~~WHAT IS~~ CLAIM~~ED I~~S:

1. An etching composition, comprising:

1) a compound of formula (I): R_1-O-N-R_2R_3, in which each of R_1, R_2, and R_3, independently, is H or C_1-C_6 alkyl;

2) at least one unsaturated C_3-C_{12} carboxylic acid;

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

4) water;

wherein the composition is free of a tetrazole.

2. The composition of claim 1, wherein the composition has a pH from about 0 to about 7.

3. The composition of claim 1, wherein the compound of formula (I) is hydroxylamine.

4. The composition of claim 1, wherein the compound of formula (I) is in the amount of from ~~about~~ 0.01% to ~~about~~ 10% by weight of the composition.

5. The composition of claim 1, wherein the at least one unsaturated C_3-C_{12} carboxylic acid comprises acrylic acid, crotonic acid, 2-pentenoic acid, trans-2-hexenoic acid, fumaric acid, 10-undecenoic acid, 2-methyl-2-pentenoic acid, 2-pentenoic acid, 2-methyl-4-pentenoic acid, 2-octenoic acid, or 3-(2-furyl)acrylic acid.

6. The composition of claim 1, wherein the at least one unsaturated carboxylic C_3-C_{12} acid is in the amount of from ~~about~~ 0.01% to ~~about~~ 3% by weight of the composition.

~~7. The composition of claim 1, wherein the at least one leveling agent comprises a sulfur-containing polymer or a nitrogen-containing polymer.~~

~~8~~7. The composition of claim 1, wherein the at least one leveling agent comprises poly(4-styrene sulfonic acid)~~, polyethylene imine, polyglycine, poly(allylamine), polyaniline, sulfonated polyaniline, polyurea, polyacrylamide, poly(melamine-co-formaldehyde), polyaminoamide, or polyalkanolamine~~.

~~9~~8. The composition of claim 1, wherein the at least one leveling agent is in the amount of from ~~about~~ 0.01% to ~~about~~ 3% by weight of the composition.

~~10~~9. The composition of claim 1, wherein the water is in the amount of from ~~about~~ 50% to ~~about~~ 99% by weight of the composition.

~~11~~10. The composition of claim 1, further comprising at least one cobalt (Co) etch accelerating agent.

~~12~~11. The composition of claim ~~11~~10, wherein the at least one Co etch accelerating agent comprises an acid selected from the group consisting of carboxylic acids or amino acids.

~~13~~12. The composition of claim ~~11~~10, wherein the at least one Co etch accelerating agent comprises citric acid, formic acid, acetic acid, oxalic acid, glycine, glycolic acid, malonic acid, lactic acid, or diethylenetriaminepentaacetic acid.

~~14~~13. The composition of claim ~~11~~10, wherein the least one Co etch accelerating agent is in the amount of from ~~about~~ 0.01% to ~~about~~ 3% by weight of the composition.

~~15~~14. The composition of claim 1, further comprising at least one pH adjusting agent.

~~16~~15. The composition of claim ~~15~~14, wherein the at least one pH adjusting agent comprises a base or an acid.

~~17~~16. The composition of claim ~~16~~15, wherein the base is free of a metal ion and is not a quaternary ammonium hydroxide or an alkyl hydroxide, and the acid is not a saturated carboxylic acid or a hydrogen halide.

~~18~~17. The composition of claim ~~15~~14, wherein the least one pH adjusting agent is in the amount of from ~~about~~ 0.01% to ~~about~~ 6% by weight of the composition.

~~19~~18. The composition of claim 1, further comprising an organic solvent selected from the group consisting of water soluble alcohols, water soluble ketones, water soluble esters, and water soluble ethers.

~~20~~19. The composition of claim ~~19~~18, wherein the organic solvent is in the amount of from ~~about~~ 0.5% to ~~about~~ 30% by weight of the composition.

20. An etching composition, comprising:

1) a compound of formula (I): R_1-O-N-R_2R_3, in which each of R_1, R_2, and R_3, independently, is H or C_1-C_6 alkyl;

2) at least one unsaturated C_3-C_{12} carboxylic acid selected from the group consisting of acrylic acid, crotonic acid, 2-pentenoic acid, trans-2-hexenoic acid, 10-undecenoic acid, 2-methyl-2-pentenoic acid, 2-pentenoic acid, 2-methyl-4-pentenoic acid, 2-octenoic acid, and 3-(2-furyl)acrylic acid;

3) at least one leveling agent comprising a sulfur-containing polymer or a nitrogen-containing polymer; and

4) water;

wherein the composition is free of a tetrazole.

21. A method, comprising:

contacting a semiconductor substrate containing a Co feature with a composition of claim 1 to remove at least a portion of the Co feature.

22. The method of claim 21, further comprising rinsing the semiconductor substrate with a rinse solvent after the contacting step.

23. The method of claim 22, further comprising drying the semiconductor substrate after the rinsing step.

24. The method of claim 21, wherein the method does not substantially form a cobalt oxide hydroxide layer in the semiconductor substrate.

~~25. An article formed by the method of claim 21, wherein the article is a semiconductor device.~~

~~26. The article of claim 25, wherein the semiconductor device is an integrated circuit.~~