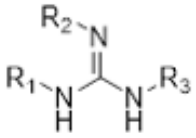
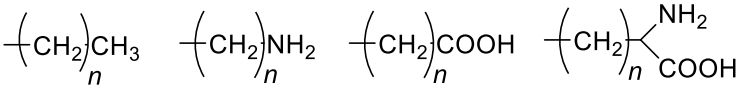
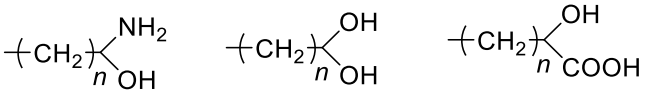
WHAT IS CLAIMED IS:

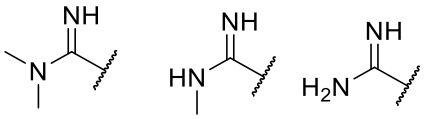
1. An electroless nickel phosphorus plating bath comprising:
    a. a source of nickel ions;
    b. a source of hypophosphite ions;
    c. at least one complexing agent;
    d. a flex additive, wherein the flex additive comprises a guanidine derivative represented by the following general structure:



wherein R_2=H and R_3 = H, methyl, ethyl, propyl, isopropyl

R_1= NH_2, COOH, CN,OH, 





where n=1-7 ;

    e. optionally, a pH adjuster;
    f. optionally, a bath stabilizer; and
    g. optionally, a source of lead ions;

wherein the electroless nickel phosphorus plating bath is configured to deposit a nickel-phosphorus plating layer on a substrate having a columnar grain structure;

wherein the electroless nickel phosphorus plating bath is at least substantially free of any ingredient that would prevent the electroless nickel phosphorus plating bath from producing the nickel phosphorus plating having the columnar grain structure.

2. The electroless nickel phosphorus plating bath according to claim 1, wherein the electroless nickel phosphorus plating bath is at least substantially free of formaldehyde and formaldehyde precursors.

3. The electroless nickel phosphorus plating bath according to claim 1 or claim 2, wherein the electroless nickel phosphorus plating bath includes at least one of a buffer and a wetting agent.

4. The electroless nickel phosphorus plating bath according to claim 1 or claim 2, wherein the electroless nickel phosphorus plating bath includes one more additional alloying metals, wherein the one or more additional alloying metals are selected from the group consisting of tungsten, tin, iron, cobalt, chromium, cobalt, manganese, and combinations of the foregoing.

5. The electroless nickel phosphorus plating bath according to claim 1 or claim 2, wherein the electroless nickel phosphorus plating bath composition is maintained at a pH within the range of about 3 to about 6.

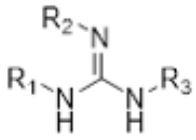
6. The electroless nickel phosphorus plating bath according to claim 1 or claim 2, wherein the at least one complexing agent comprises a carboxylic acid, a substituted carboxylic acid, an unsaturated carboxylic acid or a combination of the foregoing.

7. The electroless nickel phosphorus plating bath according to claim 6, wherein the carboxylic acid, substituted carboxylic acid or unsaturated carboxylic acid comprise at least one of a monocarboxylic acid, a dicarboxylic acid, a tricarboxylic acid, an aminocarboxylic acid, a hydroxycarboxylic acid, or combinations thereof.

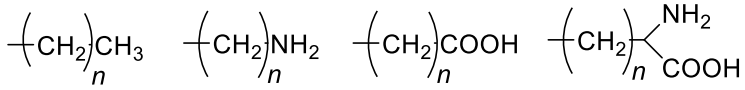
8. The electroless nickel phosphorus plating bath according to claim 6, wherein at least one of the at least one complexing agent is selected from the group consisting of acetic acid, propionic acid, glycolic acid, lactic acid, pyruvic acid, succinic acid, glutaric acid, itaconic acid, adipic acid, maleic acid, fumaric acid, malic acid, citric acid, aminoacetic acid, 2-aminopropanoic acid, aspartic acid combinations thereof.

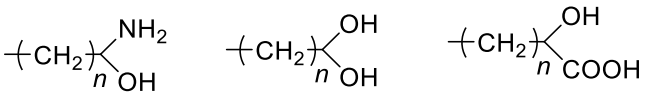
9. The electroless nickel phosphorus plating bath according to claim 6, wherein the at least one complexing agent comprises lactic acid and one or more of succinic acid, adipic acid, glutaric acid, fumaric acid, itaconic acid, and combinations thereof.

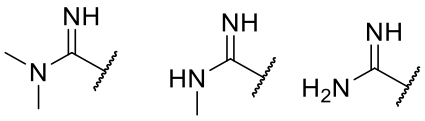
10. A method of producing a bendable nickel phosphorus plating layer on a substrate, wherein the substrate comprises a dielectric substrate with copper plating thereon, the method comprising the steps of:
    a. activating the substrate with a palladium activation solution to catalyze the substrate, and thereafter
    b. contacting the activated substrate with an electroless nickel phosphorus plating solution comprising:
        i. a source of nickel ions;
        ii. a source of hypophosphite ions;
        iii. at least one complexing agent;
        iv. a flex additive, wherein the flex additive comprises a guanidine derivative represented by the following general structure:



wherein R_2=H and R_3 = H, methyl, ethyl, propyl, isopropyl

R_1= NH_2, COOH, CN,OH, 





where n=1-7 ;

        v. optionally a pH adjuster; and

vi. optionally, a source of lead ions;

vii. optionally, stabilizer;

wherein the bendable nickel phosphorus plating layer deposited on the substrate exhibits a columnar grain structure.

11. The method according to claim 10, wherein the source of nickel ions in the electroless nickel phosphorus plating solution is selected from the group consisting of nickel chloride, nickel sulfate, nickel acetate, nickel nitrate, and combinations of the foregoing.

12. The method according to claim 10, wherein the at least one complexing agent comprises a carboxylic acid, a substituted carboxylic acid, an unsaturated carboxylic acid or a combination of the foregoing.

13. The electroless nickel phosphorus plating bath according to claim 12, wherein the carboxylic acid, substituted carboxylic acid or unsaturated carboxylic acid comprise at least one of a monocarboxylic acid, a dicarboxylic acid, a tricarboxylic acid, an aminocarboxylic acid, a hydroxycarboxylic acid, and combinations thereof.

14. The method according to claim 12, wherein at least one of the at least one complexing agent is selected from the group consisting of acetic acid, propionic acid, glycolic acid, lactic acid, pyruvic acid, succinic acid, glutaric acid, itaconic acid, adipic acid, maleic acid, fumaric acid, malic acid, citric acid, aminoacetic acid, 2-aminopropanoic acid, aspartic acid combinations thereof.

15. The method according to claim 13, wherein the at least one complexing agent comprises lactic acid and one or more of succinic acid, adipic acid, glutaric acid, fumaric acid, itaconic acid, and combinations thereof.

16. The method according to claim 10, wherein the electroless nickel phosphorus plating bath is at least substantially free of formaldehyde and formaldehyde precursors.

17. The method according to claim 10, wherein the electroless nickel phosphorus plating bath is at least substantially free of a hydroxycarboxylic acid complexing agent.

18. The method according to claim 10, wherein the electroless nickel phosphorus plating bath includes at least one of a buffer and a wetting agent.

19. The method according to claim 10, wherein the electroless nickel phosphorus plating bath includes one more additional alloying metals, wherein the one or more additional alloying metals are selected from the group consisting of tungsten, tin, iron, cobalt, chromium, cobalt, manganese, and combinations of the foregoing.

20. The method according to claim 10, further comprising the step of depositing an immersion gold layer over the flexible nickel phosphorus alloy layer.

21. The method according to claim 10, further comprising the step of depositing an electroless palladium and an immersion gold layer over the flexible nickel phosphorus alloy layer.

22. A substrate having a bendable nickel phosphorus alloy plating layer thereon made by the method of claim 10.

23. The substrate according to claim 22, wherein the substrate comprises a copper layer on a dielectric material.

24. The substrate according to claim 23, wherein the dielectric material is a polyimide.

25. The electroless nickel phosphorus plating bath according to claim 1, wherein the guanidine derivative is selected from the group consisting of aminoguanidine, (1-amino-4-guanidinobutane sulfate salt), 3-guanidinopropionic acid, 1-cyanoguanidine, 2-amino-5-guanidinopentanoic acid, (1,1-dimethylbiguanide hydrochloride, and combinations of one or more of the foregoing.

26. The method according to claim 10, wherein the guanidine derivative is selected from the group consisting of aminoguanidine, (1-amino-4-guanidinobutane sulfate salt), 3-guanidinopropionic acid, 1-cyanoguanidine, 2-amino-5-guanidinopentanoic acid, (1,1-dimethylbiguanide hydrochloride, and combinations of one or more of the foregoing.