CLAIMS

1. A method of electroplating copper on a wafer substrate comprising one or more recessed features, the method comprising:

(a) providing a wafer substrate having an exposed nickel-containing and/or cobalt-containing seed layer on at least a portion of its surface;

(b) contacting the wafer substrate with a pre-wetting liquid, the pre-wetting liquid comprising cupric (Cu^{2+}) ions at a concentration of at least ~~about~~ 10 g/L and an electroplating suppressor, to pre-wet the seed layer on the wafer substrate without electrically biasing the wafer substrate; and

(c) electrodepositing copper onto the seed layer using an acidic electroplating solution, wherein the electrodeposited copper at least partially fills the one or more recessed features.

2. The method of claim 1, wherein the seed layer is a nickel-containing layer.

~~3. The method of claim 1, wherein (c) comprises electrodepositing copper onto the seed layer using an acidic electroplating solution.~~

43. The method of claim 1, wherein the wafer substrate is contacted with the pre-wetting liquid in (b) under subatmospheric pressure.

54. The method of claim 2, wherein the pre-wetting liquid comprises cupric (Cu^{2+}) ions at a concentration of at least ~~about~~ 30 g/L.

65. The method of claim 2, wherein the concentration of the electroplating suppressor is at least ~~about~~ 50 ppm.

76. The method of claim 2, wherein the electroplating suppressor is a compound from the class of polyalkylene glycols.

~~8~~7. The method of claim 2, wherein the electroplating suppressor is a compound from the class of polyalkylene glycols containing an amino group.

~~9~~8. The method of claim 2, wherein the pH of the pre-wetting liquid is less than ~~about~~ 2.

~~10~~9. The method of claim 2, further comprising degassing the pre-wetting liquid prior to contacting the wafer substrate.

~~11~~10. The method of claim 2, wherein the concentration of cupric ions in the pre-wetting liquid is the same as or greater than a concentration of cupric ions in an electroplating solution used for electroplating copper in (c).

~~12~~11. The method of claim 2, wherein the pre-wetting liquid has the same composition as an electroplating solution used for electroplating copper in (c).

~~13~~12. The method of claim 2, wherein the pre-wetting liquid further comprises an additive selected from the group consisting of a halide, an electroplating accelerator, an electroplating leveler and combinations thereof.

~~14~~13. The method of claim 2, wherein the pre-wetting liquid comprises an acid selected from the group consisting of sulfuric acid, methanesulfonic acid and mixtures thereof.

~~15~~14. The method of claim 2, wherein the nickel-containing layer is a NiB layer.

~~16~~15. The method of claim 2, wherein the nickel-containing layer is a NiP layer.

~~17~~16. The method of claim 2, wherein the one or more recessed features are through silicon vias (TSVs).

~~18~~17. The method of claim 2, wherein the pre-wetting liquid comprises an acid, cupric ions at a concentration of at least ~~about~~ 30 g/L, and an electroplating suppressor at a concentration of at

least ~~about~~ 50 ppm, wherein the electroplating suppressor is a compound from a class of polyalkylene glycols.

~~19~~18. The method of claim 1, further comprising:

applying photoresist to the wafer substrate;

exposing the photoresist to light;

patterning the photoresist and transferring the pattern to the wafer substrate;

and selectively removing the photoresist from the wafer substrate.

~~20~~19. An apparatus for electroplating copper on an exposed nickel-containing and/or cobalt-containing seed layer on a wafer substrate comprising one or more recessed features, the apparatus comprising:

(a) a pre-wetting chamber configured for delivering a pre-wetting liquid onto the wafer substrate;

(b) a plating vessel configured for holding a copper electroplating solution, wherein the apparatus is configured for electrodepositing copper from the copper electroplating solution onto the seed layer on the wafer substrate; and

(c) a controller comprising program instructions and/or logic for causing:

(i) contact~~ing~~ of the wafer substrate with a pre-wetting liquid, the pre-wetting liquid comprising cupric (Cu^{2+}) ions at a concentration of at least ~~about~~ 10 g/L and an electroplating suppressor to pre-wet the seed layer on the wafer substrate without electrically biasing the wafer substrate; and

(ii) electrodeposition~~ng~~ of copper onto the seed layer using an acidic electroplating solution, wherein the electrodeposited copper at least partially fills the one or more recessed features.

20. The apparatus of claim 19, wherein in (i) a concentration of the electroplating suppressor is at least 50 ppm.

21. The apparatus of claim 19, wherein the controller further comprises program instructions and/or logic for causing the prewetting (i) under subatmospheric pressure.

22. The apparatus of claim 19, wherein in (i) the concentration of the cupric ions is at least 30 g/L.

23. The apparatus of claim 19, wherein in (i) the suppressor is a compound from the class of polyethyleneglycols.

24. The apparatus of claim 19, wherein in (i) the pH of the pre-wetting liquid is 2.

25. The apparatus of claim 19, wherein the controller further comprises program instructions and/or logic for causing a degassing of the pre-wetting liquid prior to pre-wetting.

26. The apparatus of claim 19, wherein the pre-wetting chamber is configured for spraying or streaming the prewetting liquid onto the wafer substrate.

27. The apparatus of claim 19, wherein the pre-wetting chamber is configured for immersing the wafer substrate into the prewetting liquid.

28. The apparatus of claim 19, wherein the pre-wetting chamber and the plating vessel are included in one module.