

CLAIMS

1. A CMP polishing liquid comprising a medium and silica particles as an abrasive grain dispersed into the medium, characterized in that:
 - (A1) the silica particles have a silanol group density of $5.0/\text{nm}^2$ or less;
 - (B1) a biaxial average primary particle diameter when arbitrary 20 silica particles are selected from an image obtained by scanning electron microscope observation is 25 to 55 nm; and
 - (C1) an association degree of the silica particles is 1.1 or more, wherein the association degree is defined as an average particle diameter divided by a biaxial average primary particle diameter, the average particle diameter being measured by a dynamic light scattering method using a grain distribution meter and the biaxial average primary particle diameter being obtained from a scanning electron microscopic observation.
2. A CMP polishing liquid comprising a medium and silica particles as an abrasive grain dispersed into the medium, characterized in that:
 - (A2) the silica particles have a silanol group density of $5.0/\text{nm}^2$ or less and are not subjected to any surface treatment;
 - (B2) a biaxial average primary particle diameter when arbitrary 20 silica particles are selected from an image obtained by scanning electron microscope observation is 60 nm or less; and
 - (C2) an association degree of the silica particles is 1.20 or less or from 1.40 to 1.80, wherein the association degree is defined as an average particle diameter divided by a biaxial average primary particle diameter, the average particle diameter being measured by a dynamic light scattering method using a grain distribution meter and the biaxial average primary particle diameter being obtained from a scanning electron microscopic observation.
3. The CMP polishing liquid according to claim 1 or 2, further comprising a metal anticorrosive agent.
4. The CMP polishing liquid according to claim 3, wherein the metal anticorrosive agent comprises at least one selected from the group consisting of a triazole compound, a pyrazole compound, a pyrimidine compound, an imidazole compound, a guanidine compound, a thiazole compound, and a tetrazole

compound.

5. The CMP polishing liquid according to claim 3, wherein the metal anticorrosive agent comprises at least one selected from the group consisting of benzotriazole and 1H-1,2,3-triazolo[4,5-b]pyridine.
6. The CMP polishing liquid according to claim 1 or 2, wherein the silica particles have a zeta potential in the CMP polishing liquid of +5 mV or more.
7. The CMP polishing liquid according to claim 1 or 2, wherein the silica particles are colloidal silica.
8. The CMP polishing liquid according to claim 1 or 2, wherein a content of the silica particles is 3.0 to 8.0 parts by mass relative to 100 parts by mass of the CMP polishing liquid.
9. The CMP polishing liquid according to claim 1 or 2, wherein a pH is in a neutral range or an acidic range.
10. The CMP polishing liquid according to claim 1 or 2, further comprising an oxidized-metal dissolving agent.
11. The CMP polishing liquid according to claim 1 or 2, further comprising an oxidizing agent.
12. A CMP polishing liquid concentrate obtainable by concentrating the CMP polishing liquid according to claim 1 or 2 at a 3-fold concentration or a higher concentration.
13. The CMP polishing liquid concentrate according to claim 12, wherein 5 parts by mass or more of the abrasive grain is contained.
14. A polishing method comprising:
a first polishing step of exposing a barrier film on a convex portion by polishing a conductive material of a substrate comprising an interlayer dielectric having a concave portion and the convex portion on a surface thereof, the barrier

film coating the interlayer dielectric along the surface, and the conductive material coating the barrier film by filling the concave portion; and

a second polishing step of exposing the interlayer dielectric of the convex portion by polishing the barrier film at least on the convex portion, characterized in that

the polishing in at least the second polishing step is performed by supplying the CMP polishing liquid according to claim 1.

15. A polishing method comprising:

a first polishing step of exposing a barrier film on a convex portion by polishing a conductive material of a substrate comprising an interlayer dielectric having a concave portion and the convex portion on a surface thereof, the barrier film coating the interlayer dielectric along the surface, and the conductive material coating the barrier film by filling the concave portion; and

a second polishing step of exposing the interlayer dielectric of the convex portion by polishing the barrier film at least on the convex portion, characterized in that

the polishing in at least the second polishing step is performed by supplying the CMP polishing liquid according to claim 2.

16. A polishing method comprising:

a mixing step of mixing the CMP polishing liquid concentrate according to claim 12 with a diluting liquid, an additive liquid, or both of the diluting liquid and the additive liquid to prepare a CMP polishing liquid;

a first polishing step of exposing a barrier film on a convex portion by polishing a conductive material of a substrate comprising an interlayer dielectric having a concave portion and the convex portion on a surface thereof, the barrier film coating the interlayer dielectric along the surface, and the conductive material coating the barrier film by filling the concave portion; and

a second polishing step of exposing the interlayer dielectric of the convex portion by polishing the barrier film at least on the convex portion, characterized in that

the polishing in at least the second polishing step is performed by supplying the CMP polishing liquid.

17. The polishing method according to claim 14 or 15, wherein the interlayer

dielectric is a silicon coating or an organic polymer film.

18. The polishing method according to claim 14 or 15, wherein the conductive material contains at least one selected from the group consisting of copper, a copper alloy, an oxide of copper, and an oxide of a copper alloy.

19. The polishing method according to claim 14 or 15, wherein the barrier film is a barrier conductive film that prevents the conductive material from diffusing into the interlayer dielectric and contains at least one selected from the group consisting of tantalum, tantalum nitride, a tantalum alloy, other tantalum compounds, titanium, titanium nitride, a titanium alloy, other titanium compounds, ruthenium, and other ruthenium compounds.

20. The polishing method according to claim 14 or 15, wherein a part of the interlayer dielectric on the convex portion is further polished in the second polishing step.

21. A semiconductor substrate produced by employing the polishing method according to claim 14 or 15.

22. An electronic device produced by employing the polishing method according to claim 14 or 15.

23. The polishing method according to claim 16, wherein the interlayer dielectric is a silicon coating or an organic polymer film.

24. The polishing method according to claim 16, wherein the conductive material contains at least one selected from the group consisting of copper, a copper alloy, an oxide of copper, and an oxide of a copper alloy.

25. The polishing method according to claim 16, wherein the barrier film is a barrier conductive film that prevents the conductive material from diffusing into the interlayer dielectric and contains at least one selected from the group consisting of tantalum, tantalum nitride, a tantalum alloy, other tantalum compounds, titanium, titanium nitride, a titanium alloy, other titanium compounds, ruthenium, and other ruthenium compounds.

26. The polishing method according to claim 16, wherein a part of the interlayer dielectric on the convex portion is further polished in the second polishing step.
27. A semiconductor substrate produced by employing the polishing method according to claim 16.
28. An electronic device produced by employing the polishing method according to claim 16.
29. The CMP polishing liquid according to claim 1 or 2, wherein a pH is 7.5 or less.
30. The CMP polishing liquid according to claim 1 or 2, wherein a pH is 1.5 or more.
31. The CMP polishing liquid according to claim 3, wherein a content of the metal anticorrosive agent is 0.001 to 10 parts by mass relative to 100 parts by mass of the CMP polishing liquid.
32. The CMP polishing liquid according to claim 11, wherein the oxidizing agent comprises at least one selected from the group consisting of hydrogen peroxide, nitric acid, potassium periodate, hypochlorous acid, and ozone water.
33. The CMP polishing liquid according to claim 11, wherein a pH is in an acidic range and a content of the oxidizing agent is in a range from 0.01 to 3 parts by mass relative to 100 parts by mass of the CMP polishing liquid.
34. The CMP polishing liquid according to claim 11, wherein a pH is in a range from 1 to 4 and a content of the oxidizing agent is 2.5 parts by mass or below relative to 100 parts by mass of the CMP polishing liquid.

CLAIMS

1. A CMP polishing liquid comprising a medium and silica particles as an abrasive grain dispersed into the medium, characterized in that:

5 (A1) the silica particles have a silanol group density of $5.0/\text{nm}^2$ or less;

(B1) a biaxial average primary particle diameter when arbitrary 20 silica particles are selected from an image obtained by scanning electron microscope observation is 25 to 55 nm; and

10 (C1) an association degree of the silica particles is 1.1 or more.

2. A CMP polishing liquid comprising a medium and silica particles as an abrasive grain dispersed into the medium, characterized in that:

15 (A2) the silica particles have a silanol group density of $5.0/\text{nm}^2$ or less and are not subjected to any surface treatment;

(B2) a biaxial average primary particle diameter when arbitrary 20 silica particles are selected from an image obtained by scanning electron microscope observation is 60 nm or less; and

20 (C2) an association degree of the silica particles is 1.20 or less or from 1.40 to 1.80.

3. The CMP polishing liquid according to claim 1 or 2, further comprising a metal anticorrosive agent.

4. The CMP polishing liquid according to claim 3, wherein the metal anticorrosive agent is a compound having a triazole skeleton.

5. The CMP polishing liquid according to claim 3, wherein the metal anticorrosive agent is at least one selected from the group consisting of benzotriazole and

5 1H-1,2,3-triazolo[4,5-b]pyridine.

6. The CMP polishing liquid according to any one of claims 1 to 5, wherein the silica particles have a zeta potential in the CMP polishing liquid of 5 mV or more.

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7. The CMP polishing liquid according to any one of claims 1 to 6, wherein each silica particle is a colloidal silica.

8. The CMP polishing liquid according to any one of claims 1 to 7, wherein a content of the silica particles is 3.0 to 8.0 parts by mass relative to 100 parts by mass of the CMP polishing liquid.

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9. The CMP polishing liquid according to any one of claims 1 to 8, wherein a pH is in a neutral range or an acidic range.

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10. The CMP polishing liquid according to any one of claims 1 to 9, further comprising an oxidized-metal dissolving agent.

11. The CMP polishing liquid according to any one of claims 1 to 10, further comprising an oxidizing agent.

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12. A CMP polishing liquid concentrate obtainable by concentrating the CMP polishing liquid defined in any one of claims

1 to 11 at a 3-fold concentration or a higher concentration.

13. The CMP polishing liquid concentrate according to claim 12, wherein 5 parts by mass or more of the abrasive grain is contained.

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14. A polishing method comprising:

a first polishing step of exposing a barrier film on a convex portion by polishing a conductive material of a substrate comprising interlayer dielectrics having a concave portion and the convex portion on a surface thereof, the barrier film coating the interlayer dielectrics along the surface, and the conductive material coating the barrier film by filling the concave portion; and

a second polishing step of exposing the interlayer dielectrics of the convex portion by polishing the barrier film at least on the convex portion, characterized in that

the polishing is performed by supplying at least one of the CMP polishing liquids defined in claim 1 to 11 at least in the second polishing step.

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15. A polishing method comprising:

a mixing step of mixing the CMP polishing liquid concentrate defined in claim 12 or 13 with a diluting liquid, an additive liquid, or both of the diluting liquid and the additive liquid to prepare a CMP polishing liquid;

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a first polishing step of exposing a barrier film on a convex portion by polishing a conductive material of a substrate comprising interlayer dielectrics having a concave portion and

the convex portion on a surface thereof, the barrier film coating the interlayer dielectrics along the surface, and the conductive material coating the barrier film by filling the concave portion; and

5 a second polishing step of exposing the interlayer dielectrics of the convex portion by polishing the barrier film at least on the convex portion, characterized in that

 the polishing is performed by supplying the CMP polishing liquid at least in the second polishing step.

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16. The polishing method according to claim 14 or 15, wherein the interlayer dielectrics are silicon coatings or organic polymer films.

15 17. The polishing method according to any one of claims 14 to 16, wherein the conductive material contains copper as a main component.

18. The polishing method according to any one of claims 14 to
20 17, wherein

 a barrier conductive film prevents the conductive material from diffusing into the interlayer dielectrics and contains at least one selected from the group consisting of tantalum, tantalum nitride, a tantalum alloy, other tantalum compounds, titanium, titanium nitride, a titanium alloy, other titanium compounds,
25 ruthenium, and other ruthenium compounds.

19. The polishing method according to any one of claims 14 to

18, wherein a part of the interlayer dielectrics on the convex portion is further polished in the second polishing step.

20. A semiconductor substrate produced by employing the
5 polishing method defined in any one of claims 14 to 19.

21. An electronic device produced by employing the polishing method defined in any one of claims 14 to 19.