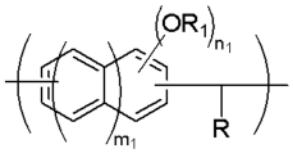
CLAIMS

1. A composition for forming an organic film, comprising:

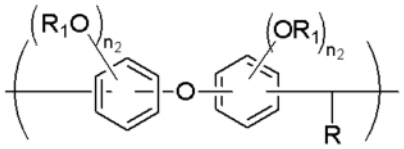
(A) an aromatic ring-containing resin;

(B) a polymer containing a repeating unit containing a β-diketone structure represented by the following formula (1):

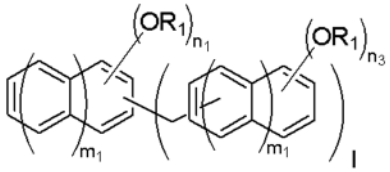
wherein the (A) aromatic ring-containing resin is a resin containing any one selected from polymers having a repeating unit represented by the following formula (P-1) or (P-2) and compounds represented by any of formulae (P-3) to (P-6):



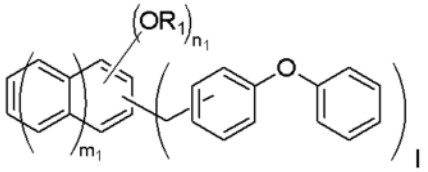
(P − 1)



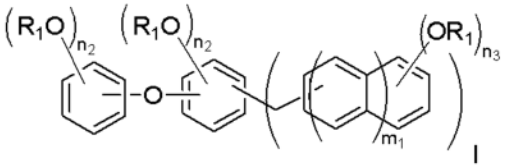
(P − 2)



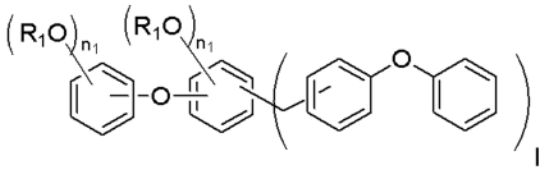
(P − 3)



(P − 4)



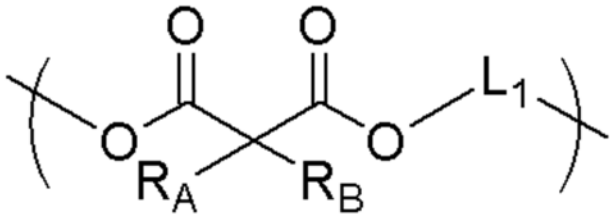
(P − 5)



(P − 6)

wherein R is a hydrogen atom or a substituted or unsubstituted benzene ring or naphthalene ring, R_1 is a hydrogen atom or a saturated or unsaturated hydrocarbon group having 1 to 20 carbon atoms; m_1 is an integer of 0 or 1; n_1 is an integer from 1 to 4; n_2 is an integer of 1

or 2; n_3 is an integer from 0 to 2; and l is an integer from 5 to 20, provided that l represents a equivalence ratio of a benzene ring, naphthalene ring, diphenyl ether containing a methylol group or a methoxymethyl group reacted to a compound containing an aromatic ring containing a hydroxy group, at condensation reaction of synthesizing aromatic ring-containing compounds (P-3) to (P-6)],



(1)

wherein L_1 is a saturated or unsaturated, linear or branched divalent hydrocarbon group having 2 to 20 carbon atoms, where the hydrocarbon group may be interrupted one or more times by an atom selected from oxygen, nitrogen and sulfur, R_A and R_B are the same or different from each other and each are a hydrogen atom, a substituted or unsubstituted linear alkyl group having 1 to 20 carbon atoms, a substituted or unsubstituted branched or cyclic alkyl group having 3 to 20 carbon atoms, a substituted or unsubstituted aliphatic unsaturated hydrocarbon group having 2 to 20 carbon atoms and containing one or more double or triple bonds, a substituted or unsubstituted heteroalkyl group having 1 to 30 carbon atoms, a substituted or unsubstituted aryl group having 6 to 30 carbon atoms, a thiol group, a hydroxy group, an amino group, a carboxy group, or a halogen group; and

(C) a solvent.

2. The composition for forming an organic film according to claim 1, wherein the aromatic ring-containing resin (A) contains hydrogen at a position in diaryl methylene or hydrogen at a position in trityl.

3. The composition for forming an organic film according to claim 2, wherein an aromatic ring in the (A) aromatic ring-containing resin contains a hydroxy group as a substituent.

4. The composition for forming an organic film according to claim 1, wherein R_A and R_B each are a hydrogen atom, a substituted or unsubstituted linear alkyl group having 1 to 20 carbon atoms, a substituted or unsubstituted branched or cyclic alkyl group having 3 to 20 carbon atoms, or a substituted or unsubstituted aliphatic unsaturated hydrocarbon group having 2 to 20 carbon atoms and containing one or more double or triple bonds.

5. The composition for forming an organic film according to claim 1, wherein R_A and R_B each are a hydrogen atom.

6. The composition for forming an organic film according to claim 1, wherein L_1 is a saturated or unsaturated linear or branched hydrocarbon group having 2 to 20 carbon atoms and containing no heteroatoms.

7. The composition for forming an organic film according to claim 1, wherein the composition comprises 0.5 to 30 parts by mass of the (B) polymer containing a repeating unit containing a β-diketone structure based

on 100 parts by mass of the (A) aromatic ring-containing resin.

8. The composition for forming an organic film according to claim 1, wherein the (C) solvent is a mixture of a solvent having a high boiling point and a solvent having a low boiling point.

9. The composition for forming an organic film according to claim 1, wherein the composition further comprises one or more of (D) a crosslinking agent and (E) a surfactant.

10. A method for forming an organic film that functions as an organic flat film used in a process for manufacturing a semiconductor device, comprising:

spin-coating a substrate to be processed with the composition for forming an organic film according to any one of claims 1 to 9; and

heat-treating the substrate coated with the composition for forming an organic film at a temperature of 100°C or higher and 600°C or lower for a period of time of 10 to 600 seconds to form a cured film.

11. A method for forming an organic film that functions as an organic flat film used in a process for manufacturing a semiconductor device, comprising:

spin-coating a substrate to be processed with the composition for forming an organic film according to any one of claims 1 to 9; and

heat-treating the substrate coated with the composition for forming an organic film in an atmosphere having an oxygen concentration of 0.1% or more and 21%

or less to form a cured film.

12. The method for forming an organic film according to claim 10, wherein the substrate to be processed is a substrate to be processed having a structure or step with a height of 30 nm or more.

13. A patterning process comprising:

forming an organic film on a body to be processed using the composition for forming an organic film according to any one of claims 1 to 9;

forming a resist middle layer film on the organic film using a resist middle layer film material containing a silicon atom;

forming a resist upper layer film on the resist middle layer film using a resist upper layer film material comprising a photoresist composition;

forming a circuit pattern on the resist upper layer film;

transferring a pattern by etching to the resist middle layer film using the resist upper layer film on which the circuit pattern is formed as a mask;

transferring a pattern by etching to the organic film using the resist middle layer film on which the pattern is transferred as a mask; and

further transferring a pattern by etching to the body to be processed using the organic film on which the pattern is transferred as a mask.

14. A patterning process comprising:

forming an organic film on a body to be processed using the composition for forming an organic film according to any one of claims 1 to 9;

forming a resist middle layer film on the organic film using a resist middle layer film material containing a silicon atom;

forming an organic anti-reflection film on the resist middle layer film;

forming a resist upper layer film on the organic anti-reflection film using a resist upper layer film material comprising a photoresist composition;

forming a circuit pattern on the resist upper layer film;

transferring a pattern by etching to the organic anti-reflection film and the resist middle layer film using the resist upper layer film on which the circuit pattern is formed as a mask;

transferring a pattern by etching to the organic film using the resist middle layer film on which the pattern is transferred as a mask; and

further transferring a pattern by etching to the body to be processed using the organic film on which the pattern is transferred as a mask.

15. A patterning process comprising:

forming an organic film on a body to be processed using the composition for forming an organic film according to any one of claims 1 to 9;

forming an inorganic hard mask selected from a silicon oxide film, a silicon nitride film, and a silicon oxide nitride film on the organic film;

forming a resist upper layer film on the inorganic hard mask using a resist upper layer film material comprising a photoresist composition;

forming a circuit pattern on the resist upper layer film;

transferring a pattern by etching to the inorganic hard mask using the resist upper layer film on which the circuit pattern is formed as a mask;

transferring a pattern by etching to the organic film using the inorganic hard mask on which the pattern is transferred as a mask; and

further transferring a pattern by etching to the body to be processed using the organic film on which the pattern is transferred as a mask.

16. A patterning process comprising:

forming an organic film on a body to be processed using the composition for forming an organic film according to any one of claims 1 to 9;

forming an inorganic hard mask selected from a silicon oxide film, a silicon nitride film, and a silicon oxide nitride film on the organic film;

forming an organic anti-reflection film on the inorganic hard mask;

forming a resist upper layer film on the organic anti-reflection film using a resist upper layer film material comprising a photoresist composition;

forming a circuit pattern on the resist upper layer film;

transferring a pattern by etching to the organic anti-reflection film and the inorganic hard mask using the resist upper layer film on which the circuit pattern is formed as a mask;

transferring a pattern by etching to the organic film using the inorganic hard mask on which the pattern is transferred as a mask; and

further transferring a pattern by etching to the body to be processed using the organic film on which the

pattern is transferred as a mask.

17. A patterning process according to claim 15, wherein the inorganic hard mask is formed by a CVD method or an ALD method.