p} is methyl and n_p is 1.

87. The composition of claim 86, wherein R_{5p} is methyl.

88. The composition of claim 86, wherein R_{5p} is H.

89. The composition of claim 86 to 88, wherein R_{3p} , R_{1p} and R_{2p} are methyl.

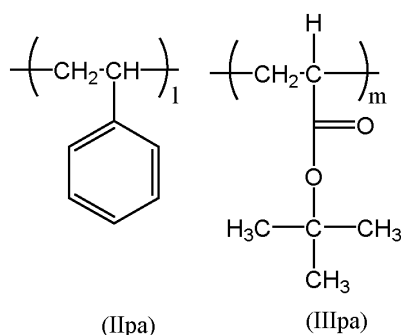
90. The composition of any one of claim 1 to 4 and 7 to 85, wherein said component B, is a polymer having structure (B-1) as defined in claim 65, wherein, n_p is 0.

91. The composition of claim 90, wherein said component B is a polymer having structure (B-1), wherein R_{5p} is methyl.

92. The composition of claim 90, wherein said component B, is a polymer having structure (B-1), wherein R_{5p} is H.

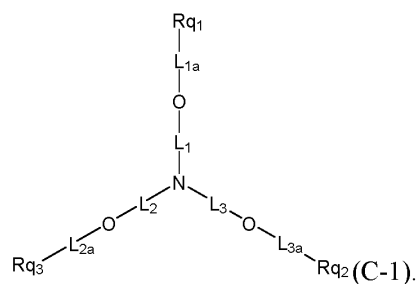
93. The composition of any one of claim 90 to 92, wherein said component B, is a polymer having structure (B-1), wherein R_{3p} , R_{1p} and R_{2p} are methyl.

94. The composition of any one of claim 90, 92 or 93, wherein said component B, said polymer having structure (B-1), is one wherein said repeat unit of structure (IIp) has structure (IIpa) and said repeat unit of structure (IIIp) has structure (IIIpa),



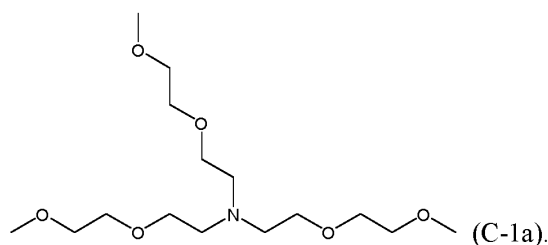
95. The composition of any one of claim 1 to 4 and 7 to 94, wherein component C, said acid quencher is an amine.

96. The composition of any one of claim 1 to 4 and 7 to 95, where Component C said acid quencher is at least one acid quencher of structure (C-1), wherein Rq₁, Rq₂, Rq₃ are independently a C-1 to C-4 alkyl, L₁, L_{1a}, L₂, L_{2a}, L₃, L_{3a} are independently a linear C-2 to C-4 alkylene spacer,



97. The composition of any one of claim 1 to 4 and 7 to 96, where Component C said acid quencher is at least one acid quencher of structure (C-1) as defined in claim 96, wherein Rq₁, Rq₂, Rq₃ are the same C-1 to C-4 alkyl, L₁, L₂ and L₃ are the same linear C-2 to C-4 alkylene spacer and L_{1a}, L_{2a} and L_{3a} are the same linear C-2 to C-4 alkylene spacer.

98. The composition of any one of claim 1 to 4 and 7 to 97, where Component C said acid quencher is at least one acid quencher of structure (C-1a),

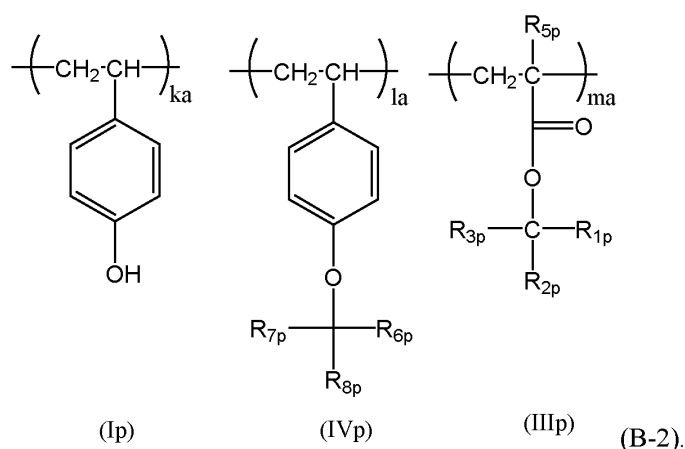


99. The composition of any one of claim 1 to 4 and 7 to 98, wherein Component B, said polymer,

has an M_w of about 8,000 to about 27,000 and a polydispersity of 1.0 to about 2.5.

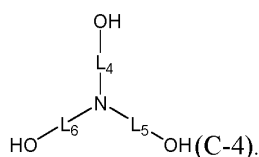
100. The composition of any one of claim 1 to 4 and 7 to 99, wherein Component B, has an M_w of about 12,684 to about 13,884 and a polydispersity of about 1.77 to about 2.17.

101. The composition of any one of claim 1 to 4 and 7 to 64, wherein component B is a polymer of structure (B-2) which comprises repeat units of structure (Ip), (IVp) and (IIIp), where R_{1p} , R_{2p} , R_{3p} , R_{6p} , R_{7p} and R_{8p} are individually selected from a C-1 to C-6 alkyl, R_{5p} is H or a C-1 to C-4 alkyl, k_a , l_a , and m_a are the number of repeat units,



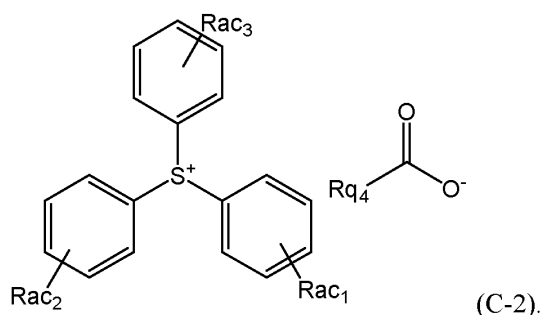
102. The composition of claim 101, wherein said composition as Component C, said acid quencher additive, comprises at least one amine.

103. The composition of any one of claims 101 or 102, wherein said composition as Component C, said acid quencher additive which is an amine has structure (C-4), wherein L_4 , L_5 and L_6 are independently a linear C-2 to C-4 alkylene spacer



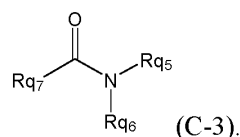
104. The composition of any one of claims 102 to 103, wherein said composition as Component C, said acid quencher additive, further comprises at least one triarylsulfonium carboxylate.

105. The composition of claim 104, wherein said triarylsulfonium carboxylate has structure (C-2), wherein R_{q4} is a C-1 to C-4 alkyl, and R_{ac1} , R_{ac2} and R_{ac3} are independently selected from H, a C-1 to C-12 alkyl and a C-1 to C-12 alkoxy,



106. The composition of any one of claims 102 to 105, wherein said composition as Component C, said acid quencher additive, further comprises at least one amide.

107. The composition of claim 106, wherein said amide has structure (C-3), wherein Rq5, Rq6, Rq7 are independently a C-1 to C-4 alkyl,



108. The composition of any one of claims 101 to 107, wherein Component C, said acid quencher is a mixture of an amine having structure (C-4) as defined in claim 103, a triarylsulfonium carboxylate having structure (C-2) as defined in claim 105 and an amide having structure (C-3) as defined in claim 107.

109. The composition of any one of claims 101 to 108, wherein in the polymer of structure (B-2) the mole % of repeat unit of structure (Ip) ranges from about 52.8 mole % to about 79.9 mole %, the mole % of structure (IVp) ranges from about 17.6 mole % to about 26.4 mole % and structure (IIIp) ranges from about 9.6 mole % to about 14.4 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IVp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

110. The composition of any one of claims 101 to 109, wherein in the polymer of structure (B-2) the mole % of repeat unit of structure (Ip) ranges from about 59.4 mole % to about 72.6 mole %, the mole % of structure (IVp) ranges from about 21.12 mole % to about 24.2 mole % and structure (IIIp) ranges from about 10.8 mole % to about 13.2 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IVp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

111. The composition of of any one of claims 101 to 110, wherein in the polymer of structure

(B-2) the mole % of repeat unit of structure (Ip) ranges from about 62.4 mole % to about 70.0 mole %, the mole % of structure (IVp) ranges from about 20.7 mole % to about 23.3 mole % and structure (IIIp) ranges from about 11.3 mole % to about 12.7 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IVp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

112. The composition of any one of claims 101 to 111, wherein in the polymer of structure (B-2) the mole % of repeat unit of structure (Ip) ranges from about 63.4 mole % to about 68.6 mole %, the mole % of structure (IVp) ranges from about 21.1 mole % to about 22.9 mole % and structure (IIIp) ranges from about 11.5 mole % to about 12.5 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IVp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

113. The composition of any one of claims 101 to 112, wherein in the polymer of structure (B-2) the mole % of repeat unit of structure (Ip) ranges from about 64.7 mole % to about 67.3 mole %, the mole % of structure (IVp) ranges from about 21.6 mole % to about 22.4 mole % and structure (IIIp) ranges from about 11.8 mole % to about 12.2 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IVp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

114. The composition of any one of claims 101 to 113, wherein in the polymer of structure (B-2) the mole % of repeat unit of structure (Ip) ranges from about 65.3 mole % to about 66.7 mole %, the mole % of structure (IVp) ranges from about 21.8 mole % to about 22.2 mole % and the mole % of structure (IIIp) ranges from about 11.9 mole % to about 12.1 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IVp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

115. The composition of any one of claims 101 to 107, wherein in the polymer of structure (B-2) the mole % of repeat unit of structure (Ip) ranges from about 65 mole % to about 67 mole %, the mole % of structure (IVp) ranges from about 21.4 mole % to about 23.4 mole % and structure (IIIp) ranges from about 11.0 mole % to about 13.0 mole %, and further that the sum of the mole % values of the repeat units of structure (Ip), the repeat unit of structure (IVp) and the repeat unit of structure (IIIp) adds up to 100 mole %.

116. The composition of any one of claims 101 to 115, wherein the ratio of the total moles of the repeat unit of structures (IVp) and (IIIp) in this polymer, to the moles of component A, said PAG,

is from about 38.5 to about 57.8.

117. The composition of any one of claims 101 to 116, wherein the ratio of the total moles of the repeat unit of structures (IVp) and (IIIp) in said polymer of structure (B-2), to the moles of component A, said PAG, is from about 43.3 to about 53.0.

118. The composition of any one of claims 101 to 117, wherein the ratio of the total moles of the repeat unit of structures (IVp) and (IIIp) in said polymer of structure (B-2), to the moles of component A, said PAG, is from about 45.3 to about 51.1.

119. The composition of any one of claims 101 to 118, wherein the ratio of the total moles of the repeat unit of structures (IVp) and (IIIp) in said polymer of structure (B-2), to the moles of component A, said PAG, is from about 46.3 to about 50.1.

120. The composition of any one of claims 101 to 119, wherein the ratio of the total moles of the repeat unit of structures (IVp) and (IIIp) in said polymer of structure (B-2), to the moles of component A, said PAG, is from about 47.2 to about 49.1.

121. The composition of any one of claims 101 to 120, wherein the ratio of the total moles of the repeat unit of structures (IVp) and (IIIp) in said polymer of structure (B-2), to the moles of component A, said PAG, is from about 47.7 to about 48.2.

122. The composition of any one of claims 101 to 116, and wherein the ratio of the total moles of the repeat unit of structures (IVp) and (IIIp) in said polymer of structure (B-2), to the moles of component A, said PAG, is about 48.2.

123. The composition of any one of claims 101 to 122, wherein said composition comprises an amine having structure (C-4) as defined in claim 103, a triarylsulfonium carboxylate having structure (C-2) as defined in claim 105 and an amide having structure (C-3) as defined in claim 107, and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-2) is from about 1.84 to about 2.76, and the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-3) is from about 0.093 to about 0.139, and the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-4) is from about 3.83 to about 5.74.

124. The composition of any one of claims 101 to 123, wherein said composition comprises an amine having structure (C-4) as defined in claim 103, a triarylsulfonium carboxylate having structure (C-2) as defined in claim 105 and an amide having structure (C-3) as defined in claim 107,

and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-2) is from about 2.07 to about 2.53, and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-3) is from about 0.105 to about 0.128, and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-4) is from about 4.31 to about 5.26.

125. The composition of any one of claims 101 to 124, wherein said composition comprises an amine having structure (C-4) as defined in claim 103, a triarylsulfonium carboxylate having structure (C-2) as defined in claim 105 and an amide having structure (C-3) as defined in claim 107, and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-2) is from about 2.16 to about 2.43, and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-3) is from about 0.109 to about 0.123, and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-4) is from about 4.50 to about 5.07.

126. The composition of any one of claims 101 to 125, wherein said composition comprises an amine having structure (C-4) as defined in claim 103, a triarylsulfonium carboxylate having structure (C-2) as defined in claim 105 and an amide having structure (C-3) as defined in claim 107, and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-2) is from about 2.20 to about 2.39, and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-3) is from about 0.111 to about 0.121, and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-4) is from about 4.60 to about 4.98.

127. The composition of any one of claims 101 to 126, wherein said composition comprises an amine having structure (C-4) as defined in claim 103, a triarylsulfonium carboxylate having structure (C-2) as defined in claim 105 and an amide having structure (C-3) as defined in claim 107, and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-2) is from about 2.25 to about 2.34, and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-3) is from about 0.114 to about 0.119, and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-4) is from about 4.69 to about 4.88.

128. The composition of any one of claims 101 to 127, wherein said composition comprises an amine having structure (C-4) as defined in claim 103, a triarylsulfonium carboxylate having structure (C-2) as defined in claim 105 and an amide having structure (C-3) as defined in claim 107, and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-2) is from about 2.27 to about 2.30, and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-3) is from about 0.115 to about 0.126, and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-4) is from about 4.73 to about 4.79.

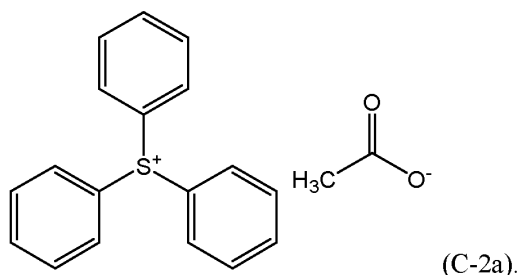
129. The composition of any one of claims 101 to 122, wherein said composition comprises an amine having structure (C-4) as defined in claim 103, a triarylsulfonium carboxylate having structure (C-2) as defined in claim 105 and an amide having structure (C-3) as defined in claim 107, and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-2) is about 2.29, and

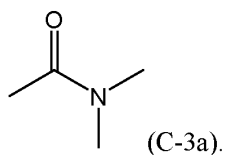
the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-3) is about 0.116, and

the mole ratio of component A, said PAG, to component C, said acid quencher of structure (C-4) is about 4.78.

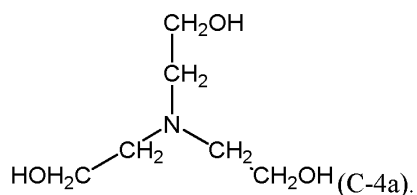
130. The composition of any one of claims 101 to 129, wherein said composition comprises a triarylsulfonium carboxylate having structure (C-2) as defined in claim 105, and said acid quencher of structure (C-2) has structure (C-2a),



131. The composition of any one of claims 101 to 130, wherein said composition comprises an amide having structure (C-3) as defined in claim 107, and said acid quencher of structure (C-3) has structure (C-3a),

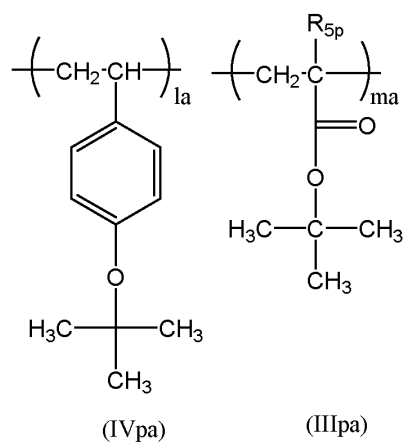


132. The composition of any one of claims 102 to 131, wherein said composition comprises an amine having structure (C-4) as defined in claim 103, and said acid quencher of structure (C-4) has structure (C4a),

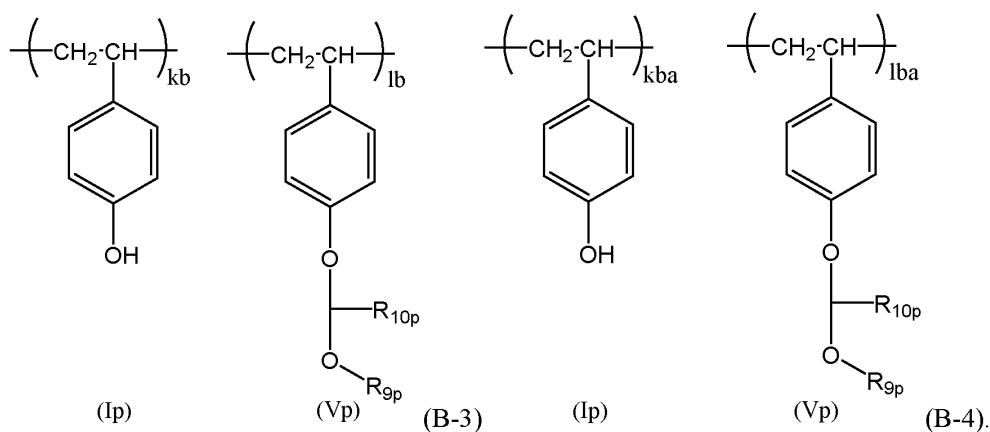


133. The composition of any one of claims 101 to 132, wherein Component B, of structure (B-2), said polymer, has an M_w of about 18,815 to about 63,659 and an polydispersity of 1.0 to about 2.5.

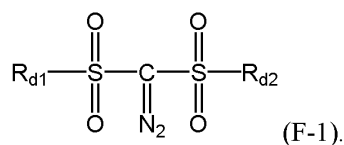
134. The composition of any one of claims 101 to 133, wherein Component B, of structure (B-2) is one where said repeat unit of structure (IVp) has structure (IVpa) and said repeat unit of structure (IIIp) has structure (IIIpa),



135. The composition of any one of claim 1 to 4 and 7 to 64, wherein component B, comprises two different polymers of structures (B-3) and (B-4), where R_{10p} , R_{9p} are individually selected from a C-1 to C-4 alkyl, k_b , l_b are the number of repeat units for polymer (B-3) and k_{ba} and l_{ba} are the number of repeat units for polymer (B-4) where the mole % of the repeat unit of structure (Vp) in the polymer of structure (B-3) and (B-4) are different,

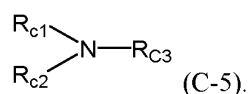


136. The composition of claim 135, which further comprises an additional PAG of structure (F-1), where R_{d1} and R_{d2} are individually selected from a C-5 to C-8 alicyclic alkyl.



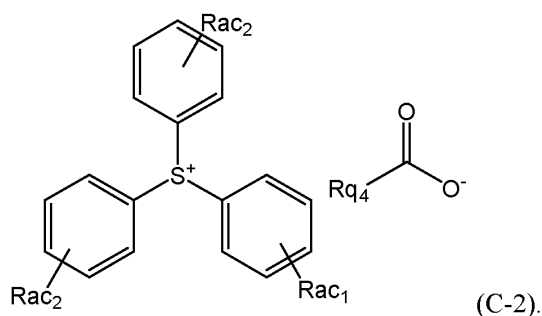
137. The composition of claim 135 or 136, wherein component C, said acid quencher comprises an amine.

138. The composition of claim 137, where said amine has structure (C-5), where R_{c3} is a C-1 to C-4 alkyl and R_{c1} and R_{c2} are independently selected from a C-5 to C-8 cyclic alkyl,



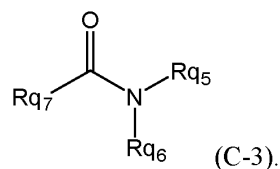
139. The composition of any one of claims 136 to 138, where Component C, said acid quencher, further comprises a triarylsulfonium carboxylate.

140. The composition of claim 139, wherein said triarylsulfonium carboxylate has structure (C-2), where R_{q4} is a C-1 to C-4 alkyl, and Rac1 , Rac2 and Rac3 are independently selected from H, a C-1 to C-12 alkyl and a C-1 to C-12 alkoxy,



141. The composition of any one of claim 136 to 140, wherein Component C, said acid quencher, further comprises an amide.

142. The composition of claim 141, where said amide has structure (C-3), where R_{q5} , R_{q6} , R_{q7} are independently a C-1 to C-4 alkyl,



143. The composition of any one of claim 135 to 142, wherein said total mole % of repeat units of structure (Vp) in both polymers of structure (B-3) and (B-4), independently, range from about

28.1 mole % to about 42.12 mole %.

144. The composition of any one of claim 135 to 143, wherein said total mole % of repeat units of structure (Vp) in both polymers of structure (B-3) and (B-4), independently, range from about 31.6 mole % to about 38.6 mole %.

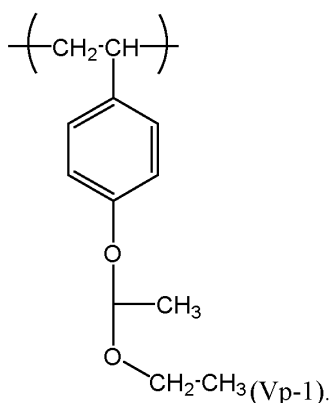
145. The composition of any one of claim 135 to 144, wherein said total mole % of repeat units of structure (Vp) in both polymers of structure (B-3) and (B-4), independently, range from about 33.0 mole % to about 37.2 mole %.

146. The composition of any one of claim 135 to 145 wherein said total mole % of repeat units of structure (Vp) in both polymers of structure (B-3) and (B-4), independently, range from about 33.7 mole % to about 36.5 mole %.

147. The composition of any one of claim 135 to 146, wherein said total mole % of repeat units of structure (Vp) in both polymers of structure (B-3) and (B-4), independently, ranges from about 34.4 mole % to about 35.8 mole %.

148. The composition of any one of claim 135 to 147, wherein said total mole % of repeat units of structure (Vp) in both polymers of structure (B-3) and (B-4), independently, ranges from about 34.7 mole % to about 35.5mole %.

149. The composition of any one of claim 135 to 148, wherein said repeat unit of structure (Vp) has structure (Vp-1),



150. The composition of any one of claim 135 to 149, wherein said polymer of structure (B-3) and (B-4) have an M_w which independently ranges from about 24,544 to about 16,363 and a polydispersity which independently ranges from 1 to about 1.35.

151. The composition of any one of claim 135 to 150, wherein it comprises a PAG of structure

(F-1) as defined in claim 136, and the mole ratio of the moles of component A, said aryl sulfate aryl onium salt PAG to said component F, said PAG of structure (F-1) ranges from about 0.0260 to about 0.0389.

152. The composition of any one of claim 135 to 151, wherein it comprises a PAG of structure (F-1) as defined in claim 136, and the mole ratio of the moles of component A, said aryl sulfate aryl onium salt PAG to said component F, said PAG of structure (F-1) ranges from about 0.0291 to about 0.0357.

153. The composition of any one of claim 135 to 152, wherein it comprises a PAG of structure (F-1) as defined in claim 136, and the mole ratio of the moles of component A, said aryl sulfate aryl onium salt PAG to said component F, said PAG of structure (F-1) ranges from about 0.0305 to about 0.0344.

154. The composition of any one of claim 135 to 153, wherein it comprises a PAG of structure (F-1) as defined in claim 136, and the mole ratio of the moles of component A, said aryl sulfate aryl onium salt PAG to said component F, said PAG of structure (F-1) ranges from about 0.0311 to about 0.0337.

155. The composition of any one of claim 135 to 154, wherein it comprises a PAG of structure (F-1) as defined in claim 136, and the mole ratio of the moles of component A, said aryl sulfate aryl onium salt PAG to said component F, said PAG of structure (F-1) ranges from about 0.0318 to about 0.0331.

156. The composition of any one of claim 135 to 155, wherein it comprises a PAG of structure (F-1) as defined in claim 136, and the mole ratio of the moles of component A, said aryl sulfate aryl onium salt PAG to said component F, said PAG of structure (F-1) ranges from about 0.0321 to about 0.0328.

157. The composition of any one of claim 135 to 156, where the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component A, said aryl sulfate aryl onium salt PAG ranges from about 398 to about 597.

158. The composition of any one of claim 135 to 157, where the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component A, said aryl sulfate aryl onium salt PAG ranges from about 448 to about 547.

159. The composition of any one of claim 135 to 158, where the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component A, said aryl sulfate aryl onium salt PAG

ranges from about 468 to about 528.

160. The composition of any one of claim 135 to 159, where the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component A, said aryl sulfate aryl onium salt PAG from about 478 to about 518.

161. The composition of any one of claim 135 to 160, where the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component A, said aryl sulfate aryl onium salt PAG is from about 488 to about 508.

162. The composition of any one of claim 135 to 161, where the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component A, said aryl sulfate aryl onium salt PAG is from about 493 to about 503.

163. The composition of any one of claim 135 to 162, where it comprises a PAG of structure (F-1) as defined in claim 136, and the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component F, said PAG of structure (F-1) is from about 12.9 to about 19.4.

164. The composition of any one of claim 135 to 163, where it comprises a PAG of structure (F-1) as defined in claim 136, and the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component F, said PAG of structure (F-1) ranges from about 14.5 to about 17.8.

165. The composition of any one of claim 135 to 164, where it comprises a PAG of structure (F-1) as defined in claim 136, and the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component F, said PAG of structure (F-1) ranges from about 15.2 to about 17.1.

166. The composition of any one of claim 135 to 165, where it comprises a PAG of structure (F-1) as defined in claim 136, and the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component F, said PAG of structure (F-1) is from about 15.5 to about 16.8.

167. The composition of any one of claim 135 to 166, where it comprises a PAG of structure (F-1) as defined in claim 136, and the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component F, said PAG of structure (F-1) is from about 15.8 to about 16.5.

168. The composition of any one of claim 135 to 167, where it comprises a PAG of structure (F-1) as defined in claim 136, and the mole ratio of the moles of repeat units of structure (Vp) to the mole % of said component F, said PAG of structure (F-1) is from about 16.0 to about 16.3.

169. The composition of any one of claim 135 to 168, where it comprises a triarylsulfonium carboxylate having structure (C-2) as defined in claim 140, and the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-2) is from

about 2.00 to about 1.38.

170. The composition of any one of claim 135 to 169, where it comprises a triarylsulfonium carboxylate having structure (C-2) as defined in claim 140, and the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-2) is from about 1.84 to about 1.50.

171. The composition of any one of claim 135 to 170, where it comprises a triarylsulfonium carboxylate having structure (C-2) as defined in claim 140, and the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-2) is from about 1.77 to about 1.57.

172. The composition of any one of claim 135 to 171, where it comprises a triarylsulfonium carboxylate having structure (C-2) as defined in claim 140, and the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-2) is from about 1.74 to about 1.61.

173. The composition of any one of claim 135 to 172, where it comprises a triarylsulfonium carboxylate having structure (C-2) as defined in claim 140, and the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-2) is from about 1.71 to about 1.65.

174. The composition of any one of claim 135 to 173, where it comprises a triarylsulfonium carboxylate having structure (C-2) as defined in claim 140, and the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-2) is from about 1.69 to about 1.66.

175. The composition of any one of claim 135 to 174, where it comprises an amide having structure (C-3) as defined in claim 142, and the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-3) is from about 0.00845 to about 0.012675.

176. The composition of any one of claim 135 to 175, where it comprises an amide having structure (C-3) as defined in claim 142, and the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-3) is from about 0.00951 to about 0.01162.

177. The composition of any one of claim 135 to 176, where it comprises an amide having structure (C-3) as defined in claim 142, and the mole ratio of said component A, said aryl sulfate

aryl onium salt PAG ranges to said acid quencher of structure (C-3) is from about 0.00993 to about 0.03438.

178. The composition of any one of claim 135 to 177, where it comprises an amide having structure (C-3) as defined in claim 142, and the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-3) is from about 0.03114 to about 0.03373.

179. The composition of any one of claim 135 to 178, where it comprises an amide having structure (C-3) as defined in claim 142, and the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-3) is from about 0.03179 to about 0.03308.

180. The composition of any one of claim 135 to 179, where it comprises an amide having structure (C-3) as defined in claim 142, and the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-3) is from about 0.03211 to about 0.0328.

181. The composition of any one of claim 135 to 180, where it comprises an amine having structure (C-5) as defined in claim 138, and the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-5) is about 1.582 to about 2.373.

182. The composition of any one of claim 135 to 181, where it comprises an amine having structure (C-5) as defined in claim 138, and the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-5) is about 1.779 to about 2.175.

183. The composition of any one of claim 135 to 182, where it comprises an amine having structure (C-5) as defined in claim 138, and the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-5) is about 1.859 to about 2.096.

184. The composition of any one of claim 135 to 183, where it comprises an amine having structure (C-5) as defined in claim 138, and the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-5) is about 1.898 to about 2.0567.

185. The composition of any one of claim 135 to 184, where it comprises an amine having structure (C-5) as defined in claim 138, and the mole ratio of said component A, said aryl sulfate aryl onium salt PAG ranges to said acid quencher of structure (C-5) is about 1.938 to about 2.0171.

186. The composition of any one of claim 135 to 185, where it comprises an amine having structure (C-5) as defined in claim 138, and the mole ratio of said component A, said aryl sulfate

aryl onium salt PAG ranges to said acid quencher of structure (C-5) is about 1.958 to about 1.997.

187. The composition of any one of claim 135 to 186, where it comprises a PAG of structure (F-1) as defined in claim 136 and a triarylsulfonium carboxylate having structure (C-2) as defined in claim 140, and the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-2), is about 61.9 to about 41.2.

188. The composition of any one of claim 135 to 187, where it comprises a PAG of structure (F-1) as defined in claim 136 and a triarylsulfonium carboxylate having structure (C-2) as defined in claim 140, and the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-2), is about 56.7 to about 46.4.

189. The composition of any one of claim 135 to 188, where it comprises a PAG of structure (F-1) as defined in claim 136 and a triarylsulfonium carboxylate having structure (C-2) as defined in claim 140, and the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-2), is about 54.6 to about 48.5.

190. The composition of any one of claim 135 to 189, where it comprises a PAG of structure (F-1) as defined in claim 136 and a triarylsulfonium carboxylate having structure (C-2) as defined in claim 140, and the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-2), is about 53.6 to about 49.5.

191. The composition of any one of claim 135 to 190, where it comprises a PAG of structure (F-1) as defined in claim 136 and a triarylsulfonium carboxylate having structure (C-2) as defined in claim 140, and the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-2), is about 52.6 to about 50.5.

192. The composition of any one of claim 135 to 191, where it comprises a PAG of structure (F-1) as defined in claim 136 and a triarylsulfonium carboxylate having structure (C-2) as defined in claim 140, and the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-2), is about 52.1 to about 51.0.

193. The composition of any one of claim 135 to 192, where it comprises a PAG of structure (F-1) as defined in claim 136 and an amide having structure (C-3) as defined in claim 142, and the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-3), is about 0.260 to about 0.391.

194. The composition of any one of claim 135 to 193, where it comprises a PAG of structure (F-1) as defined in claim 136 and an amide having structure (C-3) as defined in claim 142, and the

mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-3), is about 0.293 to about 0.358.

195. The composition of any one of claim 135 to 194, where it comprises a PAG of structure (F-1) as defined in claim 136 and an amide having structure (C-3) as defined in claim 142, and the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-3), is about 0.306 to about 0.345.

196. The composition of any one of claim 135 to 195, where it comprises a PAG of structure (F-1) as defined in claim 136 and an amide having structure (C-3) as defined in claim 142, and the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-3), is about 0.313 to about 0.339.

197. The composition of any one of claim 135 to 196, where it comprises a PAG of structure (F-1) as defined in claim 136 and an amide having structure (C-3) as defined in claim 142, and the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-3), is about 0.319 to about 0.332.

198. The composition of any one of claim 135 to 197, where it comprises a PAG of structure (F-1) as defined in claim 136 and an amide having structure (C-3) as defined in claim 142, and the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-3), is about 0.322 to about 0.329.

199. The composition of any one of claim 135 to 198, where it comprises a PAG of structure (F-1) as defined in claim 136 and an amine having structure (C-5) as defined in claim 138, and the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-5), is from about 19.28 to about 28.92.

200. The composition of any one of claim 135 to 199, where it comprises a PAG of structure (F-1) as defined in claim 136 and an amine having structure (C-5) as defined in claim 138, and the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-5), is from about 21.69 to about 26.51.

201. The composition of any one of claim 135 to 200, where it comprises a PAG of structure (F-1) as defined in claim 136 and an amine having structure (C-5) as defined in claim 138, and the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-5), is from about 22.65 to about 25.55.

202. The composition of any one of claim 135 to 201, where it comprises a PAG of structure (F-

1) as defined in claim 136 and an amine having structure (C-5) as defined in claim 138, and the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-5), is from about 23.14 to about 25.06.

203. The composition of any one of claim 135 to 202, where it comprises a PAG of structure (F-1) as defined in claim 136 and an amine having structure (C-5) as defined in claim 138, and the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-5), is from about 23.62 to about 24.58.

204. The composition of any one of claim 135 to 203, where it comprises a PAG of structure (F-1) as defined in claim 136 and an amine having structure (C-5) as defined in claim 138, and the mole ratio of said component F, said PAG of structure (F-1) to said acid quencher of structure (C-5), is from about 23.62 to about 24.58.

205. The composition of any one of claim 135 to 204, where it comprises a PAG of structure (F-1) as defined in claim 136, a triarylsulfonium carboxylate having structure (C-2) as defined in claim 140, an amide having structure (C-3) as defined in claim 142 and an amine having structure (C-5) as defined in claim 138, and the mole ratio of the sum of PAG of structure (F-1) and said aryl sulfate aryl onium salt PAG to the sum of moles of an acid quencher of structures (C-2), (C-3) and (C-5) is about 0.399 to about 0.266.

206. The composition of any one of claim 135 to 205, where it comprises a PAG of structure (F-1) as defined in claim 136, a triarylsulfonium carboxylate having structure (C-2) as defined in claim 140, an amide having structure (C-3) as defined in claim 142 and an amine having structure (C-5) as defined in claim 138, and the mole ratio of the sum of PAG of structure (F-1) and said aryl sulfate aryl onium salt PAG to the sum of moles of an acid quencher of structures (C-2), (C-3) and (C-5) is about 0.366 to about 0.300.

207. The composition of any one of claim 135 to 206, where it comprises a PAG of structure (F-1) as defined in claim 136, a triarylsulfonium carboxylate having structure (C-2) as defined in claim 140, an amide having structure (C-3) as defined in claim 142 and an amine having structure (C-5) as defined in claim 138, and the mole ratio of the sum of PAG of structure (F-1) and said aryl sulfate aryl onium salt PAG to the sum of moles of an acid quencher of structures (C-2), (C-3) and (C-5) is about 0.352 to about 0.312.

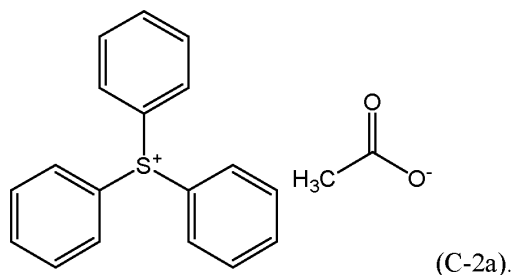
208. The composition of any one of claim 135 to 207, where it comprises a PAG of structure (F-1) as defined in claim 136, a triarylsulfonium carboxylate having structure (C-2) as defined in claim

140, an amide having structure (C-3) as defined in claim 142 and an amine having structure (C-5) as defined in claim 138, and the mole ratio of the sum of PAG of structure (F-1) and said aryl sulfate aryl onium salt PAG to the sum of moles of an acid quencher of structures (C-2), (C-3) and (C-5) is about 0.346 to about 0.319.

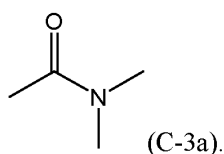
209. The composition of any one of claim 135 to 208, where it comprises a PAG of structure (F-1) as defined in claim 136, a triarylsulfonium carboxylate having structure (C-2) as defined in claim 140, an amide having structure (C-3) as defined in claim 142 and an amine having structure (C-5) as defined in claim 138, and the mole ratio of the sum of PAG of structure (F-1) and said aryl sulfate aryl onium salt PAG to the sum of moles of an acid quencher of structures (C-2), (C-3) and (C-5) is about 0.346 to about 0.319.

210. The composition of any one of claim 135 to 209, where it comprises a PAG of structure (F-1) as defined in claim 136, a triarylsulfonium carboxylate having structure (C-2) as defined in claim 140, an amide having structure (C-3) as defined in claim 142 and an amine having structure (C-5) as defined in claim 138, and the mole ratio of the sum of PAG of structure (F-1) and said aryl sulfate aryl onium salt PAG to the sum of moles of an acid quencher of structures (C-2), (C-3) and (C-5) is about 0.339 to about 0.326.

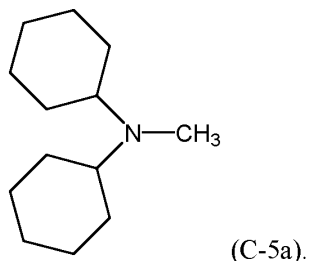
211. The composition of any one of claim 135 to 210, where it comprises an acid quencher having structure (C-2) as defined in claim 140 and said acid quencher of structure (C-2) has structure (C-2a),



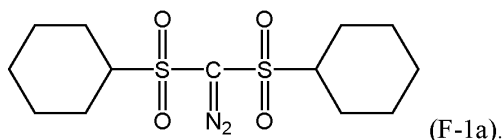
212. The composition of any one of claim 135 to 211, where it comprises an acid quencher having structure (C-3) as defined in claim 142 and said acid quencher of structure (C-3) has structure (C-3a),



213. The composition of any one of claim 135 to 212, it comprises an acid quencher having structure (C-5) as defined in claim 138 and where said acid quencher of structure (C-5) has structure (C-5a),



214. The composition of any one of claim 135 to 213, where it comprises a PAG of structure (F-1) as defined in claim 136 and said component F, said PAG of structure (F-1) has structure (F-1a),



215. The composition of any one of claim 135 to 214, wherein said Component D, said organic spin casting solvent is selected from a glycol ether derivative, a glycol ether ester derivative, an alkyl carboxylate, an alkyl carboxylates of di-basic carboxylic acid, an alkyl dicarboxylates, a alkyl ester of a hydroxyalkylcarboxylic acid, a ketone ester, a ketone, a ketone ether, a ketone alcohol, a ketal, an acetal and a lactones, an amide and mixtures thereof.

216. The composition of any one of claims 1 to 215, which additionally comprises a surfactant.

217. A process of forming a positive image by exposure to radiation, comprising step ia) to va)

ia) coating any one of the compositions of claims 1 to 216, on a substrate, forming a coated film,

iiia) baking said coated film to form a baked film,

iiia) exposing regions of said baked film through a mask with radiation, forming exposed and unexposed regions,

iva) baking said radiation exposed film of step iiia),

va) developing away the unexposed regions of said radiation exposed and baked film of step iva) forming a positive image on said substrate.

218. The use of the composition of any one of claims 1 to 216 for coating a substrate, preferably in a photolithographic process.