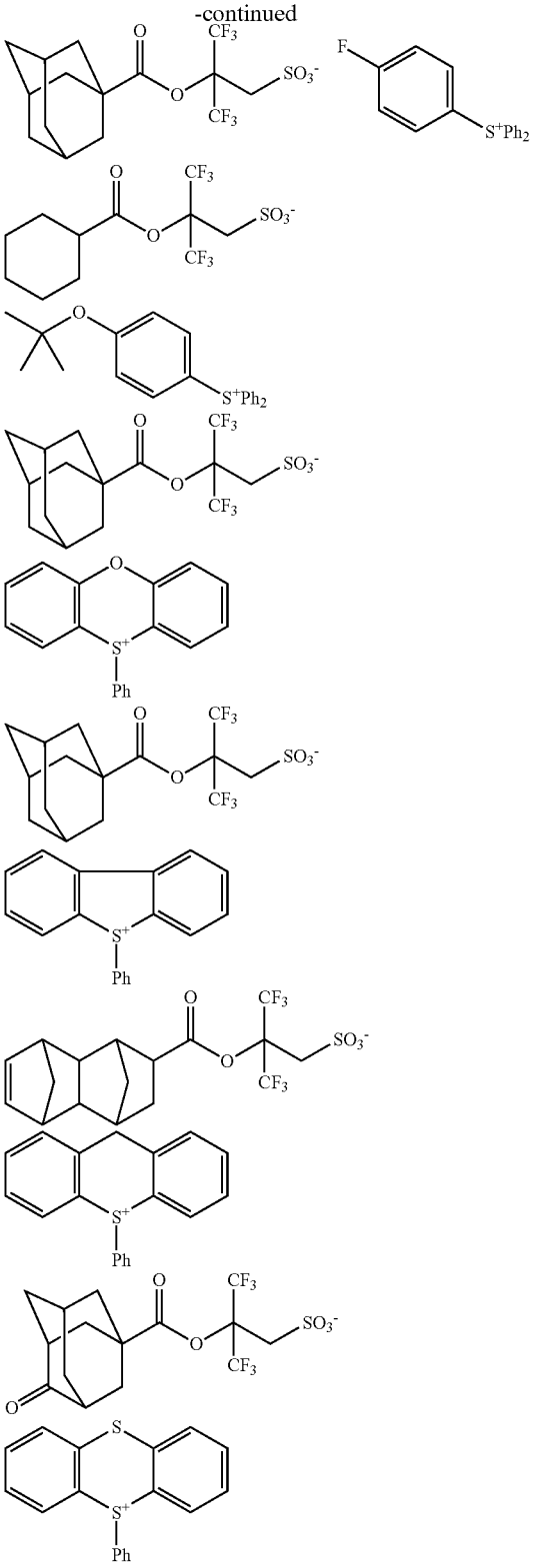
-continued



Notably, the compound having the anion of formula (8) does not have fluorine at the α-position relative to the sulfo group, but two trifluoromethyl groups at the β-position. For this reason, it has a sufficient acidity to sever the acid labile groups in the resist polymer. Thus the compound is an effective PAG.

Of the foregoing PAG's, those compounds having the structure of formula (5') or formula (8) are preferred because of suppressed acid diffusion and high solubility in the resist solvent.

The amount of the PAG (C) added is preferably 0 to 40 parts, specifically 0.1 to 40 parts if used, more preferably 0.1 to 20 parts by weight per 100 parts by weight of the base resin. Too large an amount of the PAG may give rise to problems such as degraded resolution and foreign particles during development and resist film stripping.

(D) Nitrogen-Containing Compound

To the resist composition, a nitrogen-containing compound may be added as the quencher. The inclusion of the nitrogen-containing compound holds down the diffusion rate at which the acid generated by PAG diffuses within the resist film. Suitable nitrogen-containing compounds include primary, secondary and tertiary amine compounds, specifically amine compounds having a hydroxyl group, ether bond, ester bond, lactone ring, cyano group or sulfonate bond, as described in JP-A 2008-111103, paragraphs [0146] to [0164] (U.S. Pat. No. 7,537,880). Also useful are compounds whose primary or secondary amine is protected in carbamate form as described in JP 3790649.

The quenchers may be used alone or in admixture of two or more. The quencher is preferably used in an amount of 0.001 to 12 parts, more preferably 0.01 to 8 parts by weight per 100 parts by weight of the base resin. The inclusion of quencher facilitates adjustment of resist sensitivity and holds down the rate of acid diffusion within the resist film, resulting in better resolution. In addition, it suppresses changes in sensitivity following exposure and reduces substrate and environment dependence, as well as improving the exposure latitude and the pattern profile. The inclusion of quencher is also effective for improving adhesion to the substrate.

Also, a PAG having a nitrogen-containing substituent may be used in combination. This compound functions as quencher in the unexposed region and as so-called photo-degradable base, which loses quencher ability through neutralization with the acid generated by itself, in the exposed region. The use of photo-degradable base is effective for enhancing the contrast between exposed and unexposed regions. With respect to the photo-degradable base, reference may be made to JP-A 2009-109595 and JP-A 2012-046501, for example.

(E) Organic Solvent

The organic solvent (E) used herein may be any organic solvent in which the polymer (base resin), PAG, quencher, and other components are soluble. Examples of the organic solvent include ketones such as cyclohexanone and methyl 2-n-amyl ketone; alcohols such as 3-methoxybutanol, 3-methyl-3-methoxybutanol, 1-methoxy-2-propanol, and 1-ethoxy-2-propanol; ethers such as propylene glycol monomethyl ether, ethylene glycol monomethyl ether, propylene glycol monoethyl ether, ethylene glycol monoethyl ether, propylene glycol dimethyl ether, and diethylene glycol dimethyl ether; esters such as propylene glycol monomethyl ether acetate (PGMEA), propylene glycol monoethyl ether acetate, ethyl lactate, ethyl pyruvate, butyl acetate, methyl 3-methoxypropionate, ethyl 3-ethoxypropionate, tert-butyl acetate, tert-butyl propionate, and propylene glycol mono-tert-butyl ether acetate; and lactones such as γ-butyrolactone, and mixtures thereof, as described in JP-A 2008-111103, paragraphs [0144] to [0145]. Where an acid labile group of acetal type is used, a high-boiling alcohol solvent may be added for accelerating deprotection reaction of acetal, for example, diethylene glycol, propylene glycol, glycerol, 1,4-butanediol, or 1,3-butanediol. Of the above organic solvents,