CLAIMS

What is claimed:

1. A polishing composition comprising:

    at least one abrasive;

    at least one organic acid;

    at least one anionic surfactant comprising at least a phosphate, and at least one of a hydrophobic 6 to 24 carbon alkyl chain and 2 to 16 ethylene oxide groups, wherein the anionic surfactant is in an amount of from 0.001% to 0.1% by weight of the composition;

    at least one phosphonic acid compound having a molecular weight below 500 g/mol, wherein the at least one phosphonic acid is selected from the group consisting of phenylphosphonic acid, butylphosphonic acid, hexylphosphonic acid, benzylphosphonic acid, and mixtures thereof, wherein the phosphonic acid compound is in an amount of from 0.05% to 1% by weight of the composition;

    at least one azole containing compound;

    at least one alkylamine compound having a 10-24 carbon alkyl chain, wherein the alkylamine compound is in an amount of from 0.001% to 0.1% by weight of the composition; and

    an aqueous solvent;

    optionally, a pH adjuster.

2. The polishing composition of claim 1, wherein the at least one abrasive is selected from the group consisting of alumina, silica, titania, ceria, zirconia, co-formed products of alumina, silica, titania, ceria, or zirconia, coated abrasives, surface modified abrasives, and mixtures thereof.

3. The polishing composition of claim 1, wherein the at least one abrasive is in an amount of from 0.01% to 25% by weight of the composition.

4. The polishing composition of claim 1, wherein the at least one organic acid is selected from the group consisting of gluconic acid, lactic acid, citric acid, tartaric acid, malic acid, glycolic acid, malonic acid, formic acid, oxalic acid, acetic acid, propionic acid, peracetic acid, succinic acid, lactic acid, amino acetic acid, phenoxyacetic acid, bicine, diglycolic acid, glyceric acid, tricine, maleic acid, nitrilotriacetic acid, ethylenediaminetetraacetic acid, diethylenetriaminepentaacetic acid, alanine, histidine, valine, phenylalanine, proline, glutamine, aspartic acid, glutamic acid, arginine, lysine, tyrosine, glycine, serine, asparagine, cysteine, leucine, isoleucine, methionine, threonine, tryptophan, benzoic acid, and mixtures thereof.

5. The polishing composition of claim 1, wherein there are at least two organic acids and one is an amino acid.

6. The polishing composition of claim 1, wherein the at least one organic acid is in an amount of from 0.001% to 2.5% by weight of the composition.

7. The polishing composition of claim 1, wherein the at least one anionic surfactant is selected from the group consisting of an alkyl phosphate, a polyoxyethylene alkyl ether phosphate, a polyoxyethylene aryl alkyl ether phosphate, a polyoxyethylene nonylaryl ether phosphate, a polyoxyethylene nonylphenyl ether phosphate, and mixtures thereof.

8. The polishing composition of claim 1, wherein the at least one azole is selected from the group consisting of benzotriazole, adenine, benzimidazole, thiabendazole, tolyltriazole, 1,2,3-triazole, 1,2,4-triazole, 1-hydroxybenzotriazole, 2-methylbenzothiazole, 2-aminobenzimidazole, 2-amino-5-ethyl-1,3,4-thiadazole, 3,5-diamino-1,2,4-triazole, 3-amino-5-methylpyrazole, 4-amino-4H-1,2,4-triazole, 5-methylbenzotriazole, 5-chlorobenzotriazole, 5-fluorobenzotriazole, 5-bromobenzotriazole, 5-iodobenzotriazole, 5-aminotetrazole, 5-ethylbenzotriazole, 5-butylbenzotriazole, dimethylbenzotriazole, dichlorobenzotriazole, chloromethylbenzotriazole, phenylbenzotriazole, benzylbenzotriazole, nitrobenzotriazole, imidazole, and combinations thereof.

9. The polishing composition of claim 1, wherein the at least one azole is in an amount of from 0.001% to 0.5% by weight of the composition.

10. The polishing composition of claim 1, wherein the pH of the composition is between 7 to 12.

11. The polishing composition of claim 1, further comprising:
an organic solvent in an amount of from 0.01% to 5% by weight of the composition.

12. The polishing composition of claim 11, wherein the organic solvent is selected from the group consisting of ethanol, 1-propanol, 2-propanol, n-butanol, propylene glycol, 2-methoxyethanol, 2-ethoxyethanol, propylene glycol propyl ether, ethylene glycol, and any combinations thereof.

13. A polishing composition comprising:
at least one abrasive in an amount of from 0.1% to 12% by weight of the composition;
at least two organic acids, in an amount of from 0.001% to 2.5% by weight of the composition, wherein at least one of the organic acids is an amino acid;
at least one anionic surfactant comprising at least a phosphate, and at least one of a hydrophobic 6 to 24 carbon alkyl chain and 2 to 16 ethylene oxide groups, wherein the anionic surfactant is in an amount of from 0.001% to 0.1% by weight of the composition;
at least one phosphonic acid compound having a molecular weight below 500 g/mol in an amount of from 0.05% to 1% by weight of the composition;
at least one azole containing compound in an amount of from 0.01% to 0.5% by weight of the composition;
at least one alkylamine compound having a 10-24 carbon alkyl chain in an amount of from 0.001% to 0.1% by weight of the composition; and
an aqueous solvent;
wherein the pH of the composition is between 7 to 12.

14. A method of polishing a substrate that comprises cobalt, comprising:

applying the polishing composition of any of claims 1-12 to a substrate comprising cobalt on a surface of the substrate; and

bringing a pad into contact with the surface of the substrate and moving the pad in relation to the substrate.

15. The method of claim 14, further comprising forming a semiconductor device from the substrate.