THE CLAIMS

What is claimed is:

1. An aqueous cleaning composition, comprising at least one corrosion inhibitor, water, optionally at least one chelating agent, optionally at least one etchant, optionally at least one passivating agent, and optionally at least one complexing agent, wherein said aqueous cleaning composition is suitable for cleaning post-plasma etch residue from a microelectronic device having said residue thereon.

2. The cleaning composition of claim 1, wherein the post-plasma etch residue comprises residue selected from the group consisting of titanium-containing compounds, polymeric compounds, copper-containing compounds, tungsten-containing compounds, cobalt-containing compounds, and combinations thereof.

3. The cleaning composition of any of claims 1 or 2, comprising the at least one etchant.

4. The cleaning composition of claim 3, wherein the at least one etchant comprises a fluoride species selected from the group consisting of hydrofluoric acid, fluoroboric acid, tetramethylammonium hexafluorophosphate, ammonium fluoride salts, ammonium bifluoride salts, tetrabutylammonium tetrafluoroborate, tetramethylammonium tetrafluoroborate, tetraethylammonium tetrafluoroborate, tetrapropylammonium tetrafluoroborate, tetrabutylammonium tetrafluoroborate, propylene glycol/HF, propylene glycol/tetraalkylammonium fluoride, propylene glycol/benzyltrimethylammonium fluoride, and combinations thereof.

5. The cleaning composition of claim 3, wherein the at least one etchant comprises a fluoride selected from the group consisting of ammonium bifluoride, tetrabutylammonium tetrafluoroborate, and combinations thereof.

6. The cleaning composition of any of the preceding claims, comprising the at least one passivating agent.

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7. The cleaning composition of claim 6, wherein the at least one passivating agent comprises a species selected from the group consisting of boric acid, 3-hydroxy-2-naphthoic acid, malonic acid, iminodiacetic acid, and mixtures thereof.

8. The cleaning composition of claim 6, wherein the at least one passivating agent comprises boric acid.

9. The cleaning composition of any of the preceding claims, wherein the at least one metal corrosion inhibitor comprises a species selected from the group consisting of benzotriazole (BTA), 1,2,4-triazole (TAZ), 5-aminotetrazole (ATA), 1-hydroxybenzotriazole, 5-amino-1,3,4-thiadiazol-2-thiol, 3-amino-1H-1,2,4 triazole, 3,5-diamino-1,2,4-triazole, tolyltriazole, 5-phenyl-benzotriazole, 5-nitro-benzotriazole, 3-amino-5-mercapto-1,2,4-triazole, 1-amino-1,2,4-triazole, 2-(5-amino-pentyl)-benzotriazole, 1-amino-1,2,3-triazole, 1-amino-5-methyl-1,2,3-triazole, 3-mercapto-1,2,4-triazole, 3-isopropyl-1,2,4-triazole, 5-phenylthiol-benzotriazole, halo-benzotriazoles (halo = F, Cl, Br, I), naphthotriazole, 1H-tetrazole-5-acetic acid, 2-mercaptobenzothiazole (2-MBT), 1-phenyl-2-tetrazoline-5-thione, 2-mercaptobenzimidazole (2-MBI), 4-methyl-2-phenylimidazole, 2-mercaptothiazoline, 2,4-diamino-6-methyl-1,3,5-triazine, thiazole, imidazole, benzimidazole, triazine, methyltetrazole, Bismuthiol I, 1,3-dimethyl-2-imidazolidinone, 1,5-pentamethylenetetrazole, 1-phenyl-5-mercaptotetrazole, diaminomethyltriazine, imidazoline thione, 4-methyl-4H-1,2,4-triazole-3-thiol, 5-amino-1,3,4-thiadiazole-2-thiol, benzothiazole, tritolyl phosphate, indazole, adenine, cytosine, guanine, thymine, phosphate inhibitors, amines, pyrazoles, propanethiol, silanes, secondary amines, benzohydroxamic acids, heterocyclic nitrogen inhibitors, citric acid, ascorbic acid, thiourea, 1,1,3,3-tetramethylurea, urea, urea derivatives, uric acid, potassium ethylxanthate, glycine, dodecylphosphonic acid, iminodiacetic acid, acid, boric acid, malonic acid, succinic acid, nitrilotriacetic acid, sulfolane, 2,3,5-trimethylpyrazine, 2-ethyl-3,5-dimethylpyrazine, quinoxaline, acetyl pyrrole, pyridazine, histadine, pyrazine, glutathione (reduced), cysteine, cystine, thiophene, mercapto pyridine N-oxide, thiamine HCl, tetraethyl thiuram disulfide, 2,5-dimercapto-1,3-thiadiazoleascorbic acid, ascorbic acid, and combinations thereof.

10. The cleaning composition of any of the preceding claims, comprising the at least one etchant and the at least one passivating agent.

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11. The cleaning composition of any of the preceding claims, wherein the amount of water is in a range from about 50 wt% to about 99 wt%, based on the total weight of the composition.

12. The cleaning composition of any of the preceding claims, wherein the pH is in a range from about 0 to about 7.

13. The cleaning composition of any of the preceding claims, wherein the composition is substantially devoid of abrasive material, oxidizing agents, ammonia, strong bases, and amidoxime complexing agents.

14. The cleaning composition of any of the preceding claims, wherein the composition is substantially devoid of organic solvent.

15. The cleaning composition of any of the preceding claims, wherein the composition is substantially devoid of silica sources.

16. The cleaning composition of any of the preceding claims, wherein said composition further comprises post-plasma etch residue selected from the group consisting of titanium-containing residue, polymeric-residue, copper-containing residue, tungsten-containing residue, cobalt-containing residue, and combinations thereof.

17. A kit comprising, in one or more containers, one or more of the following reagents for forming an aqueous cleaning composition, said one or more reagents selected from the group consisting of at least one corrosion inhibitor, water, optionally at least one chelating agent, optionally at least one etchant, optionally at least one passivating agent, and optionally at least one complexing agent and wherein the kit is adapted to form an aqueous cleaning composition suitable for cleaning post-plasma etch residue from a microelectronic device having said residue thereon.

18. A method of removing material from a microelectronic device having said material thereon, said method comprising contacting the microelectronic device with an aqueous cleaning composition for sufficient time to at least partially remove said material from the microelectronic device, wherein the aqueous cleaning composition includes at least one corrosion inhibitor, water,

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optionally at least one chelating agent, optionally at least one etchant, optionally at least one passivating agent, and optionally at least one complexing agent.

19. The method of claim 18, wherein the material comprises post-plasma etch residue comprising residue selected from the group consisting of titanium-containing compounds, polymeric compounds, copper-containing compounds, tungsten-containing compounds, cobalt-containing compounds, and combinations thereof.

20. The method as in any of claims 18-19, wherein said contacting comprises conditions selected from the group consisting of: time of from about 1 minute to about 30 minutes; temperature in a range of from about 40°C to about 70°C; and combinations thereof.

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THE CLAIMS

What is claimed is:

1. An aqueous cleaning composition, comprising at least one corrosion inhibitor, water, at least one etchant, and at least one passivating agent, wherein the at least one corrosion inhibitor comprises dodecylphosphonic acid, wherein said aqueous cleaning composition is suitable for cleaning post-plasma etch residue from a microelectronic device having said residue thereon.

2. The cleaning composition of claim 1, wherein the post-plasma etch residue comprises residue selected from the group consisting of titanium-containing compounds, polymeric compounds, copper-containing compounds, tungsten-containing compounds, cobalt-containing compounds, and combinations thereof.

3. The cleaning composition of claim 1, wherein the at least one etchant comprises a fluoride species selected from the group consisting of hydrofluoric acid, fluorosilicic acid, fluoroboric acid, ammonium fluorosilicate salt, tetramethylammonium hexafluorophosphate, ammonium fluoride salts, ammonium bifluoride salts, tetrabutylammonium tetrafluoroborate, tetramethylammonium tetrafluoroborate, tetraethylammonium tetrafluoroborate, tetrapropylammonium tetrafluoroborate, tetrabutylammonium tetrafluoroborate, propylene glycol/HF, propylene glycol/tetraalkylammonium fluoride, propylene glycol/benzyltrimethylammonium fluoride, quaternary phosphonium tetrafluoroborates having the formula PR_4BF_4, wherein R may be the same as or different from one another and selected from the group consisting of hydrogen, straight-chained C_1-C_6 alkyl, branched C_1-C_6 alkyl, cyclic C_1-C_6 alkyl, straight-chained C_6-C_{10} aryl, branched C_6-C_{10} aryl, and combinations thereof.

4. The cleaning composition of claim 3, wherein the at least one etchant comprises a fluoride selected from the group consisting of ammonium bifluoride, tetrabutylammonium tetrafluoroborate, quaternary phosphonium tetrafluoroborates, and combinations thereof.

5. The cleaning composition of claim 1, wherein the at least one passivating agent comprises a species selected from the group consisting of boric acid, 3-hydroxy-2-naphthoic acid, malonic acid, iminodiacetic acid, and mixtures thereof.

6. The cleaning composition of claim 1, wherein the at least one passivating agent comprises boric acid.

7. The cleaning composition of claim 1, wherein the at least one corrosion inhibitor further comprises a species selected from the group consisting of benzotriazole (BTA), 1,2,4-triazole (TAZ), 5-aminotetrazole (ATA), 1-hydroxybenzotriazole, 5-amino-1,3,4-thiadiazol-2-thiol, 3-amino-1H-1,2,4 triazole, 3,5-diamino-1,2,4-triazole, tolyltriazole, 5-phenyl-benzotriazole, 5-nitro-benzotriazole, 3-amino-5-mercapto-1,2,4-triazole, 1-amino-1,2,4-triazole, 2-(5-amino-pentyl)-benzotriazole, 1-amino-1,2,3-triazole, 1-amino-5-methyl-1,2,3-triazole, 3-mercapto-1,2,4-triazole, 3-isopropyl-1,2,4-triazole, 5-phenylthiol-benzotriazole, halo-benzotriazoles (halo = F, Cl, Br, I), naphthotriazole, 1H-tetrazole-5-acetic acid, 2-mercaptobenzothiazole (2-MBT), 1-phenyl-2-tetrazoline-5-thione, 2-mercaptobenzimidazole (2-MBI), 4-methyl-2-phenylimidazole, 2-mercaptothiazoline, 2,4-diamino-6-methyl-1,3,5-triazine, thiazole, imidazole, benzimidazole, triazine, methyltetrazole, Bismuthiol I, 1,3-dimethyl-2-imidazolidinone, 1,5-pentamethylenetetrazole, 1-phenyl-5-mercaptotetrazole, diaminomethyltriazine, imidazoline thione, 4-methyl-4H-1,2,4-triazole-3-thiol, 5-amino-1,3,4-thiadiazole-2-thiol, benzothiazole, tritolyl phosphate, indazole, adenine, cytosine, guanine, thymine, phosphate inhibitors, amines, pyrazoles, propanethiol, silanes, secondary amines, benzohydroxamic acids, heterocyclic nitrogen inhibitors, citric acid, ascorbic acid, thiourea, 1,1,3,3-tetramethylurea, urea, urea derivatives, uric acid, potassium ethylxanthate, glycine, iminodiacetic acid, acid, boric acid, malonic acid, succinic acid, nitrilotriacetic acid, sulfolane, 2,3,5-trimethylpyrazine, 2-ethyl-3,5-dimethylpyrazine, quinoxaline, acetyl pyrrole, pyridazine, histadine, pyrazine, glutathione (reduced), cysteine, cystine, thiophene, mercapto pyridine N-oxide, thiamine HCl, tetraethyl thiuram disulfide, 2,5-dimercapto-1,3-thiadiazoleascorbic acid, and combinations thereof.

8. The cleaning composition of claim 1, wherein the amount of water is in a range from about 50 wt% to about 99 wt%, based on the total weight of the composition.

9. The cleaning composition of claim 1, wherein the pH is in a range from about 0 to about 7.

10. The cleaning composition of claim 1, wherein the composition is substantially devoid of abrasive material, oxidizing agents, ammonia, strong bases, and amidoxime complexing agents.

11. The cleaning composition of claim 1, wherein the composition is substantially devoid of organic solvent.

12. The cleaning composition of claim 1, wherein the composition is substantially devoid of silica sources.

13. The cleaning composition of claim 1, wherein said composition further comprises post-plasma etch residue selected from the group consisting of titanium-containing residue, polymeric-residue, copper-containing residue, tungsten-containing residue, cobalt-containing residue, and combinations thereof.

14. A method of removing material from a microelectronic device having said material thereon, said method comprising contacting the microelectronic device with an aqueous cleaning composition for sufficient time to at least partially remove said material from the microelectronic device, wherein the aqueous cleaning composition includes at least one corrosion inhibitor, water, at least one etchant, and at least one passivating agent, wherein the at least one corrosion inhibitor comprises dodecylphosphonic acid.

15. The method of claim 14, wherein the material comprises post-plasma etch residue comprising residue selected from the group consisting of titanium-containing compounds, polymeric compounds, copper-containing compounds, tungsten-containing compounds, cobalt-containing compounds, and combinations thereof.

16. The method of claim 14, wherein said contacting comprises conditions selected from the group consisting of: time of from about 1 minute to about 30 minutes; temperature in a range of from about 40ºC to about 70ºC; and combinations thereof.

17. The cleaning composition of claim 1, further comprising at least one surfactant.

18. The method of claim 14, wherein the at least one etchant comprises a fluoride species selected from the group consisting of hydrofluoric acid, fluorosilicic acid, fluoroboric acid, ammonium fluorosilicate salt, tetramethylammonium hexafluorophosphate, ammonium fluoride salts, ammonium bifluoride salts, tetrabutylammonium tetrafluoroborate, tetramethylammonium tetrafluoroborate, tetraethylammonium tetrafluoroborate, tetrapropylammonium tetrafluoroborate, tetrabutylammonium tetrafluoroborate, propylene glycol/HF, propylene glycol/tetraalkylammonium fluoride, propylene glycol/benzyltrimethylammonium fluoride, quaternary phosphonium tetrafluoroborates having the formula PR_4BF_4, wherein R may be the same as or different from one another and selected from the group consisting of hydrogen, straight-chained C_1-C_6 alkyl, branched C_1-C_6 alkyl, cyclic C_1-C_6 alkyl, straight-chained C_6-C_{10} aryl, branched C_6-C_{10} aryl, and combinations thereof.

19. The method of claim 14, wherein the at least one passivating agent comprises a species selected from the group consisting of boric acid, 3-hydroxy-2-naphthoic acid, malonic acid, iminodiacetic acid, and mixtures thereof.

20. The method of claim 14, wherein the at least one corrosion inhibitor further comprises a species selected from the group consisting of benzotriazole (BTA), 1,2,4-triazole (TAZ), 5-aminotetrazole (ATA), 1-hydroxybenzotriazole, 5-amino-1,3,4-thiadiazol-2-thiol, 3-amino-1H-1,2,4 triazole, 3,5-diamino-1,2,4-triazole, tolyltriazole, 5-phenyl-benzotriazole, 5-nitro-benzotriazole, 3-amino-5-mercapto-1,2,4-triazole, 1-amino-1,2,4-triazole, 2-(5-amino-pentyl)-benzotriazole, 1-amino-1,2,3-triazole, 1-amino-5-methyl-1,2,3-triazole, 3-mercapto-1,2,4-triazole, 3-isopropyl-1,2,4-triazole, 5-phenylthiol-benzotriazole, halo-benzotriazoles (halo = F, Cl, Br, I), naphthotriazole, 1H-tetrazole-5-acetic acid, 2-mercaptobenzothiazole (2-MBT), 1-phenyl-2-tetrazoline-5-thione, 2-mercaptobenzimidazole (2-MBI), 4-methyl-2-phenylimidazole, 2-mercaptothiazoline, 2,4-diamino-6-methyl-1,3,5-triazine, thiazole, imidazole, benzimidazole, triazine, methyltetrazole, Bismuthiol I, 1,3-dimethyl-2-imidazolidinone, 1,5-pentamethylenetetrazole, 1-phenyl-5-mercaptotetrazole, diaminomethyltriazine, imidazoline thione, 4-methyl-4H-1,2,4-triazole-3-thiol, 5-amino-1,3,4-thiadiazole-2-thiol, benzothiazole, tritolyl phosphate, indazole, adenine, cytosine, guanine, thymine, phosphate inhibitors, amines, pyrazoles, propanethiol, silanes, secondary amines, benzohydroxamic acids, heterocyclic nitrogen inhibitors, citric acid, ascorbic acid, thiourea, 1,1,3,3-tetramethylurea, urea, urea derivatives, uric acid, potassium ethylxanthate, glycine, iminodiacetic acid, acid, boric acid, malonic acid, succinic acid, nitrilotriacetic acid, sulfolane, 2,3,5-trimethylpyrazine, 2-ethyl-3,5-dimethylpyrazine, quinoxaline, acetyl pyrrole, pyridazine, histadine, pyrazine, glutathione (reduced), cysteine, cystine, thiophene, mercapto pyridine N-oxide, thiamine HCl, tetraethyl thiuram disulfide, 2,5-dimercapto-1,3-thiadiazoleascorbic acid, and combinations thereof.