

What is claimed is:

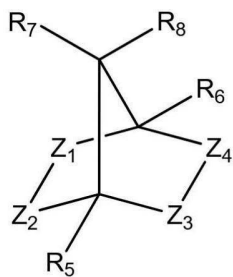
1. A polishing composition comprising cationically modified silica particles, a non-aromatic crosslinked cyclic compound having an organic acid group, and water,

wherein the cationically modified silica particles have an average secondary particle size of 10 nm or more and 250 nm or less,

wherein a concentration of the cationically modified silica particles is 0.001% by mass or more and 30% by mass or less, with respect to a total mass of the polishing composition,

wherein a concentration of the non-aromatic crosslinked cyclic compound having the organic acid group is 0.001% by mass or more and 10% by mass or less, with respect to the total mass of the polishing composition,

wherein the non-aromatic crosslinked cyclic compound having an organic acid group is a compound represented by the following general formula 1:



(General formula 1)

in the above general formula 1,

Z₁ is CR₁R₁', C=O, or O,

Z₂ is CR₂R₂', C=O, or O,

Z₃ is CR₃R₃', C=O, or O,

Z₄ is CR₄R₄', C=O, or O,

R₁, R₁', R₂, R₂', R₃, R₃', R₄, R₄', R₅, R₆, R₇, and R₈ are each independently a hydrogen atom, a deuterium atom, a halogen atom, a substituted or unsubstituted alkyl group, a substituted or unsubstituted alkenyl group, a substituted or unsubstituted alkynyl group, a substituted or unsubstituted alkoxy group, a substituted or unsubstituted polyoxyalkylene

group, or an organic acid group,

in a case where at least one of the R_1 , R_1' , R_2 , R_2' , R_3 , R_3' , R_4 , R_4' , R_5 , R_6 , R_7 , and R_8 is a substituted group, a substituent is each independently a deuterium atom, a
5 halogen atom, an unsubstituted alkyl group, an unsubstituted alkenyl group, an unsubstituted alkynyl group, an unsubstituted alkoxy group, an unsubstituted polyoxyalkylene group, or an organic acid group, and

at least one of the R_1 , R_1' , R_2 , R_2' , R_3 , R_3' , R_4 , R_4' , R_5 ,
10 R_6 , R_7 , and R_8 comprises an organic acid group,
and

wherein a pH of the polishing composition is less than 7.

2. The polishing composition according to claim 1, wherein
15 in the general formula 1, at least one of the Z_1 , Z_2 , Z_3 , and Z_4 is C=O.

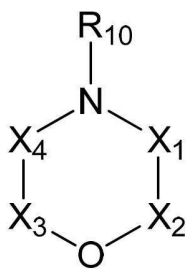
3. The polishing composition according to claim 1 or 2,
20 wherein in the general formula 1, at least one of the R_1 , R_1' , R_2 , R_2' , R_3 , R_3' , R_4 , R_4' , R_5 , R_6 , R_7 , and R_8 is an organic acid group, or an alkyl group substituted with an organic acid group.

4. The polishing composition according to any one of
25 claims 1 to 3, wherein the organic acid group is at least one selected from the group consisting of a carboxyl group, a sulfo group, a phosphonic acid group, and a phosphoric acid group.

5. The polishing composition according to any one of
30 claims 1 to 4, wherein a zeta potential of the cationically modified silica particles is a positive value.

6. The polishing composition according to any one of
35 claims 1 to 5, further comprising a compound represented by

the following general formula 2:



(General formula 2)

in the above general formula 2,

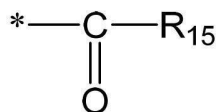
X₁ is CR₁₁R₁₁' or C=O,

5 X₂ is CR₁₂R₁₂' or C=O,

X₃ is CR₁₃R₁₃' or C=O,

X₄ is CR₁₄R₁₄' or C=O, and

R₁₀, R₁₁, R₁₁', R₁₂, R₁₂', R₁₃, R₁₃', R₁₄, and R₁₄' are each independently a hydrogen atom, a deuterium atom, a halogen atom, a substituted or unsubstituted hydrocarbon group, a substituted or unsubstituted oxyhydrocarbon group, a substituted or unsubstituted polyoxyalkylene group, or a group represented by the following general formula 3,



(General formula 3)

15 in the above general formula 3,

R₁₅ is a hydrogen atom, a deuterium atom, a halogen atom, or a substituted or unsubstituted hydrocarbon group,

* is a bond bonded to a ring-constituting nitrogen atom (N) of the above general formula 2, and

20 in a case where at least one of the R₁₀, R₁₁, R₁₁', R₁₂, R₁₂', R₁₃, R₁₃', R₁₄, R₁₄', and R₁₅ is a substituted group, a substituent is each independently a deuterium atom, a halogen atom, an unsubstituted oxyhydrocarbon group, or an unsubstituted polyoxyalkylene group.

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7. The polishing composition according to any one of claims 1 to 6, further comprising an oxidizing agent.

8. The polishing composition according to any one of claims 1 to 7, wherein an electrical conductivity is 30 μ S/cm or more and 2 mS/cm or less.

5 9. The polishing composition according to any one of claims 1 to 8, wherein the polishing composition is used for polishing an object to be polished containing silicon nitride.

10 10. The polishing composition according to claim 9, wherein the polishing composition is used for polishing an object to be polished further containing titanium nitride.

11. The polishing composition according to claim 9 or 10,
15 wherein the polishing composition is used for polishing an object to be polished further containing silicon oxide.

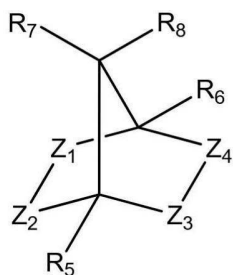
12. A production method of a polishing composition, comprising mixing cationically modified silica particles, a
20 non-aromatic crosslinked cyclic compound having an organic acid group, and water with each other,

wherein the cationically modified silica particles have an average secondary particle size of 10 nm or more and 250 nm or less,

25 wherein a concentration of the cationically modified silica particles is 0.001% by mass or more and 30% by mass or less, with respect to a total mass of the polishing composition,

wherein a concentration of the non-aromatic crosslinked cyclic compound having the organic acid group is 0.001% by
30 mass or more and 10% by mass or less, with respect to the total mass of the polishing composition,

wherein the non-aromatic crosslinked cyclic compound having an organic acid group is a compound represented by
35 the following general formula 1:



(General formula 1)

in the above general formula 1,

Z₁ is CR₁R₁', C=O, or O,

Z₂ is CR₂R₂', C=O, or O,

5 Z₃ is CR₃R₃', C=O, or O,

Z₄ is CR₄R₄', C=O, or O,

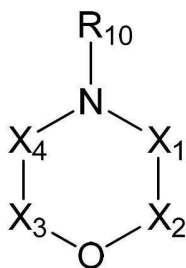
R₁, R₁', R₂, R₂', R₃, R₃', R₄, R₄', R₅, R₆, R₇, and R₈ are each independently a hydrogen atom, a deuterium atom, a halogen atom, a substituted or unsubstituted alkyl group, a substituted or unsubstituted alkenyl group, a substituted or unsubstituted alkynyl group, a substituted or unsubstituted alkoxy group, a substituted or unsubstituted polyoxyalkylene group, or an organic acid group,

10 in a case where at least one of the R₁, R₁', R₂, R₂', R₃, R₃', R₄, R₄', R₅, R₆, R₇, and R₈ is a substituted group, a substituent is each independently a deuterium atom, a halogen atom, an unsubstituted alkyl group, an unsubstituted alkenyl group, an unsubstituted alkynyl group, an unsubstituted alkoxy group, an unsubstituted polyoxyalkylene group, or an organic acid group, and

15 at least one of the R₁, R₁', R₂, R₂', R₃, R₃', R₄, R₄', R₅, R₆, R₇, and R₈ comprises an organic acid group, and

20 wherein a pH of the polishing composition is less than 7.

13. The production method of a polishing composition according to claim 12, further comprising mixing a compound represented by the following general formula 2:



(General formula 2)

in the above general formula 2,

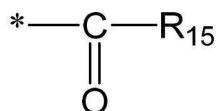
X₁ is CR₁₁R₁₁' or C=O,

X₂ is CR₁₂R₁₂' or C=O,

5 X₃ is CR₁₃R₁₃' or C=O,

X₄ is CR₁₄R₁₄' or C=O, and

R₁₀, R₁₁, R₁₁', R₁₂, R₁₂', R₁₃, R₁₃', R₁₄, and R₁₄' are each independently a hydrogen atom, a deuterium atom, a halogen atom, a substituted or unsubstituted hydrocarbon group, a substituted or unsubstituted oxyhydrocarbon group, a substituted or unsubstituted polyoxyalkylene group, or a group represented by the following general formula 3,



(General formula 3)

in the above general formula 3,

15 R₁₅ is a hydrogen atom, a deuterium atom, a halogen atom, or a substituted or unsubstituted hydrocarbon group,

* is a bond bonded to a ring-constituting nitrogen atom (N) of the above general formula 2, and

in a case where at least one of the R₁₀, R₁₁, R₁₁', R₁₂, R₁₂', R₁₃, R₁₃', R₁₄, R₁₄', and R₁₅ is a substituted group, a substituent is each independently a deuterium atom, a halogen atom, an unsubstituted oxyhydrocarbon group, or an unsubstituted polyoxyalkylene group.

25 14. A polishing method of polishing an object to be polished by using the polishing composition according to any one of claims 1 to 11, or

by producing a polishing composition by the production method according to claim 12 or 13 and using the produced

polishing composition.

15. A manufacturing method of a semiconductor substrate,
comprising polishing a substrate material by the polishing
5 method according to claim 14,

wherein the object to be polished is the substrate
material.