CLAIMS

1. A composition for forming a film for semiconductor devices, comprising:

a compound (A) including a Si-O bond and a cationic functional group containing at least one of a primary nitrogen atom or a secondary nitrogen atom;

a crosslinking agent (B) which includes three or more -C(=O)OX groups (X is a hydrogen atom or an alkyl group having from 1 to 6 carbon atoms) in a molecule, wherein from one to six of the three or more -C(=O)OX groups are -C(=O)OH groups, and which has a weight average molecular weight of from 200 to 600;

a polar solvent (D); and

at least one additive (C) selected from the group consisting of an acid (C-1) having a carboxy group and having a weight average molecular weight of from 46 to 195 and a base (C-2) having a nitrogen atom and having a weight average molecular weight of from 17 to 120, wherein;

Si and non-crosslinkable groups bonded to Si included in the compound (A) satisfy a relationship of (non-crosslinkable group)/Si < 2 in terms of molar ratio.

2. A composition for forming a film for semiconductor devices, comprising:

a compound (A) including a Si-O bond and a cationic functional group containing at least one of a primary nitrogen atom or a secondary nitrogen atom, and having a weight average molecular weight of from 130 to 10,000;

a crosslinking agent (B) which includes three or more -C(=O)OX groups (X is a hydrogen atom or an alkyl group having from 1 to 6 carbon atoms) in a molecule, wherein from one to six of the three or more -C(=O)OX groups are -C(=O)OH groups, and which has a weight average molecular weight of from 200 to 600;

a polar solvent (D); and

at least one additive (C) selected from the group consisting of an acid (C-1) having a carboxy group and having a weight average molecular weight of from 46 to 195 and a base (C-2) having a nitrogen atom and having a weight average molecular weight of from 17 to 120, wherein;

Si and non-crosslinkable groups bonded to Si included in the compound (A) satisfy a relationship of (non-crosslinkable group)/Si < 2 in terms of molar ratio.

3. The composition for forming a film for semiconductor devices according to claim 1 or 2, wherein the crosslinking agent (B) has a ring structure in the molecule.

4. The composition for forming a film for semiconductor devices according to claim 3, wherein the ring structure is at least one of a benzene ring or a naphthalene ring.

5. The composition for forming a film for semiconductor devices according to any one of claims 1 to 4, wherein, in the crosslinking agent (B), in the three or more -C(=O)OX groups, at least one X is an alkyl group having from 1 to 6 carbon atoms.

6. The composition for forming a film for semiconductor devices according to any one of claims 1 to 5, comprising at least one selected from the group consisting of an aliphatic amine having a weight average molecular weight of from 10,000 to 400,000 and an amine compound having a ring structure in a molecule and having a weight average molecular weight of from 90 to 600.

7. Use of the composition for forming a film for semiconductor devices according to any one of claims 1 to 6 for a filling material for a recess formed on a substrate.

8. Use of the composition for forming a film for semiconductor devices according to any one of claims 1 to 6 in a multilayer resist method.

9. A method of manufacturing the composition for forming a film for semiconductor devices according to any one of claims 1 to 8,

the method comprising:

a mixing step of mixing the compound (A) and the crosslinking agent (B).

10. The method according to claim 9, wherein the mixing step comprises mixing a mixture of an acid (C-1) having a carboxy group and having a weight average molecular weight of from 46 to 195 and the compound (A), and the crosslinking agent (B).

11. The method according to claim 9, wherein the mixing step comprises mixing a mixture of a base (C-2) having a nitrogen atom and having a weight average molecular weight of from 17 to 120 and the crosslinking agent (B), and the compound (A).

12. A method of manufacturing a semiconductor member using the composition for forming a film for semiconductor devices according to any one of claims 1 to 6, the method

comprising:

an application step of applying the composition for forming a film for semiconductor devices to a substrate; and

a heating step of heating the substrate to which the composition for forming a film for semiconductor devices has been applied, at a temperature of from 250°C to 425°C.

13. A method of manufacturing a semiconductor processing material using the composition for forming a film for semiconductor devices according to any one of claims 1 to 6, the method comprising:

an application step of applying the composition for forming a film for semiconductor devices to a substrate; and

a heating step of heating the substrate to which the composition for forming a film for semiconductor devices has been applied, at a temperature of from 250°C to 425°C.

14. A method of manufacturing a semiconductor device using the composition for forming a film for semiconductor devices according to any one of claims 1 to 6, the semiconductor device comprising:

a substrate; and

a reaction product of a compound (A) including a Si-O bond and a cationic functional group containing at least one of a primary nitrogen atom or a secondary nitrogen atom, and having a weight average molecular weight of from 130 to 10,000, and a crosslinking agent (B) which includes three or more -C(=O)OX groups (X is a hydrogen atom or an alkyl group having from 1 to 6 carbon atoms) in a molecule, wherein from one to six of the three or more -C(=O)OX groups are -C(=O)OH groups, and which has a weight average molecular weight of from 200 to 600, wherein;

Si and non-crosslinkable groups bonded to Si included in the compound (A) satisfy a relationship of (non-crosslinkable group)/Si < 2 in terms of molar ratio.

15. The method of manufacturing a semiconductor device according to claim 14, wherein the reaction product includes at least one of an amide bond or an imide bond.