WHAT IS CLAIMED IS:

1. An etching composition, comprising:

1) at least one oxidizing agent;

2) at least one first carboxylic acid, wherein the first carboxylic acid comprises at least one unit of unsaturation;

3) at least one chelating agent;

4) at least one leveling agent, wherein the at least one leveling agent comprises a sulfur-containing polymer or a nitrogen-containing polymer, wherein the nitrogen-containing polymer is selected from the group consisting of polyethylene imine, polyglycine, poly(allylamine), polyaniline, sulfonated polyaniline, polyurea, poly(melamine-co-formaldehyde), polyaminoamide, and polyalkanolamine; and

5) water;

wherein the composition is free of an abrasive.

2. The composition of claim 1, wherein the composition has a pH between about 1 and about 5.

3. The composition of claim 1 or claim 2, wherein the at least one oxidizing agent comprises hydrogen peroxide.

4. The composition of any one of claims 1 to 3, wherein the at least one oxidizing agent is in the amount of from about 0.01% to about 20% by weight of the composition.

5. The composition of any one of claims 1 to 4, wherein the at least one oxidizing agent is in the amount of from about 0.1% to about 10% by weight of the composition.

6. The composition of any one of claims 1 to 5, wherein the at least one oxidizing agent is in the amount of from about 0.5% to about 1% by weight of the composition.

7. The composition of any one of claims 1 to 6, wherein the at least one first carboxylic acid comprises a carboxylic acid having three to ten carbon atoms.

8. The composition of any one of claims 1 to 7, wherein the at least one first carboxylic acid comprises crotonic acid, maleic acid, fumaric acid, propenoic acid, 3-pentenoic acid, 5-hexenoic acid, 6-heptenoic acid, 7-octenoic acid, 8-nonenoic acid, or 9-undecylenic acid.

9. The composition of any one of claims 1 to 8, wherein the at least one first carboxylic acid is in the amount of from about 0.005% to about 3% by weight of the composition.

10. The composition of any one of claims 1 to 9, further comprising at least one second carboxylic acid.

11. The composition of claim 10, wherein the at least one second carboxylic acid comprises a monocarboxylic acid.

12. The composition of claim 11, wherein the monocarboxylic acid is a C_1 to C_{10} monocarboxylic acid.

13. The composition of claim 12, wherein the monocarboxylic acid is glycolic acid, gluconic acid, acetic acid, gallic acid, or lactic acid.

14. The composition of any one of claims 10 to 13, wherein the at least one second carboxylic acid comprises a polycarboxylic acid.

15. The composition of claim 14, wherein the polycarboxylic acid is a C_2 to C_{10} polycarboxylic acid.

16. The composition of claim 15, wherein the polycarboxylic acid.is oxalic acid, malonic acid, succinic acid, glutaric acid, citric acid, tartaric acid, malic acid, phthalic acid, or 1,2,3-benzenetricarboxylic acid.

17. The composition of any one of claims 10 to 16, wherein the at least one second carboxylic acid is in the amount of from about 0.005% to about 3% by weight of the composition.

18. The composition of any one of claims 1 to 17, wherein the at least one leveling agent comprises poly(4-styrene sulfonic acid)..

19. The composition of any one of claims 1 to 18, wherein the at least one leveling agent is in the amount of from about 0.01% to about 3% by weight of the composition.

20. The composition of any one of claims 1 to 19, further comprising at least one metal corrosion inhibitor.

21. The composition of claim 20, wherein the at least one metal corrosion inhibitor comprises a substituted or unsubstituted azole.

22. The composition of claim 21, wherein the azole is a triazole, an imidazole, a thiadiazole, or a tetrazole.

23. The composition of any one of claims 20 to 22, wherein the at least one metal corrosion inhibitor comprises a benzotriazole optionally substituted by at least one substituent selected from the group consisting of alkyl groups, aryl groups, halogen groups, amino groups, nitro groups, alkoxy groups, and hydroxyl groups.

24. The composition of any one of claims 20 to 23, wherein the at least one metal corrosion inhibitor comprises a compound selected from the group consisting of benzotriazole, 5-aminobenzotriazole, 1-hydroxybenzotriazole, 5-phenylthiol-benzotriazole, 5-chlorobenzotriazole, 4-chlorobenzotriazole, 5-bromobenzotriazole, 4-bromobenzotriazole, 5-fluorobenzotriazole, 4-fluorobenzotriazole, naphthotriazole, tolyltriazole, 5-phenyl-benzotriazole, 5-nitrobenzotriazole, 4-nitrobenzotriazole, 3-amino-5-mercapto-1,2,4-triazole, 2-(5-amino-pentyl)-benzotriazole, 1-amino-benzotriazole, 5-methyl-1H-benzotriazole, benzotriazole-5-carboxylic acid, 4-methylbenzotriazole, 4-ethylbenzotriazole, 5-ethylbenzotriazole, 4-

propylbenzotriazole, 5-propylbenzotriazole, 4-isopropylbenzotriazole, 5-isopropylbenzotriazole, 4-n-butylbenzotriazole, 5-n-butylbenzotriazole, 4-isobutylbenzotriazole, 5-isobutylbenzotriazole, 4-pentylbenzotriazole, 5-pentylbenzotriazole, 4-hexylbenzotriazole, 5-hexylbenzotriazole, 5-methoxybenzotriazole, 5-hydroxybenzotriazole, dihydroxypropylbenzotriazole, 1-[N,N-bis(2-ethylhexyl)aminomethyl]-benzotriazole, 5-t-butyl benzotriazole, 5-(1',1'-dimethylpropyl)-benzotriazole, 5-(1',1',3'-trimethylbutyl)benzotriazole, 5-n-octyl benzotriazole, and 5-(1',1',3',3'-tetramethylbutyl)benzotriazole.

25. The composition of any one of claims 20 to 24, wherein the at least one metal corrosion inhibitor is in the amount of from about 0.005% to about 3% by weight of the composition.

26. The composition of any one of claims 1 to 25, wherein the at least one chelating agent comprises a polyaminopolycarboxylic acid.

27. The composition of any one of claims 1 to 26, wherein the at least one chelating agent comprises butylenediaminetetraacetic acid, diethylenetriaminepentaacetic acid, ethylenediaminetetrapropionic acid, triethylenetetraminehexaacetic acid, 1,3-diamino-2-hydroxypropane-N,N,N',N'-tetraacetic acid, propylenediaminetetraacetic acid, ethylenediaminetetraacetic acid, trans-1,2-diaminocyclohexane tetraacetic acid, ethylenediamine diacetic acid, ethylenediamine dipropionic acid, 1,6-hexamethylene-diamine-N,N,N',N'-tetraacetic acid, N,N-bis(2-hydroxybenzyl)ethylenediamine-N,N-diacetic acid, diaminopropane tetraacetic acid, iminodiacetic acid; 1,4,7,10-tetraazacyclododecane-tetraacetic acid, diaminopropanol tetraacetic acid, or (hydroxyethyl)ethylenediaminetriacetic acid.

28. The composition of any one of claims 1 to 27, wherein the at least one chelating agent is in the amount of from about 0.005% to about 3% by weight of the composition.

29. The composition of any one of claims 1 to 28, wherein the water is in the amount of from about 60% to about 99% by weight of the composition.

30. The composition of any one of claims 1 to 29, further comprising at least one organic solvent selected from the group consisting of water soluble alcohols, water soluble ketones, water soluble esters, and water soluble ethers.

31. The composition of claim 30, wherein the at least one organic solvent is in the amount of from about 0.5% to about 30% by weight of the composition.

32. The composition of any one of claims 1 to 31, further comprising at least one pH adjusting agent.

33. The composition of claim 32, wherein the at least one pH adjusting agent comprises a base or an acid.

34 The composition of claim 33, wherein the base is a quaternary ammonium hydroxide, ammonium hydroxide, an amine, an imine, or a guanidine salt.

35. The composition of any one of claims 1 to 12, wherein the composition is free of tetrazole.

36. A method, comprising:

contacting a semiconductor substrate containing a Co feature with a composition of any one of claims 1 to 35 to remove at least a portion of the Co feature.

37. The method of claim 36, wherein the semiconductor substrate further comprises a TiN feature and the method removes at least a portion of the TiN feature.

38. The method of claim 36 or claim 37, further comprising rinsing the semiconductor substrate with a rinse solvent after the contacting step.

39. The method of claim 38, further comprising drying the semiconductor substrate after the rinsing step.

40. The method of any one of claims 36 to 39, wherein the method does not substantially form a cobalt oxide hydroxide layer on the semiconductor substrate.

41. An article formed by the method of claim 40, wherein the article is a semiconductor device.

42. The article of claim 41, wherein the semiconductor device is an integrated circuit.