CLAIMS

1. A composition useful for removing residue from a semiconductor substrate consisting of, in effective cleaning amounts:

from 0.3 to 5.0% by weight of EDTA;

from 10.0 to 30.0% by weight of an amine compound wherein the amine compound is selected from the group consisting of a secondary amine, a tertiary amine, and mixtures thereof;

from 0.1 to 5.0% by weight of a polyfunctional organic acid;

from 0.01 to 8.0% by weight of a fluoride ion source selected from the group consisting of ammonium fluoride, a quaternary ammonium fluoride, and a fluoride salt of an aliphatic primary, secondary or tertiary amine having the formula:

$$R^1NR^2R^3R^4F$$

wherein R^1, R^2, R^3 and R^4 each individually represent H or a (C_1-C_4) alkyl group;

from 0 to 60% by weight of a water-miscible organic solvent;

from 0.3 to 1.5% by weight of a corrosion inhibitor, wherein the corrosion inhibitor is a triazole compound selected from the group consisting of o-tolyltriazole, m-tolyltriazole, p-tolyltriazole, and mixtures thereof; and

remainder is water.

2. The composition of claim 1 wherein the amine compound is selected from the group consisting of triethanolamine (TEA), diethanolamine, N-methyl diethanolamine, diisopropanolamine, N-methyl ethanol amine, and mixtures thereof.

3. The composition of claim 1 wherein the polyfunctional organic acid is selected from the group consisting of malonic acid, malic acid, phthalic acid, citric acid, trimellitic acid, and combinations thereof.

4. The composition of claim 1 wherein the water-miscible organic solvent is present and is selected from the group consisting of dimethylacetamide (DMAC), N-methyl pyrrolidinone (NMP), dimethylsulfoxide (DMSO), dimethylformamide, N-methylformamide, formamide, dimethyl-2-piperidone (DMPD), tetrahydrofurfuryl alcohol, glycerol, ethylene glycol, an amide, an alcohol, a sulfoxide, a hydroxyamide, an amino alcohols, a (C_2– C_{20}) alkanediol, a (C_3– C_{20}) alkanetriol, a cyclic alcohol, propylene glycol, tetrahydrofurfuryl alcohol, diacetone alcohol, 1, 4-cyclohexanedimethanol.

5. The composition of claim 4 wherein the water-miscible organic solvent is selected from the group consisting of DMSO, NMP, and DMAC.

6. The composition of claim 1 wherein the water-miscible organic solvent is present and is a glycol ether selected from the group consisting of ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, ethylene glycol monobutyl ether, ethylene glycol dimethyl ether, ethylene glycol diethyl ether, diethylene glycol monomethyl ether, diethylene glycol monoethyl ether, diethylene glycol monopropyl ether, diethylene glycol monoisopropyl ether, diethylene glycol monobutyl ether, diethylene glycol monoisobutyl either, diethylene glycol monobenzyl ether, diethylene glycol dimethyl ether, diethylene glycol diethyl ether, triethylene glycol monomethyl ether, triethylene glycol dimethyl ether, polyethylene glycol monomethyl ether, diethylene glycol methyl ethyl ether, triethylene glycol ethylene glycol monomethyl ether acetate, ethylene glycol monethyl ether acetate, propylene glycol methyl ether acetate, propylene glycol monomethyl ether, propylene glycol dimethyl ether, propylene glycol monobutyl ether, propylene glycol, monopropyl ether, dipropylene glycol monomethyl ether, dipropylene glycol monopropyl ether, dipropylene glycol monoisopropyl ether, dipropylene monobutyl ether, diproplylene glycol diisopropyl ether, tripropylene glycol monomethyl ether, 1-methoxy-2-butanol, 2-methoxy-1-butanol, 2-methoxy-2-methylbutanol, 1,1-dimethoxyethane, and 2-(2-butoxyethoxy) ethanol.

7. The composition of claim 1 consisting of:

from 0.3 to 3.5% by weight of EDTA;

from 20.0 to 30.0% by weight of an amine compound wherein the amine compound is selected from the group consisting of a secondary amine, a tertiary amine, and mixtures thereof;

from 0.5 to 2.0% by weight of a polyfunctional organic acid;

from 0.025 to 5.0% by weight of a fluoride ion source selected from the group consisting of ammonium fluoride, a quaternary ammonium fluoride, and a fluoride salt of an aliphatic primary, secondary or tertiary amine having the formula:

$$R^1NR^2R^3R^4F$$

wherein R^1, R^2, R^3 and R^4 each individually represent H or a (C_1-C_4) alkyl group;

from 20 to 40% by weight of a water-miscible organic solvent;

from 0.3 to 1.5% by weight of a corrosion inhibitor, wherein the corrosion inhibitor is a triazole compound selected from the group consisting of o-tolyltriazole, m-tolyltriazole, p-tolyltriazole, and mixtures thereof; and remainder is water.

8. A method for removing residue from a substrate optionally comprising aluminum, the method comprising the steps of:

contacting the substrate at a temperature of from 25° C to 85° C for a period of time ranging from 1 minute to 1 hour with a composition consisting of:

from 0.3 to 5.0% by weight of EDTA;

from 10.0 to 30.0% by weight of an amine compound wherein the amine compound is selected from the group consisting of a secondary amine, a tertiary amine, and mixtures thereof;

from 0.1 to 5.0% by weight of a polyfunctional organic acid;

from 0.01 to 8.0% by weight of a fluoride ion source selected from the group consisting of ammonium fluoride, a quaternary ammonium fluoride, and a fluoride salt of an aliphatic primary, secondary or tertiary amine having the formula:

$$R^1NR^2R^3R^4F$$

wherein R^1, R^2, R^3 and R^4 each individually represent H or a (C_1-C_4) alkyl group;

from 0 to 60% by weight of a water-miscible organic solvent;

from 0.3 to 1.5% by weight of a corrosion inhibitor, wherein the corrosion inhibitor is a triazole compound selected from the group consisting of o-tolyltriazole, m-tolyltriazole, p-tolyltriazole, and mixtures thereof; and remainder is water;

rinsing the substrate with water; and

drying the substrate, wherein the method excludes an intermediate IPA rinse step prior to the step of rinsing the substrate with water.

9. The method of claim 8 wherein the substrate is a semiconductor substrate.

10. The method of claim 8 wherein the amine compound is selected from the group consisting of triethanolamine (TEA), diethanolamine, N-methyl diethanolamine, diisopropanolamine, N-methyl ethanol amine, and mixtures thereof.

11. The method of claim 8 wherein the polyfunctional organic acid is selected from the group consisting of malonic acid, malic acid, phthalic acid, citric acid, trimellitic acid, and combinations thereof.

12. The method of claim 8 wherein the water-miscible organic solvent is present and is selected from the group consisting of dimethylacetamide (DMAC), N-methyl pyrrolidinone (NMP), dimethylsulfoxide (DMSO), dimethylformamide, N-methylformamide, formamide, dimethyl-2-piperidone (DMPD), tetrahydrofurfuryl alcohol, glycerol, ethylene glycol, an amide, an alcohol, a sulfoxide, a hydroxyamide, an amino alcohols, a (C_2– C_{20}) alkanediol, a (C_3– C_{20}) alkanetriol, a cyclic alcohol, propylene glycol, tetrahydrofurfuryl alcohol, diacetone alcohol, 1, 4-cyclohexanedimethanol.

13. The method of claim 12 wherein the water-miscible organic solvent is selected from the group consisting of DMSO, NMP, and DMAC.

14. The method of claim 8 wherein the water-miscible organic solvent is present and is a glycol ether selected from the group consisting of ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, ethylene glycol monobutyl ether, ethylene glycol dimethyl ether, ethylene glycol diethyl ether, diethylene glycol monomethyl ether, diethylene glycol monoethyl ether, diethylene glycol monopropyl ether, diethylene glycol monoisopropyl ether, diethylene glycol monobutyl ether, diethylene glycol monoisobutyl either, diethylene glycol monobenzyl ether, diethylene glycol dimethyl ether, diethylene glycol diethyl ether, triethylene glycol monomethyl ether, triethylene glycol dimethyl ether, polyethylene glycol monomethyl ether, diethylene glycol methyl ethyl ether, triethylene glycol ethylene glycol monomethyl ether acetate, ethylene glycol monethyl ether acetate, propylene glycol methyl ether acetate, propylene glycol monomethyl ether, propylene glycol dimethyl ether, propylene glycol monobutyl ether, propylene glycol, monopropyl ether, dipropylene glycol monomethyl ether, dipropylene glycol monopropyl ether, dipropylene glycol monoisopropyl ether, dipropylene monobutyl ether, diproplylene glycol diisopropyl ether, tripropylene glycol monomethyl ether, 1-methoxy-2-butanol, 2-methoxy-1-butanol, 2-methoxy-2-methylbutanol, 1,1-dimethoxyethane, and 2-(2-butoxyethoxy) ethanol.

15. The method of claim 8 wherein the composition consists of:

from 0.3 to 3.5% by weight of EDTA;

from 20.0 to 30.0% by weight of an amine compound wherein the amine compound is selected from the group consisting of a secondary amine, a tertiary amine, and mixtures thereof;

from 0.5 to 2.0% by weight of a polyfunctional organic acid;

from 0.025 to 5.0% by weight of a fluoride ion source selected from the group consisting of ammonium fluoride, a quaternary ammonium fluoride, and a fluoride salt of an aliphatic primary, secondary or tertiary amine having the formula:

$$R^1NR^2R^3R^4F$$

wherein R^1, R^2, R^3 and R^4 each individually represent H or a (C_1-C_4) alkyl group;

from 20 to 40% by weight of a water-miscible organic solvent;

from 0.3 to 1.5% by weight of a corrosion inhibitor, wherein the corrosion inhibitor is a triazole compound selected from the group consisting of o-tolyltriazole, m-tolyltriazole, p-tolyltriazole, and mixtures thereof; and remainder is water.

16. The method of claim 9 where the substrate comprises cobalt metal and aluminum.

17. The method of claim 16 wherein the composition protects the cobalt metal by providing a cobalt metal etch rate of 4 Å/min or less.

18. The method of claim 17 wherein the composition protects the cobalt metal by providing a cobalt metal etch rate of 3 Å/min or less.

19. The method of claim 18 wherein the composition protects the cobalt metal by providing a cobalt metal etch rate of 2 Å/min or less.