

activator;

an additive;

pH adjusting agent; and

remaining being water;

- 5 wherein the pH of the slurry is between 1 and 14, preferably is between 2 and 10, more preferably is between 3 and 9, and most preferably is between 6-5 and 8.

[0016] In another aspect, described herein is a system for is a system for chemical mechanical planarization, comprising:

a semiconductor substrate comprising at least one surface containing tungsten;

10 a polishing pad; and

a polishing composition comprising:

abrasive, at least one oxidizing agent, activator, an additive, pH adjusting agent, and remaining being water; wherein the pH of the slurry is between 1 and 14, preferably is between 2 and 10, more preferably is between 3 and 9, and most preferably is between 6-5 and 8;

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wherein the at least one surface containing tungsten is in contact with the polishing pad and the polishing composition.

[0017] In yet another aspect, described herein is a polishing method for chemical mechanical planarization of a semiconductor substrate comprising at least one surface containing tungsten, comprising the steps of:

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a) contacting the at least one surface containing tungsten with a polishing pad;

b) delivering a polishing composition to the surface, the polishing composition comprising:

c) abrasive, at least one oxidizing agent, activator, an additive, pH adjusting agent, and remaining being water; wherein the pH of the slurry is between 1 and 14, preferably is between 2 and 10, more preferably is between 3 and 9, and most preferably is between 6-5 and 8;

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and

C) polishing the at least one surface containing tungsten with the polishing

30 composition.

[0018] The abrasive includes, but is not limited to colloidal silica, fumed silica, alumina, titania, ceria, zirconia, surface modified particles selected from the group consisting of activator-containing particles, composite particles, and lattice doped and inorganic oxide particles; and combinations thereof; and combinations thereof.

[0019] The concentration of abrasive can range from 0.01 wt% to 30 wt%, the preferred is from about 0.05 wt% to about 10 wt%, the more preferred is from about 0.1 and 2 wt%. The weight percent is relative to the weight of the composition.

[0020] The oxidizing agent includes, but is not limited to peroxy compound selected from the group consisting of hydrogen peroxide, urea peroxide, peroxyformic acid, peracetic acid, propaneperoxoic acid, substituted or unsubstituted butaneperoxoic acid, hydroperoxy-acetaldehyde, potassium periodate, ammonium peroxymonosulfate; and non-peroxy compound selected from the group consisting of ferric nitrite, KClO_4 , KBrO_4 , KMnO_4 .

[0021] The oxidizer concentration can range from 0.01 wt% to 30 wt% while the more preferred amount of oxidizing agents is from about 0.5 wt% to about 10 wt%. The weight percent is relative to the composition.

[0022] The activator includes, but is not limited to, (1) inorganic oxide particle with transition metal coated onto its surface, where the transition metal is selected from the group consisting of iron, copper, manganese, cobalt, cerium, and combinations thereof; (2) soluble catalyst includes, but is not limited to ammonium iron (III) oxalate trihydrate, iron(III) citrate tribasic monohydrate, iron(III) acetylacetonate and ethylenediamine tetraacetic acid, iron (III) sodium salt hydrate, a metal compound having multiple oxidation states selected from the group consisting of Ag, Co, Cr, Cu, Fe, Mo, Mn, Nb, Ni, Os, Pd, Ru, Sn, Ti, V; and combinations thereof.

[0023] The amount of activator in a slurry ranges from about 0.0005 wt% to about 10 wt%; preferably 0.001 wt % to 2 wt %, more preferably between 0.01 wt % to 1 wt%; most preferably between 0.05 wt % to 0.5 wt%.

[0024] The additive includes, but is not limited to sarcosinate, ~~sarcosinate~~-related carboxylic compound, and hydrocarbon substituted sarcosinate; organic polymer and copolymer having molecules containing ethylene oxide repeating units, such as polyethylene oxide (PEO), and ethoxylated surfactant.

[0025] The general amount of additive ranges from 0.1 to 10,000 ppm, preferably 1 ppm to 1000 ppm, more preferably 10 to 500 ppm.

[0026] The sarcosinates, ~~sarcosinate~~-related carboxylic compounds, and hydrocarbon substituted sarcosinate can be present at a concentration of 0.1 to 1000 ppm, preferably 1 to 500 ppm and more preferably 10 to 250 ppm.

[0027] Example of sarcosinate includes but is not limited to oleoyl sarcosinate, N-Lauroylsarcosinate.

[0028] The amount of polyethylene oxide (PEO) and ethoxylated surfactants range from 1 ppm to 10,000 ppm, preferably 10 ppm to 1000 ppm, and more preferably 50 to 500 ppm.

[0029] The pH adjusting agent includes, but is not limited to amine, ammonium hydroxide, nitric acid, phosphoric acid, sulfuric acid, organic acid, potassium hydroxide, and/or salt thereof, and any combination thereof.

[0030] The pH of the composition is desirably on the order of from about pH 4 to about pH 10, and preferably from about pH 5 to about pH 9, and more preferably from about pH 6.5 to about pH 8.

[0031] The polishing composition may further comprise biocide ranging from about 0.0001 weight % to about 0.03 weight %.

[0032] The polishing composition optionally comprises surfactant; stabilizing and passivating agent; dispersion agent; chelator; film-forming anticorrosion agent; and a polish enhancement agent.

[0033] Other aspects, features and embodiments of the invention will be more fully apparent from the ensuing disclosure and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] The present invention will hereinafter be described in conjunction with the appended figures wherein like numerals denote like elements:

[0035] Figure 1 shows dishing reducing results from slurries without (the control) and with additives(sarcosinates and polyethylene oxide (PEO with MW = 100,000 g/mol)) on large and small feature sizes (large bond pad and small 0.5 μ line).

[0036] Figure 2 shows dishing reducing results from slurries having different concentrations of additives(sarcosinates and polyethylene oxide (PEO with MW = 100,000 g/mol)) on large feature size.

5 [0037] Figure 3 shows dishing reducing results from slurries without (the control) and with additives (ethoxylated surfactants) on large feature size.

[0038] Figure 4 shows the polishing results(Removal rates for W and TEO) from slurries without (the control) and with additives(sarcosinates and polyethylene oxide (PEO with MW = 100,000 g/mol)).

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DETAILED DESCRIPTION

[0039] It can be seen that previous works done to reduce dishing or generally improve performance on patterned wafers had been focused on cationic polymeric additives which proved to be very useful in acidic slurries. However, these cannot be used in neutral pH tungsten slurries as it would lead to unstable formulation due to the negatively charged silica particles at the neutral pH. Therefore there is a need for slurries which can reduce the dishing of large bond pad features as well as fine line structures without retarding the tungsten removal rate.

15 [0040] Present invention pertains to slurries that can be used in chemical mechanical planarization (CMP) of tungsten containing semiconductor devices, substrates, or films. CMP slurries of present invention provide the unique result of reduced dishing on large features and/or small lines depending on desired application without a decrease in tungsten removal rate.

20 [0041] The CMP slurries comprise abrasive, one or more oxidizing agents(i.e., an oxidizer that is not a free radical producer), activator or catalyst, an additive to reduce dishing, pH adjusting agent, and remaining being water. The pH of the slurry is between 1 and 14, preferably is between 2 and 10, more preferably is between 3 and 9, and most preferably is between 6-5 and 8.

25 [0042] The CMP slurries may as well contain surfactant; stabilizing and passivating agents; dispersion agents; chelators; film-forming anticorrosion agents; and a polish enhancement agent.

30 [0043] **Abrasive**

polymer and copolymer having molecules containing ethylene oxide repeating units, such as polyethylene oxide (PEO); and (3) Ethoxylated surfactants.

[0062] The suitable sarcosinates include, but are not limited to, cocoyl, lauroyl, myristoyl, oleoyl, and stearoyl sarcosinate.

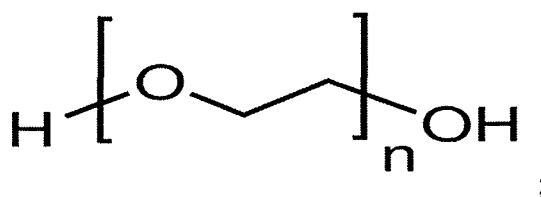
5 **[0063]** The suitable sarcosinates-related carboxylic compounds include, but are not limited to, unsaturated salts of fatty acids such as myristoleic, palmitoleic, sapienic, oleic, elaidic, vaccenic, linoleic, linoelaidic, α -linolenic, arachidonic, eicosapentaenoic, erucic and decosahexaenoic acid; and salts of saturated fatty acids such as sodium, potassium, or ammonia salts of stearate, caprylic, capric, lauric, myristic, palmitic, stearic, arachidic, 10 behenic, lignoceric and cerotic acid.

[0064] The suitable hydrocarbon substituted sarcosinate has a substituent includes, but is not limited to, an alkyl, alkenyl or alkynyl, having ranging from 1 carbon atom for the alkyl substituent, 2 carbon atoms for the alkenyl, or 3 up to 24 carbon atoms for alkynyl substituent. The number of double bonds for the alkenyl substituent or the 15 number of triple bonds for the alkynyl substituent can be up to 4.

[0065] The sarcosinates, related carboxylic compounds, and hydrocarbon substituted sarcosinate can be present at a concentration of 0.1 to 5000 ppm, more preferred 1 to 500 ppm and most preferred 10 to 250 ppm.

[0066] The suitable organic polymer and copolymer have molecules containing 20 ethylene oxide repeating units, includes Polyoxyethylene (POE). Polyoxyethylene (POE), is also called polyethylene oxide (PEO), or polyethylene glycol(PEG). The three names are chemically synonymous, but historically PEG has tended to refer to oligomers and polymers with a molecular mass below 20,000 g/mol, PEO to polymers with a molecular mass above 20,000 g/mol, and POE to a polymer of any molecular mass.

25 **[0067]** An example is polyethylene oxide (PEO), having the general molecular structure of



[00150] Particles having the activator can be treated with various agents to enhance colloidal stability, including carboxylic acids and polycarboxylic acids.

[00151] Soluble iron catalysts can also be used with the additives described herein as part of the invention. Suitable soluble iron catalysts for the pH range of this invention but not limited to are ammonium iron (III) oxalate trihydrate, iron(III) citrate tribasic monohydrate, iron(III) acetylacetonate and ethylenediamine tetraacetic acid, iron (III) sodium salt hydrate. A soluble catalyst can also be a metal compound of Ag, Co, Cr, Cu, Fe, Mo, Mn, Nb, Ni, Os, Pd, Ru, Sn, Ti, V and mixtures thereof having multiple oxidation states.

[00152] In most embodiments of the present invention, the activator includes, but is not inorganic oxide particle with transition metal coated onto its surface and soluble catalyst.

[00153] Transition metals include, but not limited to, copper, manganese, cobalt, and cerium, as well as the more traditional iron and copper, and other transition metals, after these transition metals are coated onto the inorganic oxide particle surfaces, they become immobilized heterogeneous catalysts which are able to catalyze the chemical reactions involved in W CMP processes.

[00154] Soluble catalyst includes, but is not limited to ammonium iron (III) oxalate trihydrate, iron (III) citrate tribasic monohydrate, iron (III) acetylacetonate and ethylenediamine tetraacetic acid, iron (III) sodium salt hydrate, a metal compound having multiple oxidation states selected from the group consisting of Ag, Co, Cr, Cu, Fe, Mo, Mn, Nb, Ni, Os, Pd, Ru, Sn, Ti, V; and combinations thereof.

[00155] The amount of activator in a slurry ranges from about 0.0005 wt% to about 10 wt%; preferably 0.001 wt % to 2 wt %, more preferably between 0.01 wt % to 1 wt%; most preferably between 0.05 wt % to 0.5 wt%.

[00156] pH Adjustors

[00157] The pH of the composition is desirably on the order of from about 1 to about 12, preferably from about 2 to about 10, more preferably from about 3 to about 9, and most preferably from about 6-5 to about 8.

[00158] The pH of the composition may be adjusted using an appropriate pH adjusting agent, such as a suitable acid, base, amine, or any combination thereof. Preferably, a pH adjusting agent used in the composition does not contain metal ions, such that undesirable metal components are not introduced into the composition. Suitable pH

adjusting agents include amines, ammonium hydroxide, nitric acid, phosphoric acid, sulfuric acid, organic acids, potassium hydroxide, and/or salts thereof, and any combination thereof.

5 [00159] In certain embodiments, the CMP composition further comprises a biocide. The use of biocide in the enclosed CMP polishing compositions reduces or eliminates bacteria and other microorganisms, especially when the pH values of the CMP polishing compositions is close or around neutral pH conditions.

[00160] The biocide ranges from about 0.0001 weight % to about 0.03 weight %.

[00161] Promoters

10 [00162] As stated above, although metals having multiple oxidation states that are dissolved in the fluid contacting the substrate can act as oxidizers, the most preferred embodiments of this invention have substantially no metals having multiple oxidation states.

15 [00163] In some embodiments, compounds of Al, Ag, Ce, Co, Cr, Cu, Fe, Mo, Mn, Nb, Nd, Ni, Os, Pd, Pt, Rh, Ru, Sc, Sm, Ta, Ti, V, or W in minor amounts dissolved in the solution are useful. These are believed to facilitate the action of the oxidizers, as discussed in U.S. Pat. No. 5,958,288, the disclosure of which is incorporated herein by reference. Metal ions in solution are believed to act as oxidizers with a degree of affinity to the substrate, particularly to metal substrates. If they are able to be oxidized by other
20 oxidizers in the fluid, there will be some synergistic action between the two. In most cases the promoters are believed not to facilitate the action of the free radicals, however. Compounds that form promoters on exposure to a catalyst or substrate, such as those compounds described in U.S. Pat. No. 5,863,838, the disclosure of which is incorporated by reference, are also useful.

25 [00164] In some embodiments of the present invention, the fluid composition contacting the substrate has a small amount of metal ion oxidizers, herein called promoters. Soluble compounds or salts of copper, aluminum, cerium, and iron are used as oxidizers or promoters in CMP solutions. If used, a preferred metal-containing oxidizer promoter is soluble cerium salts or aluminum salts.

30 [00165] The amount of promotor in a slurry ranges from about 0.0001 wt% to about 1.0 wt%; preferably 0.0005 wt % to 0.5 wt %, more preferably between 0.0025wt % to 0.1wt%.

[00166] Chelators

Claims

1. A polishing composition comprising:

0.01 wt% to 30 wt% of abrasive;

0.01 wt% to 30 wt% of at least one oxidizing agent;

5 0.0005 wt% to about 10 wt% of activator;

0.1ppm to 10,000 ppm of additive;

pH adjusting agent; and

remaining being water;

wherein

10 the abrasive is selected from the group consisting of colloidal silica, fumed silica, alumina, titania, ceria, zirconia, surface modified particles selected from the group consisting of activator-containing particles, composite particles, and lattice doped and inorganic oxide particles; and combinations thereof;

15 the oxidizing agent is selected from the group consisting of peroxy compound selected from the group consisting of hydrogen peroxide, urea peroxide, peroxyformic acid, peracetic acid, propaneperoxoic acid, substituted or unsubstituted butaneperoxoic acid, hydroperoxy-acetaldehyde, potassium periodate, ammonium peroxymonosulfate; and non-per-oxy compound selected from the group consisting of ferric nitrite, KClO_4 , KBrO_4 , KMnO_4 ; and
20 combinations thereof;

the activator is selected from the group consisting of (1) inorganic oxide particle with transition metal coated onto its surface; and the transition metal is selected from the group consisting of Fe, Cu, Mn, Co, Ce, and combinations thereof; (2)soluble catalyst selected from the group consisting of ammonium iron (III) oxalate trihydrate, iron(III) citrate tribasic monohydrate, iron(III) acetylacetonate and ethylenediamine tetraacetic acid, iron (III) sodium salt hydrate;(3) a metal
25 compound having multiple oxidation states selected from the group consisting of Ag, Co, Cr, Cu, Fe, Mo, Mn, Nb, Ni, Os, Pd, Ru, Sn, Ti, V; and combinations thereof;

30 the additive is selected from the group consisting of sarcosinate, -sarcosinates related carboxylic compound, hydrocarbon substituted sarcosinate; organic

polymer and copolymer having molecules containing ethylene oxide repeating units; ethoxylated surfactant; and combinations thereof;

the pH adjusting agent is selected from the group consisting of amine, ammonium hydroxide, nitric acid, phosphoric acid, sulfuric acid, organic acid, potassium hydroxide, and/or salt thereof, and combinations thereof; and

pH of the composition is between 2 and 10.

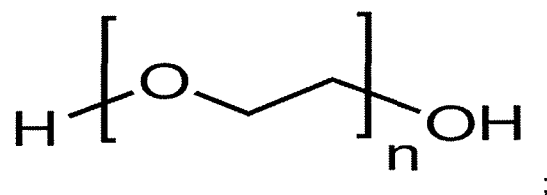
2. The polishing composition of Claim 1, wherein

the sarcosinate is selected from the group consisting of cocoyl, lauroyl, myristoyl, oleoyl, stearyl sarcosinate, and combinations thereof;

the sarcosinates-related carboxylic compound is selected from the group consisting of unsaturated salt of fatty acid selected from the group consisting of myristoleic, palmitoleic, sapienic, oleic, elaidic, vaccenic, linoleic, linoelaidic, α -linolenic, arachidonic, eicosapentaenoic, erucic decosahexaenoic acid; and salt of saturated fatty acid selected from the group consisting of sodium, potassium, or ammonia salts of stearate, caprylic, capric, lauric, myristic, palmitic, stearic, arachidic, behenic, lignoceric and cerotic acid; and combinations thereof;

the hydrocarbon substituted sarcosinate has a substituent selected from the group consisting of an alkyl, alkenyl or alkynyl, having ranging from 1 carbon atom for the alkyl substituent, 2 carbon atoms for the alkenyl, or 3 up to 24 carbon atoms for alkynyl substituent, wherein the number of double bonds for the alkenyl substituent or the number of triple bonds for the alkynyl substituent is up to 4.

3. The polishing composition of Claim 1, wherein the organic polymer and copolymer have molecules containing ethylene oxide repeating units is polyoxyethylene (POE), polyethylene oxide (PEO), or polyethylene glycol(PEG); wherein the polyethylene oxide (PEO) has the general molecular structure of



wherein n refers to the total numbers of the repeating unit ranging from 4 to 113636.

5 4. The polishing composition of Claim 1, wherein the ethoxylated surfactant is selected from the group consisting of alkyl phenol ethoxylate, fatty alcohol ethoxylate, fatty amine ethoxylate, propylene glycol (PPG)- ethylene glycol (PEG) block copolymer, polyether silicone surfactant, and combinations thereof.

10 5. The polishing composition of Claim 1, wherein the additive is selected from the group consisting of polyethylene oxide (PEO), oleoyl sarcosinate, N-Lauroylsarcosinate, fatty alcohol ethoxylate, fatty amine ethoxylate, propylene glycol (PPG)- ethylene glycol (PEG) block copolymer, polyether silicone
15 surfactant, and combinations thereof;

6. The polishing composition of Claim 1 comprises colloidal silica; iron coated silica particle or ammonium iron (III) oxalate trihydrate; hydrogen peroxide; one selected from the group consisting of propylene glycol (PPG)- ethylene glycol (PEG) block copolymer, polyether silicone surfactant, oleoyl sarcosinate, N-Lauroylsarcosinate, and combination thereof, and the pH is between 6.5 and 8.
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7. The polishing composition of Claim 1 further comprises biocide ranging from 0.0001 wt % to 0.03 wt %.

25 8. The polishing composition of Claim 1 further comprises at least one selected from the group consisting of surfactant; stabilizing and passivating agent; dispersion agent; chelator; film-forming anticorrosion agent; a polish enhancement agent; and combinations thereof.

30 9. A system for chemical mechanical planarization, comprising:
a semiconductor substrate comprising at least one surface containing tungsten;
a polishing pad; and

polymer and copolymer having molecules containing ethylene oxide repeating units; ethoxylated surfactant; and combinations thereof;

the pH adjusting agent is selected from the group consisting of amine, ammonium hydroxide, nitric acid, phosphoric acid, sulfuric acid, organic acid, potassium hydroxide, and/or salt thereof, and combinations thereof; and

pH of the composition is between 2 and 10;

wherein the at least one surface containing tungsten is in contact with the polishing pad and the polishing composition.

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10. The system of Claim 9, wherein

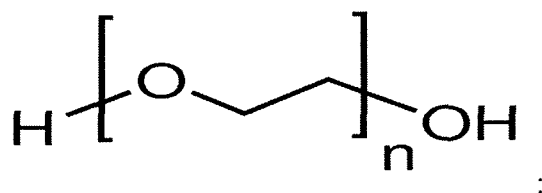
the sarcosinate is selected from the group consisting of cocoyl, lauroyl, myristoyl, oleoyl, stearyl sarcosinate, and combinations thereof;

the ~~sarcosinate~~-related carboxylic compound is selected from the group consisting of unsaturated salt of fatty acid selected from the group consisting of myristoleic, palmitoleic, sapienic, oleic, elaidic, vaccenic, linoleic, linoelaidic, α -linolenic, arachidonic, eicosapentaenoic, erucic decosahexaenoic acid; and salt of saturated fatty acid selected from the group consisting of sodium, potassium, or ammonia salts of stearate, caprylic, capric, lauric, myristic, palmitic, stearic, arachidic, behenic, lignoceric and cerotic acid; and combinations thereof;

the hydrocarbon substituted sarcosinate has a substituent selected from the group consisting of an alkyl, alkenyl or alkynyl, having ranging from 1 carbon atom for the alkyl substituent, 2 carbon atoms for the alkenyl, or 3 up to 24 carbon atoms for alkynyl substituent, wherein the number of double bonds for the alkenyl substituent or the number of triple bonds for the alkynyl substituent is up to 4.

11. The system of Claim 9,, wherein the organic polymer and copolymer having molecules containing ethylene oxide repeating units is polyoxyethylene (POE), polyethylene oxide (PEO), or polyethylene glycol(PEG);

wherein the polyethylene oxide (PEO) has the general molecular structure of



wherein n refers to the total numbers of the repeating unit ranging from 4 to 113636.

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12. The system of Claim 9, wherein the ethoxylated surfactant is selected from the group consisting of alkyl phenol ethoxylate, fatty alcohol ethoxylate, fatty amine ethoxylate, propylene glycol (PPG)- ethylene glycol (PEG) block copolymer, polyether silicone surfactant, and combinations thereof.

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13. The system of Claim 9, wherein the polishing composition comprises colloidal silica; iron coated silica particle or ammonium iron (III) oxalate trihydrate; hydrogen peroxide; one selected from the group consisting of propylene glycol (PPG)- ethylene glycol (PEG) block copolymer, polyether silicone surfactant, oleoyl sarcosinate, N-Lauroylsarcosinate, and combination thereof, and the pH is between 6.5 and 8.

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14. The system of Claim 9, wherein the polishing composition further comprises at least one selected from the group consisting of biocide ranging from 0.0001 wt % to 0.03 wt %; surfactant; stabilizing and passivating agent; dispersion agent; chelator; film-forming anticorrosion agent; a polish enhancement agent; and combinations thereof.

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15. A polishing method for chemical mechanical planarization of a semiconductor substrate comprising at least one surface containing tungsten, comprising the steps of:

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contacting the at least one surface containing tungsten with a polishing pad; delivering a polishing composition to the surface, the polishing composition comprising:

organic polymer and copolymer having molecules containing ethylene oxide repeating units; ethoxylated surfactant; and combinations thereof;

the pH adjusting agent is selected from the group consisting of amine, ammonium hydroxide, nitric acid, phosphoric acid, sulfuric acid, organic acid, potassium hydroxide, and/or salt thereof, and combinations thereof; and

pH of the composition is between 2 and 10;

and

10 C) polishing the at least one surface containing tungsten with the polishing composition.

16. The polishing method of Claim 15, wherein

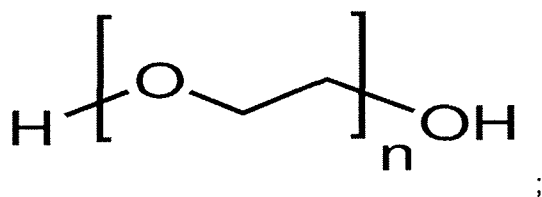
the sarcosinate is selected from the group consisting of cocoyl, lauroyl, myristoyl, oleoyl, stearyl sarcosinate, and combinations thereof;

15 the ~~sarcosinates~~-related carboxylic compound is selected from the group consisting of unsaturated salt of fatty acid selected from the group consisting of myristoleic, palmitoleic, sapienic, oleic, elaidic, vaccenic, linoleic, linoelaidic, α -linolenic, arachidonic, eicosapentaenoic, erucic decosaheptaenoic acid; and salt of saturated fatty acid selected from the group consisting of sodium, potassium, or ammonia salts of stearate, caprylic, capric, lauric, myristic, palmitic, stearic, arachidic, behenic, lignoceric and cerotic acid; and combinations thereof;

20 the hydrocarbon substituted sarcosinate has a substituent selected from the group consisting of an alkyl, alkenyl or alkynyl, having ranging from 1 carbon atom for the alkyl substituent, 2 carbon atoms for the alkenyl, or 3 up to 24 carbon atoms for alkynyl substituent, wherein the number of double bonds for the alkenyl substituent or the number of triple bonds for the alkynyl substituent is up to 4.

30 17. The polishing method of Claim 15, wherein the organic polymer and copolymer having molecules containing ethylene oxide repeating units is polyoxyethylene (POE), polyethylene oxide (PEO), or polyethylene glycol(PEG);

wherein the polyethylene oxide (PEO) has the general molecular structure of



wherein n refers to the total numbers of the repeating unit ranging from 4 to 113636.

18. The polishing method of Claim 15, wherein the ethoxylated surfactant is selected from the group consisting of alkyl phenol ethoxylate, fatty alcohol ethoxylate, fatty amine ethoxylate, propylene glycol (PPG)- ethylene glycol (PEG) block copolymer, polyether silicone surfactant, and combinations thereof.

19. The polishing method of Claim 15, wherein the polishing composition comprises colloidal silica; iron coated silica particle or ammonium iron (III) oxalate trihydrate; hydrogen peroxide; one selected from the group consisting of propylene glycol (PPG)- ethylene glycol (PEG) block copolymer, polyether silicone surfactant, oleoyl sarcosinate, N-Lauroylsarcosinate, and combination thereof, and the pH is between 6.5 and 8.

20. The polishing method of Claim 19, wherein the semiconductor substrate further comprising at least one surface containing TEOS; and the ratio of the removal rates of tungsten(W_{RR}) to TEOS($TEOS_{RR}$) is greater than 60.

21. The polishing method of Claim 15, wherein the polishing composition further comprises at least one selected from the group consisting of biocide ranging from 0.0001 wt % to 0.03 wt %; surfactant; stabilizing and passivating agent; dispersion agent; chelator; film-forming anticorrosion agent; a polish enhancement agent; and combinations thereof.