CLAIMS:

1. A polishing composition, comprising:

an abrasive;

a pH adjuster;

a barrier film removal rate enhancer, wherein the barrier film removal rate enhancer comprises an organic acid or a salt thereof;

a first low-k removal rate inhibitor, wherein the first low-k removal rate inhibitor comprises a nonionic surfactant;

a second low-k removal rate inhibitor different from the first low-k removal rate inhibitor, wherein the second low-k removal rate inhibitor comprises an amphiphilic copolymer;

an azole-containing corrosion inhibitor; and

a cobalt corrosion inhibitor.

2. The polishing composition of claim 1, wherein the 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 abrasive is in an amount of from 0.1% to 50% by weight of the composition.

4. The polishing composition of claim 1, wherein the organic acid or the salt thereof 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, potassium acetate, potassium citrate, amino acetic acid, phenoxyacetic acid, bicine, diglycolic acid, glyceric acid, tricine, alanine, histidine, valine, phenylalanine, proline, glutamine, aspartic acid, glutamic acid, arginine, lysine, tyrosine, benzoic acid, 1,2-ethanedisulfonic acid, 4-amino-3-hydroxy-1-naphthalenesulfonic acid, 8-hydroxyquinoline-5-sulfonic acid, aminomethanesulfonic acid, benzenesulfonic acid, hydroxylamine O-sulfonic acid, methanesulfonic acid, m-xylene-4-sulfonic acid, poly(4-styrenesulfonic acid),

polyanetholesulfonic acid, p-toluenesulfonic acid, trifluoromethane-sulfonic acid, ethyl phosphoric acid, cyanoethyl phosphoric acid, phenyl phosphoric acid, vinyl phosphoric acid, poly(vinylphosphonic acid), 1-hydroxyethane-1,1-diphosphonic acid, nitrilotri(methylphosphonic acid), diethylenetriaminepentakis (methylphosphonic acid), N,N,N',N'-ethylenediaminetetrakis(methylene phosphonic acid), n-hexylphosphonic acid, benzylphosphonic acid, phenylphosphonic acid, salts thereof, and mixtures thereof.

5. The polishing composition of claim 1, wherein the barrier film removal rate enhancer is in an amount of from 0.02% to 4% by weight of the composition.

6. The polishing composition of claim 1, where the nonionic surfactant is selected from the group consisting of alcohol alkoxylates, alkylphenol alkoxylates, tristyrylphenol alkoxylates, sorbitan ester alkoxylates, polyalkoxylates, polyalkylene oxide block copolymers, tetrahydroxy oligomers, an alkoxylated diamine, and mixtures thereof.

7. The polishing composition of claim 1, wherein the first low-k removal rate inhibitor is in an amount of from 0.005% to 5% by weight of the composition.

8. The polishing composition of claim 1, wherein the amphiphilic copolymer is a styrene maleic anhydride copolymer.

9. The polishing composition of claim 1, wherein the second low-k removal rate inhibitor is in an amount of from 0.005% to 5% by weight of the composition.

10. The polishing composition of claim 1, wherein the azole-containing corrosion inhibitor is selected from the group consisting of triazole, tetrazole, benzotriazole, tolyltriazole, ethyl benzotriazole, propyl benzotriazole, butyl benzotriazole, pentyl benzotriazole, hexyl benzotriazole, dimethyl benzotriazole, chloro benzotriazole, dichloro benzotriazole, chloromethyl benzotriazole, chloroethyl benzotriazole, phenyl benzotriazole, benzyl

benzotriazole, aminotriazole, aminobenzimidazole, pyrazole, imidazole, aminotetrazole, and mixtures thereof.

11. The polishing composition of claim 1, wherein the azole-containing corrosion inhibitor is in an amount of from 0.0001% to 1% by weight of the composition.

12. The polishing composition of claim 1, wherein the cobalt corrosion inhibitor is an anionic surfactant.

13. The polishing composition of claim 12, wherein the anionic surfactant comprises one or more phosphate groups and one or more of the following: a six to twenty four carbon alkyl chain, zero to eighteen ethylene oxide groups, or a combination thereof.

14. The polishing composition of claim 1, wherein the cobalt corrosion inhibitor is in an amount of from 0.0001% to 1% by weight of the composition.

15. The polishing composition of claim 1, wherein the pH adjuster is selected from the group consisting of ammonium hydroxide, sodium hydroxide, potassium hydroxide, cesium hydroxide, monoethanolamine, diethanolamine, triethanolamine, methylethanolamine, methyldiethanolamine tetrabutylammonium hydroxide, tetrapropylammonium hydroxide, tetraethylammonium hydroxide, tetramethylammonium hydroxide, ethyltrimethylammonium hydroxide, diethyldimethylammonium hydroxide, dimethyldipropylammonium hydroxide, benzyltrimethylammonium hydroxide, tris(2-hydroxyethyl)methylammonium hydroxide, choline hydroxide, and any combinations thereof.

16. The polishing composition of claim 1, wherein the pH adjuster is in an amount of from 0.05% to 10% by weight of the composition.

17. The polishing composition of claim 1, further comprising:
a chelating agent selected from the group consisting of ethylenediaminetetracetic acid, iminodiacetic acid, N-hydroxyethyl-ethylenediaminetriacetic acid, nitrilotriacetic acid, diethylenetriaminepentacetic acid, hydroxyethylethylenediaminetriacetic acid, triethylenetetraaminehexaacetic acid, diaminocycloheanetetraacetic acid, nitrilotrimethylphosphonic acid, ethylenediaminetetra(methylenephosphonic acid), 1-hydroxyl ethylidene-1,1,-diphosphonic acid, diethylenetriamine penta (methylene phosphonic acid), and combinations thereof.

18. The polishing composition of claim 17, wherein the chelating agent is in an amount of from 0.001% to 1% by weight of the composition.

19. The polishing composition of claim 1, wherein the composition comprises:
the abrasive in an amount of from 0.1% to 50% by weight of the composition;
the pH adjuster in an amount of from 0.05% to 10% by weight of the composition;
the barrier film removal rate enhancer in an amount of from 0.02% to 4% by weight of the composition;
the first low-k removal rate inhibitor in an amount of from 0.005% to 5% by weight of the composition;
the second low-k removal rate inhibitor in an amount of from 0.005% to 5% by weight of the composition;
the azole-containing corrosion inhibitor in an amount of from 0.0001% to 1% by weight of the composition; and
the cobalt corrosion inhibitor in an amount of from 0.0001% to 1% by weight of the composition.

20. The polishing composition of claim 1, wherein the pH of the composition is between 7 and 14.

21. A polishing composition, comprising:

an abrasive;

a pH adjuster;

an organic acid or a salt thereof;

a nonionic surfactant;

an amphiphilic copolymer;

an azole-containing corrosion inhibitor; and

an anionic surfactant.

22. A method of polishing a substrate, comprising the steps of:

applying the polishing composition of any one of claims 1-21 to a surface of a substrate, wherein the surface comprises cobalt; and

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