Claims

What is claimed is:

1. A formulation comprising:

(i) at least one alkanolamine having at least two carbon atoms, at least one amino substituent and at least one hydroxyl substituent with the amino and hydroxyl substituents attached to two different carbon atoms,

(ii) at least one pH adjuster for adjusting the pH of the formulation to between approximately 9 and approximately 12, wherein the at least one pH adjuster is one or more of phosphoric acid, trifluoroacetic acid, methanesulfonic acid, and halogen acids of the formula H-X where X = Cl, Br, or I;

(iii) at least one chelating agent; and

(iv) water.

2. The formulation of claim 1 further comprising:

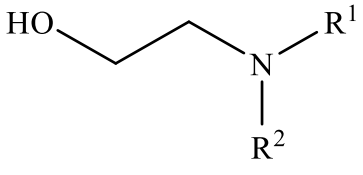
(v) at least one water miscible solvent.

3. The formulation of claim 1 further comprising:

(v) at least one water miscible solvent; and

(vi) at least one wettability adjusting material.

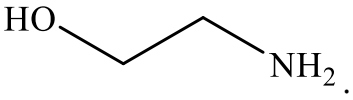
4. The formulation of claim 1, wherein the at least one alkanolamine comprises a compound of formula (I):



(I)

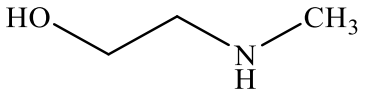
wherein each of R^1 and R^2 is independently selected from H, an unsubstituted C_1-C_6 alkyl, a substituted C_1-C_6 alkyl, a branched C_3-C_6 alkyl and a C_1-C_6 alkylamino.

5. The formulation of claim 1, wherein the at least one alkanolamine comprises



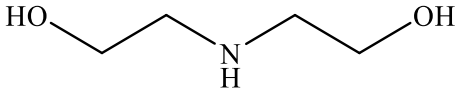
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6. The formulation of claim 1, wherein the at least one alkanolamine comprises



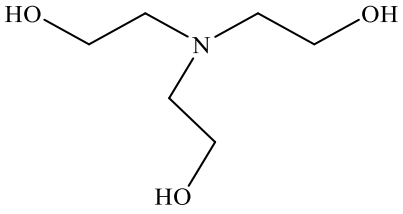
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7. The formulation of claim 1, wherein the at least one alkanolamine comprises



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8. The formulation of claim 1, wherein the at least one alkanolamine comprises



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9. The formulation of claim 1, wherein the at least one pH adjuster comprises methanesulfonic acid.

10. The formulation of claim 1, wherein the at least one chelating agent is one or more of ethylenediaminetetraacetic acid (EDTA), butylenediaminetetraacetic acid, (1,2-cyclohexylenediamine)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), iminodiacetic acid, methyliminodiacetic acid, propylenediaminetetraacetic acid, nitrotriacetic acid (NTA), citric acid, tartaric acid, gluconic acid, saccharic acid, glyceric acid, oxalic acid, phthalic acid, maleic acid, mandelic acid, malonic acid, lactic acid, salicylic acid, propyl gallate, pyrogallol, 8-hydroxyquinoline, and cysteine.

11. The formulation of claim 1, wherein the at least one chelating agent comprises EDTA.

12. The formulation of claim 1, wherein the at least one chelating agent comprises CyDTA.

13. The formulation of claim 1, wherein the at least one chelating agent comprises iminodiacetic acid.

14. The formulation of claim 4, wherein the at least one water miscible solvent comprises one or more of ethylene glycol, propylene glycol (PG), 1,4-butanediol, tripropylene glycol methyl ether, propylene glycol propyl ether, diethylene gycol n-butyl ether (BDG), dipropylene glycol methyl ether (DPM), hexyloxypropylamine, poly(oxyethylene)diamine, dimethyl sulfoxide (DMSO), tetrahydrofuran, tetrahydrofurfuryl alcohol, glycerol, alcohols, sulfolane, sulfoxides, and mixtures thereof.

15. The formulation of claim 4, wherein the at least one water miscible solvent comprises from about 10 wt. % to about 20 wt. % of propylene glycol.

16. The formulation of claim 1, wherein the at least one water miscible solvent comprises from about 10 wt. % to about 20 wt. % of diethylene glycol butyl ether.

17. The formulation of claim 1, wherein the formulation has a copper etching rate of greater than approximately 50Å/minute and a cobalt etching rate of greater than approximately 50Å/minute when copper and cobalt are coupled.

18. The formulation of claim 1, wherein the formulation has a copper to cobalt etching rate ratio of approximately 0.9 to approximately 2.25 when copper and cobalt are coupled.

19. The formulation of claim 1, wherein the formulation has a copper to cobalt etching rate ratio of approximately 1.0 when copper and cobalt are coupled.

20. A method of etching a substrate comprising copper and cobalt, the method comprising:

(i) applying a composition comprising the formulation of claim 1 onto the substrate.