CLAIMS

~~What is claimed is:~~

1. A method of fabricating a semiconductor device, the method comprising:
providing a substrate; and
forming an electrical conductor on or in the substrate by:
providing a mixture comprising metal particles greater than 0.2 micrometers in size and an electroless deposition solution, electrolessly depositing a metal matrix and co-depositing the metal particles; or
providing a mixture comprising metal particles greater than 0.2 micrometers in size and an electrochemical plating solution, electrochemically plating a metal matrix and co-depositing the metal particles.

2. The method claim 1, wherein the metal particles and the metal matrix have substantially the same composition.

3. The method of claim 1, wherein the metal particles and the metal matrix have different compositions.

4. The method of claim 1, wherein the metal matrix comprises copper and the metal particles comprise copper.

5. The method of claim 1, wherein the metal matrix comprises at least one of the elements cobalt, copper, gold, iridium, iron, molybdenum, nickel, osmium, palladium, platinum, rhenium, rhodium, ruthenium, silver, tin, tungsten, and zinc.

6. The method of claim 1, wherein the metal particles are particles of a substantially pure metal element of the periodic table.

7. The method of claim 1, wherein the metal particles comprise a least one of the elements selected from the group consisting of cobalt, copper, gold, iridium, iron,

molybdenum, nickel, osmium, palladium, platinum, rhenium, rhodium, ruthenium, silver, tin, tungsten, and zinc.

8. The method of claim 1, wherein the metal particles have a maximum size less than 30 micrometers.

9. The method of claim 1, wherein the metal particles have a maximum size ~~in the range from 0.1 micrometer~~ to 10 micrometers.

10. The method of claim 1, wherein the metal particles comprise a least one of the elements selected from the group consisting of cobalt, copper, gold, iridium, iron, molybdenum, nickel, osmium, palladium, platinum, rhenium, rhodium, ruthenium, silver, tin, tungsten, and zinc and the particles have a maximum size of less than 30 micrometers.

11. The method of claim 1, wherein the crystalline structure and/or crystalline grain size of the metal matrix is substantially the same as the crystalline structure and/or crystalline grain size of the metal particles.

12. The method of claim 1, wherein the crystalline structure and/or crystalline grain size of the metal matrix is different from the crystalline structure and/or crystalline grain size of the metal particles.

13. The method claim 1, wherein the providing a substrate comprises providing a substrate having one or more vias; and the forming an electrical conductor on or in the substrate comprises:

loading the one or more vias with a mixture comprising metal particles and an electroless deposition solution, electrolessly depositing a metal matrix and co-depositing the metal particles in the one or more vias; or

loading the one or more vias with a mixture comprising metal particles and an electrochemical plating solution, electrochemically plating a metal matrix and co-depositing the metal particles in the one or more vias.

14. The method of claim 13, wherein the loading the vias is accomplished using particles having a mixture of particle sizes and a maximum size of less than 30 micrometers.

15. The method of claim 13, wherein the loading the vias includes using metal particles having a maximum size ~~in the range from 0.1 micrometer to~~ 10 micrometers.

~~16. A mixture for forming copper structures on or in a substrate, the mixture comprising:~~

~~particles comprising copper and an electroless deposition solution containing copper ions for electroless deposition of a matrix comprising copper; or~~

~~particles comprising copper and an electrochemical plating solution containing copper ions for electrochemical plating of a matrix comprising copper.~~

~~17. The mixture of claim 16, wherein the particles have a maximum size of less than 30 micrometers.~~

~~18. The mixture of claim 16, wherein the particles have a maximum size in the range from 0.1 micrometer to 10 micrometers.~~

~~19. The mixture of claim 16, wherein the electroless deposition solution or the electrochemical plating solution comprises one or more metal salts, one or more reducing agents, one or more complexing agents, one or more pH adjustors, one or more buffering agents, one or more surfactants, and/or one or more additives.~~

~~20. An electronic device comprising:~~

~~a substrate having one or more through-substrate vias;~~

~~a barrier layer on the walls of the one or more substrate vias;~~

~~a matrix comprising copper; and~~

~~metal particles embedded in the matrix;~~

~~wherein the metal particles and the matrix comprising copper substantially fill the one or more vias.~~

~~21 . The electronic device of claim 20, wherein the metal particles comprise copper.~~

~~22. The electronic device of claim 20, wherein the metal particles are copper.~~

~~23. The electronic device of claim 20, wherein the matrix comprising copper is copper.~~

~~24. The electronic device of claim 20, wherein the metal particles are copper and the matrix comprising copper is copper.~~

~~25. The electronic device of claim 20, wherein the metal particles comprise silver or gold.~~

~~26. The electronic device of claim 20, wherein the barrier layer comprises barrier metal particles embedded in a barrier metal matrix.~~

~~27. The electronic device of claim 20, wherein the substrate is a silicon chip.~~

~~28. The electronic device of claim 20, wherein the metal particles size are in the range from 0.1 micrometer to 10 micrometer.~~

16. A method of fabricating a semiconductor device, the method comprising:

providing a substrate; and

forming an electrical conductor on or in the substrate by providing a mixture comprising metal particles in the range 0.2 micrometers to 30 micrometers in size and an electroless deposition solution, electrolessly plating a metal matrix and co-depositing the metal particles.

17. The method of claim 16, wherein the metal matrix comprises copper the metal particles comprise a least one of the elements selected from the group consisting of cobalt, gold, iridium, iron, molybdenum, nickel, osmium, palladium, platinum, rhenium, rhodium, ruthenium, silver, tin, tungsten, and zinc.

18. The method of claim 16, wherein the metal matrix comprises cobalt, cobalt alloy, cobalt tungsten alloy, cobalt tungsten phosphorous alloy, nickel, or nickel alloy and the metal particles comprise copper.

19. The method of claim 16, wherein the electroless deposition solution has a composition to deposit a matrix comprising copper and the mixture includes copper particles; the composition of the matrix comprising copper and the composition of the copper particles are different.

20. The method of claim 16, wherein the particles have a mixture of particle sizes.

21. The method claim 16, wherein the providing a substrate comprises providing a substrate having one or more vias 5-30 micrometers in diameter and 70-300 micrometers deep; and the forming an electrical conductor on or in the substrate comprises:

loading the one or more vias with a mixture comprising metal particles and an electroless deposition solution, electrolessly depositing a metal matrix and co-depositing the metal particles in the one or more vias; or

loading the one or more vias with a mixture comprising metal particles and an electrochemical plating solution, electrochemically plating a metal matrix and co-depositing the metal particles in the one or more vias.