to provide a semiconductor film composition from which a film having few aggregates and pits, and having high smoothness can be obtained, a method of manufacturing the same, and a method of manufacturing a semiconductor member using the semiconductor film composition, and a method of manufacturing a semiconductor processing material using the semiconductor film composition, and a semiconductor device provided with a reaction product having high smoothness.

MEANS FOR SOLVING THE PROBLEMS

[0005] Specific means for solving the above described problems are as follows.

According to a first aspect of the present invention, there is provided a semiconductor film composition, including: a compound (A) including a Si-O bond and a cationicfunctional 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; and a polar solvent (D), 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.

According to a second aspect of the present invention, there is provided a semiconductor film composition, including: 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; and a polar solvent (D), 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.

In an embodiment of the above semiconductor film composition, the crosslinking agent (B) has a ring structure in the molecule.

In an embodiment of the above semiconductor film composition, the ring structure is at least one of a benzene ring or a naphthalene ring.

In an embodiment of the above semiconductor film composition, 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.

An embodiment of the above semiconductor film composition further comprises 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.

An embodiment of the above semiconductor film composition comprises 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.

An embodiment of the above semiconductor film composition is used for a filling material for a recess formed on a substrate.

An embodiment of the above semiconductor film composition is used in a multilayer resist method.

[0006] According to a third aspect of the present invention, there is provided a method of manufacturing the above semiconductor film composition, the method including: a mixing step of mixing the compound (A) and the crosslinking agent (B).

In an embodiment of the above method, 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).

In an embodiment of the above method, 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).

[0007] According to a fourth aspect of the present invention, there is provided a method of manufacturing a semiconductor member using the above semiconductor film composition, the method including: an application step of applying the semiconductor film composition to a substrate; and a heating step of heating the substrate to which the semiconductor film composition has been applied, at a temperature of from 250°C to 425°C.

[0008] According to a fifth aspect of the present invention, there is provided a method of manufacturing a semiconductor processing material using the above semiconductor film composition, the method including: an application step of applying the semiconductor film composition to a substrate; and a heating step of heating the substrate to which the semiconductor film composition has been applied, at a temperature of from 250°C to 425°C.

[0009] According to a sixth aspect of the present invention, there is provided a semiconductor device including: 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.

[0010] In an embodiment of the above semiconductor device, the reaction product includes at least one of an amide bond or an imide bond.

EFFECTS OF THE INVENTION

[0011] According to embodiments of the invention, a semiconductor film composition from which a film having few aggregates and pits, and having high smoothness can be obtained, a method of manufacturing the same, and a method of manufacturing a semiconductor member using the semiconductor film composition, and a method of manufacturing a semiconductor processing material using the semiconductor film composition, and a semiconductor device provided with a reaction product having high smoothness can be provided.

DESCRIPTION OF EMBODIMENT

[0012] In the present specification, a numeral value range represented by “(a value) to (a value)” means a range including the numeral values represented before and after “(a value) to (a value)” as a lower limit value and an upper limit value, respectively.

[0013] [Semiconductor Film Composition]

Hereinafter, an embodiment of a semiconductor film composition according to the invention will be described. The semiconductor film composition according to the embodiment (hereinafter also referred to as "composition" in some cases) includes 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, in which 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, and a polar solvent (D).

[0014] A semiconductor film composition according to the embodiment is used. Specifically, by coating the semiconductor film composition on a member to form a film, a