Claims

1. A method for removing ruthenium and/or copper from a microelectronic device comprising ruthenium and/or copper and further comprising dielectrics, which comprises:

i) contacting the electronic device with a composition for a sufficient time under sufficient conditions to at least partially remove said ruthenium and/or copper from the microelectronic device, the composition comprising

(i) one or more heptavalent oxidants chosen from H_5IO_6 or HIO_4 ;

(ii) ~~an alkylammonium hydroxide compound or~~ an alkylphosphonium hydroxide compound; and

(iii) water;

wherein said composition has a pH of about 9 to about 12.5, and

ii) etching the ruthenium and/or copper at an etch rate of greater than 20 Å/min while minimizing the etching of the dielectrics to an etch rate of less than 2 Å/min.

~~2. The composition of claim 1, wherein the alkylammonium compound is chosen from tetramethylammonium hydroxide, tetraethylammonium hydroxide, tetrapropylammonium hydroxide, tetrabutylammonium hydroxide, tributylmethylammonium hydroxide, benzyltrimethylammonium hydroxide, choline hydroxide, ethyltrimethylammonium hydroxide, tris(2-hydroxyethyl)methyl ammonium hydroxide, diethyldimethylammonium hydroxide, and combinations thereof.~~

~~3. The composition of claim 2, wherein the alkylammonium compound is tetramethylammonium hydroxide.~~

~~4~~2. The ~~composition~~ method of claim 1, wherein the alkylphosphonium hydroxide compound is chosen from tetrabutylphosphonium hydroxide, tetramethylphosphonium hydroxide, tetraethylphosphonium hydroxide, tetrapropylphosphonium hydroxide, benzyltriphenylphosphonium hydroxide, methyl triphenylphosphonium hydroxide, ethyl triphenylphosphonium hydroxide, and n- propyl triphenylphosphonium hydroxide, and combinations thereof.

~~5~~3. The ~~composition~~ method of claim 1, further comprising

(iv) a carbonate/bicarbonate buffering compound.

~~6~~4. The ~~composition~~ method of claim ~~5~~3, wherein the buffering compound is formed *in situ* by sparging the composition with carbon dioxide.

~~7~~5. The ~~composition~~ method of claim 1, wherein component (i) is present in an amount of about 0.01 to 20 percent by weight; component (ii) is present in an amount of about 0.02 to 40 percent by weight; with the total of (i), (ii) component (iii) being 100 percent.

~~8~~6. The ~~composition~~ method of claim 1, wherein component (i) is present in an amount of about 0.5 to 10 percent by weight; component (ii) is present in an amount of about 1 to 20 percent by weight; with the total of (i), (ii) component (iii) being 100 percent.

~~9~~7. The ~~composition~~ method of claim 1, wherein component (i) is present in an amount of about 1 to 5 percent by weight; component (ii) is present in an amount of about 2 to 10 percent by weight; with the total of (i), (ii) component (iii) being 100 percent.

~~10~~8. The ~~composition~~ method of claim ~~7~~5, further comprising

(iv) a carbonate/bicarbonate buffering compound in an amount of about 0.01 to 5 weight percent, with the total of (i), (ii), (iii), and (iv) being 100 percent.

~~11~~9. The ~~composition~~ method of claim ~~8~~6, further comprising

(iv) a carbonate/bicarbonate buffering compound in an amount of about 0.1 to 2 weight percent, with the total of (i), (ii), (iii), and (iv) being 100 percent.

~~12~~10. The ~~composition~~ method of claim ~~9~~7, further comprising

(iv) a carbonate/bicarbonate buffering compound in an amount of about 0.2 to 1 weight percent, with the total of (i), (ii), (iii), and (iv) being 100 percent.

~~12. The composition of claim 1, further comprising at least one corrosion inhibitor.~~

~~13~~11. The ~~composition~~ method of claim 1, wherein the oxidant is H_5IO_6.

~~14~~12. The ~~composition~~ method of claim 1, wherein the oxidant is HIO_4.

13. The method of claim 1, further comprising at least one corrosion inhibitor.

~~15~~14. A method for removing ruthenium and/or copper from a microelectronic device comprising ruthenium and/or copper and further comprising dielectrics, which comprises:

i) contacting the electronic device with a composition ~~of claim 1,~~ for a sufficient time under sufficient conditions to at least partially remove said ruthenium and/or copper from the microelectronic device, the composition comprising

(i) one or more heptavalent oxidants chosen from H_5IO_6 or HIO_4,

(ii) an alkylammonium hydroxide compound, and

(iii) water,

wherein said composition has a pH of about 10.5 to about 12.2 and wherein said composition has an excess of (ii) relative to (i) and

ii) etching ruthenium and/or copper at an etch rate of greater than 20 Å/min while minimizing the etching of dielectrics to an etch rate of less than 2 Å/min.

15. The method of claim 14, wherein the alkylammonium compound is chosen from tetramethylammonium hydroxide, tetraethylammonium hydroxide, tetrapropylammonium hydroxide, tetrabutylammonium hydroxide, tributylmethylammonium hydroxide, benzyltrimethylammonium hydroxide, choline hydroxide, ethyltrimethylammonium hydroxide, tris(2-hydroxyethyl)methyl ammonium hydroxide, diethyldimethylammonium hydroxide, and combinations thereof.

16. The method of claim 15, wherein the alkylammonium compound is tetramethylammonium hydroxide.

17. The method of claim 14, further comprising

(iv) a carbonate/bicarbonate buffering compound.