CLAIMS

1. An etching solution suitable for both tungsten-containing metals and TiN-containing materials, which comprises:

water;

two or more oxidizers, wherein the oxidizers comprise phosphoric acid and nitric acid, and wherein the combined amount of the two or more oxidizers is 0.5 to 50 % by weight of the etching solution; and

one or more of the components selected from:

0.01 to 20 % by weight of the etching solution of one or more fluorine-containing-etching compounds selected from the group consisting of ammonium fluoride, quaternary ammonium fluorides, HF, tetrafluoroboric acid, hexafluorosilicic acid, tetrabutylammonium tetrafluoroborate (TBA-BF4), H2ZrF6, H2TiF6, HPF6, ammonium hexafluorosilicate, ammonium hexafluorotitanate, and mixtures thereof,

0.00001 to 70 % by weight of the etching solution of one or more organic solvents selected from the group consisting of alcohols, glycol ethers, diols, glycerol, sulfoxides, amides, acids, esters, ketones, ethers, sulfolane, and mixtures thereof,

0.00001 to 10 % by weight of the etching solution of one or more chelating agents,

0.000001 to 5 % by weight of the etching solution of one or more corrosion inhibitors selected from the group consisting of aromatic hydroxyl compounds, phenolic derivatives with at least the two hydroxyl groups, acetylenic alcohols, carboxyl group-containing organic compounds and anhydrides thereof, triazole compounds, D-fructose, L-ascorbic acid, vanillin, salicylic acid, diethyl hydroxylamine, amines, alkanolamines, heterocylic amines, polyethyleneimines, morpholines, piperazines, and mixtures thereof, and

up to 5 % by weight of the etching solution of one or more surfactants,

wherein the etching solution is capable of etching TiN-containing material and tungsten-containing material at etch rates from 1 to 400 Å/min at room temperature.

2. The etching solution of claim 1 comprising said one or more fluorine-containing-etching compounds.

3. The etching solution of claim 2 wherein said one or more fluorine-containing-etching compounds are selected from quaternary ammonium fluorides and HF and mixtures thereof.

4. The etching solution of any one of claims 1 to 4 comprising said one or more organic solvents.

5. The etching solution of claim 4 wherein said one or more organic solvents are selected from DMSO, pyridine, triethyl phosphate, DMAC, NMP, 1,3-Dimethyl-3,4,5,6-tetrahydro-2(1H)-pyrimidinone, 1,3-dimethyl-2-imidazolidnone, 1-butyl-2-pyrrolidinone, methanesulfonic acid, propionic acid, lactic acid, acetic acid, 2-(1-Methoxy)propyl acetate, propylene carbonate, cyclopentanone, 1,4-dioxane, dimethoxyethane, poly(propylene glycol)monobutyl ether, sulfolane and mixtures thereof.

6. The etching solution of any one of claims 1 to 5 comprising said one or more corrosion inhibitors.

7. The etching solution of any one of claims 1 to 6 comprising said one or more surfactants.

8. The etching solution of claim 7 wherein said one or more surfactants are selected are selected from hexadecyl trimethylammonium p-toulenesulfonate, fluorosurfactants and mixtures thereof.

9. The etching solution of any one of claims 1 to 8 comprising said one or more chelating agents.

10. The etching solution of claim 9 wherein said one or more chelating agents are selected from (ethylenedinitrilo)tetraacetic acid (EDTA), butylenediaminetetraacetic acid, (1,2-cyclohexylenedinitrilo-)tetraacetic acid (CyDTA), diethylenetriaminepentaacetic acid (DETPA), ethylenediaminetetrapropionic acid, (hydroxyethyl)ethylenediaminetriacetic acid

(HEDTA), N, N,N', N'-ethylenediaminetetra(methylenephosphonic) acid (EDTMP), triethylenetetraminehexaacetic acid (TTHA), 1,3-diamino-2-hydroxypropane-N,N,N',N'-tetraacetic acid (DHPTA), methyliminodiacetic acid, propylenediaminetetraacetic acid, nitrolotriacetic acid (NTA), citric acid, tannic acid, tartaric acid, gluconic acid, saccharic acid, glyceric acid, oxalic acid, phthalic acid, maleic acid, mandelic acid, malonic acid, salicylic acid, propyl gallate, pyrogallol, 8-hydroxyquinoline, and cysteine, and mixtures thereof.

11. The etching solution of any one of claims 1 to 10, wherein said two or more oxidizers further comprise hydrogen peroxide (H2O2).

12. The etching solution of any one of claims 1 to 11, wherein the etching solution has a TiN:W etching ratio of 1:10 to 10:1.

13. The etching solution of any one of claims 1 to 12, wherein the etching solution has a TiN:W etching ratio of 1:5 to 5:1.

14. The etching solution of any one of claims 1 to 13, wherein the etching solution has a TiN:W etching ratio of 1:3 to 3:1.

15. The etching solution of any one of claims 1 to 14, wherein the etching solution has a TiN:W etching ratio of 1:2 to 2:1.

16. The etching solution of any one of claims 1 to 15 having a pH of less than 6.

17. The etching solution of any one of claims 1 to 16 being substantially free of ammonium compounds.

18. A method for etching both TiN-containing material and tungsten-containing metal from a microelectronic device comprising at least one of TiN-containing material and tungsten-containing material during the manufacture of the microelectronic device, the method comprising the steps of:

contacting the microelectronic device with an aqueous etching solution of any one of claims 1 to 17 for a time sufficient to at least partially remove the TiN-containing material and the tungsten-containing metal from the device at rates of from 1 to 400 Å/min at room temperature.

19. The method of claim 18, further wherein the solution is capable of etching TiN-containing material and tungsten-containing material at relative etch rates from 1:2 to 2:1.