CLAIMS:

1. A method of electroplating copper on a substrate, comprising:

immersing a substrate in a copper electroplating bath;

disposing a copper salt in solid form within a container located in the copper electroplating bath, a chamber of the container being in fluid communication with the copper electroplating bath;

electroplating copper on the substrate, and

solubilizing the copper salt to supply copper ions to the copper electroplating bath.

2. The method of claim 1, wherein the solublizing the copper salt maintaining the copper electroplating bath at about saturation levels.

3. A method of electroplating copper on a substrate comprising:

providing a copper electroplating bath, wherein the copper electroplating bath comprises an aqueous solution that comprises a copper salt and at least one acid and a container that comprises a copper salt in solid form, wherein the container is immersed in the aqueous solution and supplies copper ions to the aqueous solution to maintain the copper ion concentration of the aqueous solution at about saturation levels while retaining the copper salt in solid form within the container;

providing a substrate;

placing the substrate in contact with the copper electroplating bath; and

electroplating copper on the substrate.

4. The method of any one of claims 1, 2, or 3 wherein the copper salt is copper sulfate.

5. The method of claim 4, wherein the copper sulfate concentration of the aqueous solution ranges from about 50 grams/liter to about 250 grams/liter.

6. The method of claim 3, wherein the acid is sulfuric acid.

7. The method of claim 6, wherein the sulfuric acid concentration ranges of the aqueous solution from about 20 grams/liter to about 100 grams/liter.

8. The method of claim 3, wherein the aqueous solution further comprises chloride ions.

9. The method of claim 8, wherein the chloride ion concentration ranges of the aqueous solution from about 10 ppm to about 100 ppm.

10. The method of any one of claims 1, 2, or 3, wherein the copper salt in solid form is copper sulfate.

11. The method of claim 10, wherein the amount of copper sulfate in solid form ranges from about 100 grams to about 300 grams per liter of the aqueous solution.

12. The method of any one of claims 1, 2, or 3, wherein the temperature of the copper electroplating bath ranges from about 30°C to about 60°C.

13. The method of any one of claims 1, 2, or 3, wherein the electroplating speed is about 4 microns per minute or greater.

14. The method of any one of claims 1, 2, or 3, wherein one or more high aspect ratio copper structures are electroplated on the substrate.

15. The method of claim 14, wherein the high aspect ratio structures are selected from the group consisting of copper pillars, copper bumps and copper through-silicon vias.

16. A copper electroplating bath comprising:

an aqueous solution that comprises a copper salt and at least one acid; and

a container that comprises a copper salt in solid form, wherein the container is immersed in the aqueous solution and supplies copper ions to the aqueous solution to

maintain the copper ion concentration of the aqueous solution at about saturation levels while retaining the copper salt in solid form within the container.

17. The copper electroplating bath of claim 16, wherein the copper salt is selected from the group consisting of copper sulfate, copper methane sulfonate, copper fluoroborate, copper acetate, copper nitrate, copper oxide, copper hydroxide and copper chloride.

18. The copper electroplating bath of claim 17, wherein the copper salt is copper sulfate.

19. The copper electroplating bath of claim 16, wherein the concentration of the copper salt ranges of the aqueous solution from about 10 grams/liter to about 400 gram/liter.

20. The copper electroplating bath of claim 18, wherein the copper sulfate concentration of the aqueous solution ranges from about 50 grams/liter to about 250 grams/liter.

21. The copper electroplating bath of claim 16, wherein the acid is selected from the group consisting of sulfuric acid, methanesulfonic acid, fluoroboric acid, hydro boric acid, hydrochloric acid, hydroiodic acid, phosphoric acid and boric acid.

22. The copper electroplating bath of claim 21, wherein the acid is sulfuric acid.

23. The copper electroplating bath of claim 16, wherein the concentration of the acid of the aqueous solution ranges from about 10 grams/liter to about 250 grams/liter.

24. The copper electroplating bath of claim 22, wherein the sulfuric acid concentration of the aqueous solution ranges from about 20 grams/liter to about 100 grams/liter.

25. The copper electroplating bath of claim 16, wherein the aqueous solution further comprises chloride ions.

26. The copper electroplating bath of claim 25, wherein the chloride ion concentration of the aqueous solution ranges from about 10 ppm to about 100 ppm.

27. The copper electroplating bath of claim 16, wherein the aqueous solution further comprises at least one additive to accelerate the copper deposition rate of the copper electroplating bath.

28. The copper electroplating bath of claim 27, wherein the additive is a sulfide compound.

29. The copper electroplating bath of claim 16, wherein the aqueous solution further comprises at least one suppressor additive.

30. The copper electroplating bath of claim 29, wherein the suppressor additive is selected from the group consisting of a surfactant, a chelating agent, a leveler agent and a wetting agent.

31. A copper electroplating bath of claim 16, wherein the copper salt in solid form is selected from the group consisting of copper sulfate, copper methane sulfonate, copper fluoroborate, copper acetate, copper nitrate, copper oxide, copper hydroxide and copper chloride.

32. The copper electroplating bath of claim 31, wherein the copper salt in solid form is copper sulfate.

33. The copper electroplating bath of claim 32, wherein the amount of copper sulfate in solid form ranges from about 100 grams to about 300 grams per liter of the aqueous solution.

34. The copper electroplating bath of claim 16, wherein the container comprises a membrane that allows copper ions in solution to leave the container while retaining the copper salt in solid form within the container.

35. The copper electroplating bath of claim 16, wherein the container comprises an enclosure containing a porous membrane material having pore sizes ranging from about 1 μm to about 100 μm.

36. The copper electroplating bath of claim 16, wherein the container includes one or more openings formed therein, the one or more openings being configured to allow flow of the aqueous solution and copper ions therethrough.

37. The copper electroplating bath of claim 36, wherein the one or more openings are covered by a porous membrane.

CLAIMS

1. A method of changing a copper concentration in an electroplating bath, comprising:

placing a substrate in a copper electroplating bath comprising an acidic, aqueous solution exhibiting a copper ion concentration;

disposing a copper salt in solid form within a container located in the copper electroplating bath, a chamber of the container being in fluid communication with an the aqueous solution of the copper electroplating bath;

dissolving at least some of the copper salt in solid form to raise the copper ion concentration in the aqueous solution and maintain the copper ion concentration in the aqueous solution at about saturation to achieve high copper ion concentrations for accommodating high speed plating; and

electroplating copper on the substrate using a copper containing anode.

2. The method of claim 1, wherein the aqueous solution comprises at least one of copper sulfate, copper methane sulfonate, copper fluoroborate, copper acetate, copper nitrate, copper oxide, copper hydroxide and copper chloride.

3. The method of claim 1, wherein a concentration of the copper salt in the aqueous solution ranges from about 10 grams/liter to about 400 gram/liter.

4. The method of claim 1, wherein the aqueous solution comprises at least one of sulfuric acid, methanesulfonic acid, fluoroboric acid, hydroboric acid, hydrochloric acid, hydroiodic acid, phosphoric acid and boric acid.

5. The method of claim 1, wherein a concentration of acid in the aqueous solution ranges from about 10 grams/liter to about 250 grams/liter.

6. The method of claim 1, wherein the aqueous solution comprises at least one additive to accelerate the copper deposition rate of the copper electroplating bath.

7. The method of claim 1, wherein the aqueous solution comprises at least one suppressor additive.

8. The method of claim 1, wherein the copper salt in solid form is selected from the group consisting of copper sulfate, copper methane sulfonate, copper fluoroborate, copper acetate, copper nitrate, copper oxide, copper hydroxide and copper chloride.

9. The method of claim 1, wherein the container comprises a membrane that allows dissolved copper salt to leave the container while retaining the copper salt in solid form within the container.

10. The method of claim 9, wherein an area of the membrane comprises about 50% to about 90% of a surface area of the container.

11. The method of claim 1, wherein the container comprises an enclosure containing a porous membrane material having pore sizes ranging from about 1 μm to about 100 μm.

12. The method of claim 1, wherein the copper salt comprises copper sulfate.

13. The method of claim 12, wherein a copper sulfate concentration of the aqueous solution ranges from about 50 grams/liter to about 250 grams/liter.

14. The method of claim 12, wherein a concentration of copper sulfate in the aqueous solution ranges from about 100 grams to about 300 grams per liter.

15. The method of claim 1, wherein the aqueous solution comprises sulfuric acid.

16. The method of claim 15, wherein a sulfuric acid concentration of the aqueous solution ranges from about 20 grams/liter to about 100 grams/liter.

17. The method of claim 1, wherein the aqueous solution comprises chloride ions.

18. The method of claim 17, wherein a chloride ion concentration of the aqueous solution ranges from about 10 ppm to about 100 ppm.

19. The method of claim 1, wherein a temperature of the aqueous solution ranges from about 30° C. to about 60° C.

20. The method of claim 1, wherein electroplating copper comprises an electroplating speed of about 4 microns per minute or greater.

21. The method of claim 1, wherein electroplating copper comprises electroplating one or more high aspect ratio copper structures on the substrate.

22. The method of claim 21, wherein the high aspect ratio structures are selected from the group consisting of pillars, bumps and through-silicon vias.

23. The method of claim 1, further comprising:
retaining at least a portion of the copper salt in solid form within the container.

24. The method of claim 1, wherein the container is immersed in the aqueous solution.

25. The method of claim 1, wherein said step of placing the substrate in the copper electroplating bath is performed after said step of dissolving at least some of the copper salt.