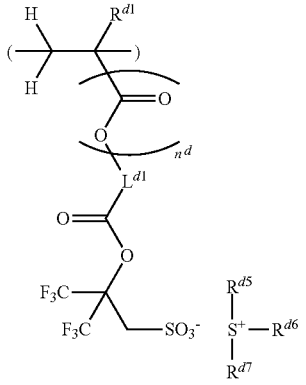
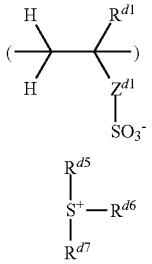
-continued

(c3)



(c4)



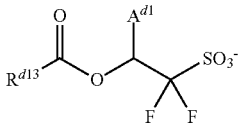
In formulae (c1) to (c4), R^{d1} is each independently hydrogen, fluorine, methyl or trifluoromethyl. R^{d2} is a single bond, phenylene group, —O—R^{d11}—, or —C(=O)—Y^{d1}—R^{d11}—, wherein Y^{d1} is —O— or —NH—, and R^{d11} is a C_1-C_{20} straight, branched or cyclic alkylene group, C_2-C_{20} straight, branched or cyclic alkenylene group, or phenylene group, which may contain a heteroatom. R^{d3}, R^{d4}, R^{d5}, R^{d6} and R^{d7} are each independently a C_1-C_{20} straight, branched or cyclic monovalent hydrocarbon group which may contain a heteroatom. Any two of R^{d2}, R^{d3} and R^{d4} may bond together to form a ring with the sulfur atom to which they are attached, and any two of R^{d5}, R^{d6} and R^{d7} may bond together to form a ring with the sulfur atom to which they are attached. Xd^- is a non-nucleophilic counter ion. A^{d1} is hydrogen or trifluoromethyl. L^{d1} is a single bond or a C_1-C_{20} straight, branched or cyclic divalent hydrocarbon group which may contain a heteroatom. The subscript n^d is 0 or 1, and n^d is 0 when L^{d1} is a single bond. Z^{d1} is a single bond, methylene, ethylene, phenylene, fluorinated phenylene, —O—R^{d11}, or —C(=O)—Y^{d1}—R^{d12}— wherein R^{d12} is an optionally substituted phenylene group.

In formulae (c1) to (c4), preferably R^{d2} to R^{d7} are each independently a structure containing a phenyl group which bonds with S^+ in the formula.

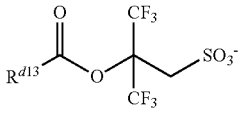
Examples of the non-nucleophilic counter ion represented by Xd^- in formula (c1) include halide ions such as chloride and bromide ions; fluoroalkylsulfonate ions such as triflate, 1,1,1-trifluoroethanesulfonate, and nonafluorobutanesulfonate; arylsulfonate ions such as tosylate, benzenesulfonate, 4-fluorobenzenesulfonate, and 1,2,3,4,5-pentafluorobenzenesulfonate; alkylsulfonate ions such as mesylate and butanesulfonate; imides such as bis(trifluoromethylsulfonyl)imide, bis(perfluoroethylsulfonyl)imide, and bis(perfluorobutylsulfonyl)imide; and methides such as tris(trifluoromethylsulfonyl)methide and tris(perfluoroethylsulfonyl)methide.

Other non-nucleophilic counter ions include anions having the formulae (c5) and (c6).

(c5)



(c6)



In formulae (c5) and (c6), A^{d1} is as defined above, and R^{d13} is a C_1-C_{40} straight, branched or cyclic monovalent hydrocarbon group which may contain a heteroatom.

The anion moiety of formula (c5) is exemplified by the aforementioned structures of the anion of formula (3), (4) or (5) and those structures illustrated in JP-A 2014-177407, paragraphs [0100]-[0101]. The anion moiety of formula (c6) is exemplified by the aforementioned structures of the anion of formula (3), (4) or (5) and those structures illustrated in JP-A 2010-215608, paragraphs [0080]-[0081].

Illustrative structures of the anion moiety in formula (c2) include those described in JP-A 2014-177407, paragraphs [0021]-[0026]. Illustrative structures of the anion moiety in formula (c2) wherein A^{d1} is hydrogen include those described in JP-A 2010-116550, paragraphs [0021]-[0028]. Illustrative structures of the anion moiety in formula (c2) wherein Ad is trifluoromethyl include those described in JP-A 2010-077404, paragraphs [0021]-[0027]. Illustrative structures of the cation moiety in formula (c2) include those described in JP-A 2008-158339, paragraph [0223].

Illustrative structures of the anion moiety in formula (c3) include the structures illustrated for formula (c2) wherein —$CH(A^{d1})CF_2SO_3^-$ is replaced by —$C(CF_3)_2CH_2SO_3^-$.

Illustrative structures of the sulfonium cation in formulae (c2) to (c4) include those cations described in JP-A 2008-158339, paragraph [0223] and those cations in the onium salt having formula (6) which will be exemplified later.

The polymer as the base resin may have further copolymerized therein recurring units of the structure having a hydroxyl group protected with an acid labile group. The recurring unit of the structure having a hydroxyl group protected with an acid labile group is not particularly limited as long as it has one or more protected hydroxyl-bearing structure such that the protective group may be decomposed to generate a hydroxyl group under the action of acid. Examples of these recurring units include those described in JP-A 2014-225005, paragraphs [0055]-[0065] and JP-A 2015-214634, paragraphs [0110]-[0115].

In addition to the foregoing units, the polymer may further comprise other recurring units, for example, recurring units having an oxirane ring or oxetane ring. The inclusion of recurring units having an oxirane or oxetane ring ensures that the exposed region of resist film is improved in film retention and etch resistance because the exposed region is crosslinked.

Also included in the other recurring units are units derived from substituted acrylates such as methyl methacrylate, methyl crotonate, dimethyl maleate, and dimethyl itaconate; unsaturated carboxylic acids such as maleic acid, fumaric acid, and itaconic acid; cyclic olefins such as norbornene, norbornene derivatives, and tetracyclo[6.2.1.1^{3,6}.0^{2,7}]dodecane derivatives; unsaturated acid anhydrides such as itaconic anhydride; vinyl aromatics such as styrene, vinylnaphthalene, hydroxystyrene, hydroxyvinylnaphthalene,