Claims

1. A chemical mechanical planarization polishing composition comprising:

ceria-coated inorganic oxide particles;
a gelatin molecule comprising organic carboxylate functional groups providing negative charges and protonated organic amino groups providing the positive charges on the same molecule;
a water soluble solvent; and
optionally
a biocide; and
a pH adjuster;
wherein
the composition has a pH value of 2 to 12, 3 to 10, 4 to 9, or 4.5 to 7.5.

2. The chemical mechanical planarization polishing composition of Claim 1, wherein the ceria-coated inorganic oxide particles are selected from the group consisting of ceria-coated colloidal silica, ceria-coated high purity colloidal silica, ceria-coated alumina, ceria-coated titania, ceria-coated zirconia particles and combinations thereof.

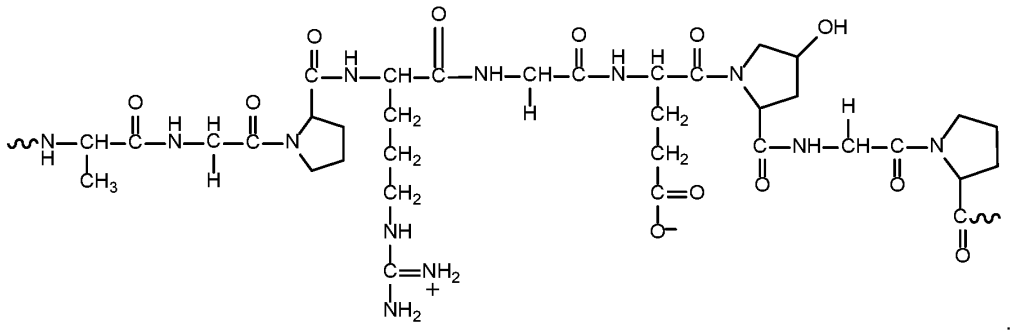
3. The chemical mechanical planarization polishing composition of Claim 1, wherein the ceria-coated inorganic oxide particles have a concentration of from 0.01 wt.% to 20 wt.%, from 0.02 wt.% to 10 wt.%, from 0.005 wt.% to 5 wt.%, or from 0.01 wt.% to 3 wt. %.

4. The chemical mechanical planarization polishing composition of Claim 1, wherein the gelatin molecule further comprises organic amide functional groups, and 5-membered non-aromatic rings with one nitrogen atom as a hetero-atom.

5. The chemical mechanical planarization polishing composition of Claim 1, wherein the gelatin molecule is an organic gelatin molecule made from an animal skin.

6. The chemical mechanical planarization polishing composition of Claim 1, wherein the gelatin molecule is an organic gelatin molecule made from an animal skin selected from the group consisting of cold water fish skin, porcine skin, bovine skin, and combinations thereof.

7. The chemical mechanical polishing composition of Claim 1, wherein the gelatin molecule has a molecular structure of:



8. The chemical mechanical planarization polishing composition of Claim 1, wherein the gelatin molecule has a concentration of 0.0001 wt.% to 5 wt. %, 0.0005 wt.% to 2 wt. %, 0.001 wt.% to 1 wt. %, 0.002 wt.% to 0.5 wt. %, 0.0025 wt.% to 0.25 wt. %, or 0.003 wt.% to 0.1 wt. %.

9. The chemical mechanical planarization polishing composition of Claim 1, wherein the water soluble solvent is selected from the group consisting of deionized (DI) water, distilled water, and alcoholic organic solvents.

10. The chemical mechanical planarization polishing composition of Claims 1, wherein the composition further comprises the biocide having a concentration of from 0.0001 wt.% to 0.05 wt.%; from 0.0005 wt.% to 0.025 wt.%, or from 0.001 wt.% to 0.01 wt.%.

11. The chemical mechanical planarization polishing composition of Claims 1, wherein the composition further comprises the biocide having an active ingredient of 5-chloro-2-methyl-4-isothiazolin-3-one or 2-methyl-4-isothiazolin-3-one.

12. The chemical mechanical planarization polishing composition of Claims 1, wherein the composition further comprises the pH adjuster having a concentration of from 0 wt.% to 1 wt.%; 0.01 wt.% to 0.5 wt.%; or 0.1 wt.% to 0.25 wt.%.

13. The chemical mechanical planarization polishing composition of Claim 1, wherein the composition further comprises the pH adjuster selected from the group consisting of nitric acid, hydrochloric acid, sulfuric acid, phosphoric acid, other inorganic or organic acids, and mixtures thereof for acidic pH conditions; or selected from the group consisting of sodium hydride, potassium hydroxide, ammonium hydroxide, tetraalkyl ammonium hydroxide, organic quaternary ammonium hydroxide compounds, organic amines, and combinations thereof for alkaline pH conditions.

14. The chemical mechanical planarization polishing composition of Claim 1, wherein the composition comprises ceria-coated colloidal silica particles as the ceria-coated inorganic oxide particles, and the gelatin molecule made from animal skin selected from the group consisting of cold water fish skin, porcine skin, bovine skin, and combinations thereof.

15. The chemical mechanical planarization polishing composition of Claim 1, wherein the composition comprises ceria-coated colloidal silica particles as the ceria-coated inorganic oxide particles, the gelatin molecule made from animal skin selected from the group consisting of cold water fish skin, porcine skin, bovine skin, and combinations thereof; and the pH value of the chemical mechanical planarization polishing composition is 4 to 9.

16. The chemical mechanical planarization polishing composition of Claim 1, wherein the composition comprises ceria-coated colloidal silica particles as the ceria-coated inorganic oxide particles, and the gelatin molecule made from cold water fish skin.

17. The chemical mechanical planarization polishing composition of Claim 1, wherein the composition comprises ceria-coated colloidal silica particles as the ceria-coated inorganic oxide particles, and the gelatin molecular made from cold water fish skin, and the pH value of the chemical mechanical polishing composition is 4 to 9.

18. A method of chemical mechanical planarization (CMP) a semiconductor substrate having at least one surface comprising a silicon dioxide film, comprising
providing the semiconductor substrate;
providing a polishing pad;
providing the chemical mechanical planarization polishing composition in any one of claims 1 to 17;
contacting the semiconductor substrate with the polishing pad and the chemical mechanical polishing composition; and
polishing the at least one surface comprising the silicon dioxide film.

19. The method of claim 18; wherein the silicon dioxide film is selected from the group consisting of Chemical vapor deposition (CVD) silicon dioxide film, Plasma Enhance CVD (PECVD) silicon dioxide film, High Density Deposition CVD(HDP) silicon dioxide film, spin on silicon dioxide film, and combinations thereof.

20. The method of claim 18; wherein the semiconductor substrate further has at least one surface comprising a silicon nitride film.

21. The method of claim 18; wherein the semiconductor substrate further has at least one surface comprising a silicon nitride film, and polishing rate of the silicon dioxide film vs polishing rate of the silicon nitride film is ≥ 1.

22. A system of chemical mechanical planarization (CMP) a semiconductor substrate having at least one surface comprising a silicon dioxide film, comprising
    a. the semiconductor substrate;
    b. the chemical mechanical planarization polishing composition in any one of Claims 1 to 17; and
    c. a polishing pad;

wherein the at least one surface comprising the silicon dioxide film is in contact with the polishing pad and the chemical mechanical polishing composition.

23. The system of claim 22; wherein the silicon dioxide film is selected from the group consisting of Chemical vapor deposition (CVD) silicon dioxide film, Plasma Enhance CVD (PECVD) silicon dioxide film, High Density Deposition CVD(HDP) silicon dioxide film, or spin on silicon dioxide film.

24. The system of claim 22; wherein the semiconductor substrate further has at least one surface comprising a silicon nitride film.

25. The system of claim 22; wherein the semiconductor substrate further has at least one surface comprising a silicon nitride film, and polishing rate of the silicon dioxide film vs polishing rate of the silicon nitride film is ≥ 1.