CLAIMS

1. A coating liquid for resist pattern coating comprising:

a component A: a polymer including at least one hydroxy group or carboxy group;

a component B: a sulfonic acid of $A\text{-}SO_3H$ where A is a linear or branched alkyl group or fluorinated alkyl group having a carbon atom number of 1 to 16, an aromatic group having at least one of the alkyl group or the fluorinated alkyl group as a substituent, or a $C_{4\text{-}16}$ alicyclic group optionally having a substituent; and

a component C: an organic solvent capable of dissolving the polymer and including a compound of $R^1\text{-}O\text{-}R^2$ and/or $R^1\text{-}C(=O)\text{-}R^2$ where $R^1$ is a linear, branched, or cyclic alkyl group or fluorinated alkyl group having a carbon atom number of 3 to 16; and $R^2$ is a linear, branched, or cyclic alkyl group or fluorinated alkyl group having a carbon atom number of 1 to 16;

wherein the polymer being the component A is a polymer having a structure unit of Formula (A) below with the proviso that the polymer having the structure unit of Formula (A) below includes at least one hydroxy group or carboxy group, or at least one hydroxy group or carboxy group and a linear or branched alkyl group having a carbon atom number of 1 to 10 in which a halogen atom is optionally substituted for at least one hydrogen atom:




(A)

where $R^0$ is a hydrogen atom or methyl group;

L is a divalent aromatic group optionally having at least one substituent, -C(=O)-O- group or -C(=O)-NH- group, and a carbon atom of the -C(=O)-O- group or the -C(=O)-NH- group is bonded to the main chain of the polymer;

X is a hydrogen atom or a linear or branched alkyl group having a carbon atom number of 1 to 10 or an alkoxy group having a carbon atom number of 1 to 10, and a

halogen atom or hydroxy group is optionally substituted for at least one hydrogen atom of the alkyl group; and

wherein the polymer being the component A is a copolymer having at least two structure units of Formula (A), and

the copolymer has:

a structural unit of a divalent aromatic group optionally having at least one substituent as L; and

a structure unit of -C(=O)-O- group and/or a structure unit of -C(=O)-NH- group as L.

2. The coating liquid for resist pattern coating according to claim 1, wherein the polymer being the component A further includes a linear, branched, or cyclic alkyl group having a carbon atom number of 1 to 10 in which a halogen atom is optionally substituted for at least one hydrogen atom.

3. The coating liquid for resist pattern coating according to claim 1 or 2, wherein the divalent aromatic group in L is phenylene group or naphthylene group.

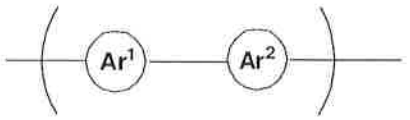
4. A coating liquid for resist pattern coating comprising:

a component A: a polymer including at least one hydroxy group or carboxy group;

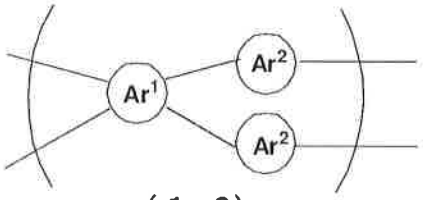
a component B: a sulfonic acid of $A\text{-}SO_3H$ where A is a linear or branched alkyl group or fluorinated alkyl group having a carbon atom number of 1 to 16, an aromatic group having at least one of the alkyl group or the fluorinated alkyl group as a substituent, or a $C_{4\text{-}16}$ alicyclic group optionally having a substituent; and

a component C: an organic solvent capable of dissolving the polymer and including a compound of $R^1\text{-}O\text{-}R^2$ and/or $R^1\text{-}C(=O)\text{-}R^2$ where $R^1$ is a linear, branched, or cyclic alkyl group or fluorinated alkyl group having a carbon atom number of 3 to 16; and $R^2$ is a linear, branched, or cyclic alkyl group or fluorinated alkyl group having a carbon atom number of 1 to 16;

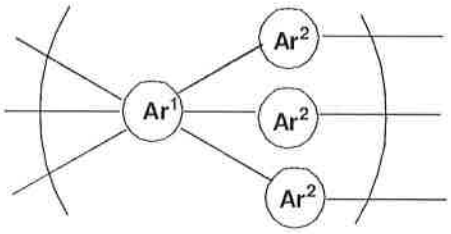
wherein the polymer being the component A is a polymer having a structure unit of any one of Formulas (1-1) to (1-4) below, or a polymer having a structure unit of any one of Formulas (1-1) to (1-4) below and optionally including a linear or branched alkyl group having a carbon atom number of 1 to 10 in which a halogen atom is optionally substituted for at least one hydrogen atom:



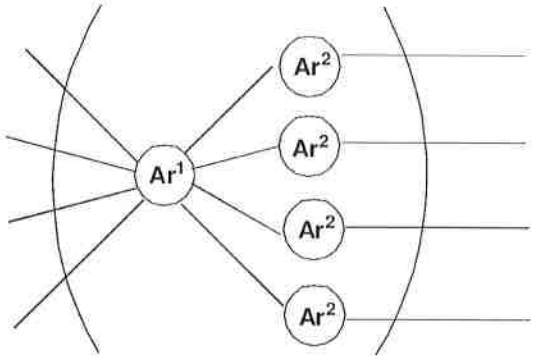

(1−1)




(1−2)




(1−3)



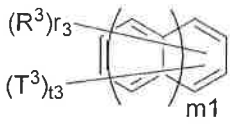

(1−4)

where $Ar^1$ is a divalent, tetravalent, hexavalent, or octavalent organic group including at least one $C_{6-18}$ aromatic ring; $Ar^2$ is a divalent organic group including a $C_{6-18}$ aromatic ring bonded to $Ar^1$ through methylene group or a tertiary carbon atom, and at least one of the aromatic rings have hydroxy group and/or carboxy group as a substituent.

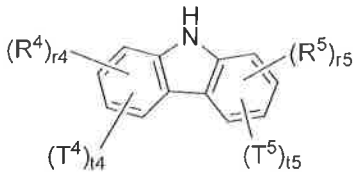
5. The coating liquid for resist pattern coating according to claim 4, wherein

the divalent, tetravalent, hexavalent, or octavalent organic group of $Ar^1$ is a group having bonded ends bonded to any two, four, six, or eight positions of aromatic rings in a compound of any one of Formulas (2-1) to (2-5) below, and

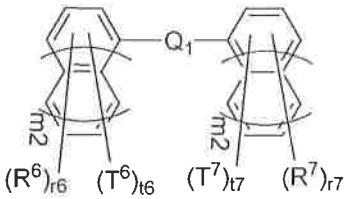
$Ar^2$ is a divalent organic group of Formula (3-1) below, or a divalent organic group of Formula (3- 2) below:



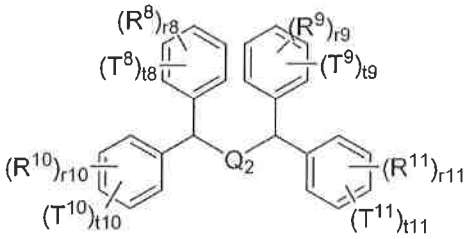

(2-1)



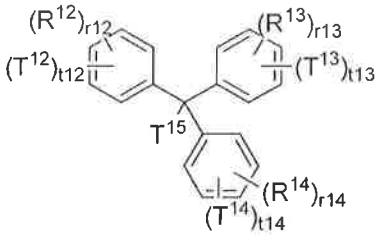

(2-2)



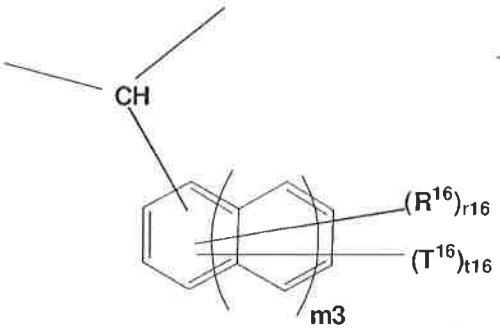

(2-3)



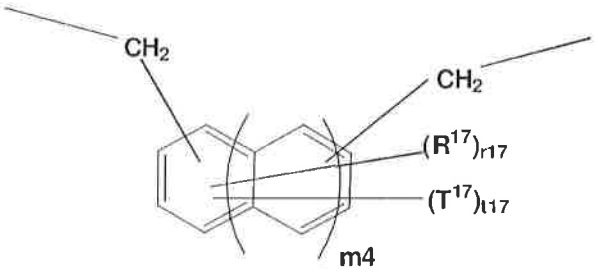

(2-4)




(2-5)




(3-1)




(3-2)

where $R^3$ to $R^{14}$, $R^{16}$, and $R^{17}$ are each independently a linear, branched, or cyclic alkyl group having a carbon atom number of 1 to 10, a linear or branched alkoxy group having a carbon atom number of 1 to 9, a halogen atom, nitro group, cyano group, acetoxy group, methylthio group, or amino group; hydroxy group or a halogen atom is optionally substituted for at least one hydrogen atom of the alkyl group; a linear or branched alkyl group having a carbon atom number of 1 to 3 is optionally substituted for at least one hydrogen atom of the amino group; $T^3$ to $T^{14}$, $T^{16}$, and $T^{17}$ are each

independently hydroxy group or carboxy group; $T^{15}$ is a hydrogen atom or methyl group; $Q_1$ and $Q_2$ are each independently a single bond, an oxygen atom, a sulfur atom, sulfonyl group, carbonyl group, imino group, a $C_{6-40}$ arylene group, or a linear, branched, or cyclic alkylene group having a carbon atom number of 1 to 10; a halogen atom is optionally substituted for at least one hydrogen atom of the alkylene group; m1 to m4 are each independently an integer of 0 to 2; r4, r5, and r8 to r14 are each independently an integer of 0 to 2; t4, t5, and t8 to t14 are each independently an integer of 0 to 2; r3, r6, r7, and r17 are each independently an integer of 0 to 8; t3, t6, t7, and t17 are each independently an integer of 0 to 8; r16 is an integer of 0 to 9; t16 is an integer of 0 to 9; and the sum of r3 and t3, the sum of r4 and t4, the sum of r5 and t5, the sum of r6 and t6, the sum of r7 and t7, the sum of r8 and t8, the sum of r9 and t9, the sum of r10 and t10, the sum of r11 and t11, the sum of r12 and t12, the sum of r13 and t13, the sum of r14 and t14, the sum of r16 and t16, and the sum of r17 and t17 are each independently an integer of 1 to 10.

6. The coating liquid for resist pattern coating according to claim 4 or 5, wherein the polymer being the component A has a weight average molecular weight of 1,000 to 20,000.

7. The coating liquid for resist pattern coating according to any one of claims 1 to 3, wherein the polymer being the component A has a weight average molecular weight of 1,000 to 2,000.

8. The coating liquid for resist pattern coating according to any one of claims 1 to 7, wherein the aromatic group of A in the formula of the sulfonic acid is phenyl group or naphthyl group.

9. The coating liquid for resist pattern coating according to claim 1 to 7, wherein in the formula of the sulfonic acid, the group of A is a linear or branched alkyl group or fluorinated alkyl group having a carbon atom number of 4 to 12, or phenyl group

having at least one of the alkyl group or the fluorinated alkyl group as a substituent, and

the sulfonic acid has a content ratio of 0.5% by mass to 60% by mass relative to the polymer being the component A.

10. The coating liquid for resist pattern coating according to any one of claims 1 to 9, including 1 ppm by mass to 1% by mass of water.

11. A method for forming a resist pattern comprising the steps of:

forming a resist pattern on a substrate on which an underlayer film is formed;

applying the coating liquid for resist pattern coating as claimed in any one of claims 1 to 10 so that the resist pattern is coated with the coating liquid for resist pattern coating;

heating the substrate onto which the coating liquid for resist pattern coating is applied at 50°C to 130°C to form a coated film on a surface of the resist pattern;

cooling the heated substrate and thereafter developing the coated film with a developing liquid; and

rinsing the resist pattern with a rinsing liquid after developing the coated film with the developing liquid.

12. A method for forming a reverse pattern comprising the steps of:

forming a resist pattern on a substrate on which an underlayer film is formed;

applying a coating liquid for resist pattern coating comprising

a component A: a polymer including at least one hydroxy group or carboxy group;

a component B: a sulfonic acid of A-$SO_3H$ where A is a linear or branched alkyl group or fluorinated alkyl group having a carbon atom number of 1 to 16, an aromatic group having at least one of the alkyl group or the fluorinated alkyl group as a substituent, or a $C_{4-16}$ alicyclic group optionally having a substituent; and

a component C: an organic solvent capable of dissolving the polymer and including a compound of $R^1$-O-$R^2$ and/or $R^1$-C(=O)-$R^2$ where $R^1$ is a linear, branched, or cyclic alkyl group or fluorinated alkyl group having a carbon atom number of 3 to 16; and $R^2$ is

a linear, branched, or cyclic alkyl group or fluorinated alkyl group having a carbon atom number of 1 to 16, so that the resist pattern is coated with the coating liquid for resist pattern coating;

heating the substrate onto which the coating liquid for resist pattern coating is applied at 50°C to 130°C to form a coated film on a surface of the resist pattern;

cooling the heated substrate and thereafter developing the coated film with a developing liquid;

applying a second coating liquid including polysiloxane and a solvent including water and/or alcohols so that a space between patterns of the resist pattern after developing the coated film with the developing liquid is filled with the second coating liquid;

removing or reducing components except polysiloxane included in the second coating liquid and the developing liquid to form a coated film;

carrying out etch-back of the coated film to expose an upper surface of the resist pattern after developing with the developing liquid; and

removing the resist pattern the upper surface of which is exposed.

13. A method for forming a reverse pattern comprising the steps of:

forming a resist pattern on a substrate on which an underlayer film is formed;

applying a coating liquid for resist pattern coating comprising

a component A: a polymer including at least one hydroxy group or carboxy group;

a component B: a sulfonic acid of A-$SO_3H$ where A is a linear or branched alkyl group or fluorinated alkyl group having a carbon atom number of 1 to 16, an aromatic group having at least one of the alkyl group or the fluorinated alkyl group as a substituent, or a $C_{4-16}$ alicyclic group optionally having a substituent; and

a component C: an organic solvent capable of dissolving the polymer and including a compound of $R^1$-O-$R^2$ and/or $R^1$-C(=O)-$R^2$ where $R^1$ is a linear, branched, or cyclic alkyl group or fluorinated alkyl group having a carbon atom number of 3 to 16; and $R^2$ is a linear, branched, or cyclic alkyl group or fluorinated alkyl group having a carbon atom

number of 1 to 16, so that the resist pattern is coated with the coating liquid for resist pattern coating;

heating the substrate onto which the coating liquid for resist pattern coating is applied at 50°C to 130°C to form a coated film on a surface of the resist pattern;

cooling the heated substrate and thereafter developing the coated film with a developing liquid;

rinsing the resist pattern with a rinsing liquid after developing the coated film with the developing liquid;

applying a second coating liquid including polysiloxane and a solvent including water and/or alcohols so that a space between patterns of the resist pattern after rinsing with the rinsing liquid is filled with the second coating liquid;

removing or reducing components except polysiloxane included in the second coating liquid and the rinsing liquid to form a coated film;

carrying out etch-back of the coated film to expose an upper surface of the resist pattern after rinsing with the rinsing liquid; and

removing the resist pattern the upper surface of which is exposed.