Claims

1. A method of manufacturing a leadframe having a GAM value of greater than 2.0, the method comprising the steps of:

(a) providing a copper plated leadframe or FPC, where the copper plating is etched and is coated with an anti-tarnish layer;

(b) subjecting the copper plated leadframe or FPC to a first electrolytic cleaning step to provide an electrolytically cleaned leadframe;

(c) subjecting the electrolytically cleaned leadframe or FPC to a microetching step to provide a microetched leadframe or FPC or subjecting the electrolytically cleaned leadframe or FPC to a copper plating process to provide a double copper plated leadframe or FPC;

(d) subjecting the microetched leadframe or FPC or double copper plated leadframe or FPC to a bright-deposition nickel plating process to provide a nickel plated leadframe or FPC;

(e) subjecting the nickel plated leadframe or FPC to a silver strike electoplating process to provide a silver strike plated leadframe or FPC;

(f) subjecting the silver strike plated leadframe or FPC to a bright silver plating process to provide a bright silver leadframe or FPC;

(g) subjecting the bright silver plated leadframe or FPC to a silver stripping process to provide a mirror bright silver leadframe or FPC; and

(h) applying an anti-tarnish coating to the mirror bright silver plated leadframe or FPC.

2. The method of Claim 1, wherein before step (b) is performed, the copper plated leadframe or FPC of step (a) is subjected to a soaking step in an acid bath to provide an acid-cleaned copper plated leadframe or FPC, optionally wherein the acid is selected from one or more of the group selected from sulfuric acid, polysulfuric acids, dithionic acids, and peroxysulfuric acids.

3. The method of Claim 1 or Claim 2, wherein, when used in step (c), the microetching process comprises spraying a microetchant solution onto the electrolytically cleaned leadframe or FPC in an amount and for a sufficient period of time to remove from 0.5 to 1.3 μm of copper from the copper plating layer.

4. The method of Claim 3, wherein the microetchant solution comprises an organic peroxide (e.g. ammonium persulfate) at a concentration of from 60 to 90 g/L and sulfuric acid at a concentration of from 1 to 2 vol%, optionally wherein the contact time of the microetchant solution with the electrolytically cleaned leadframe or FPC is from 30 to 60 seconds.

5. The method of any one of the preceding claims, wherein in step (c) the copper plating step uses a copper cyanide bath and is conducted using a current density of from about 3.0 to about 4.0 A/dm^2, at a temperature of from about 50 to about 55°C.

6. The method of any one of the preceding claims, wherein in step (d) the nickel plating process uses a nickel electrolyte solution that comprises:

nickel sulfate (e.g. nickel sulfate hexahydrate) in an amount of from about 300 to about 350g/L;

nickel chloride in an amount of from about 40 to about 60 g/L;

boric acid in an amount of from about 40 to about 50 g/L;

a wetting agent in an amount of around 0.3%v/v;

additive A in an amount of from 1.0 to 2.0%vv;

additive B in an amount of from 0.2 to 0.3%vv; and

additive C in an amount of from 0.5 to 0.75%vv; where:

additive A is selected from one or more of the group consisting of a substituted or unsubstituted aryl sulfonamide, a substituted or unsubstituted unsaturated alkyl sulfonamide, a substituted or unsubstituted aryl sulfonate, a substituted or unsubstituted unsaturated alkyl sulfonate, an aryl sulfonic acid and salts and solvates thereof;

additive B is selected from one or more of the group consisting of trifluoromethane sulfonic acid, halides of trifluoromethane sulfonic acid and aromatic substitted sufonic acids and salts and solvates thereof;

additive C is selected from one or more of the group consisting of 1,2-methyl-4-isothiazoline, carbendaxin, 1,2-benzisothiazole-3(2*H*)-one, 2-phenoxyethanol, benzoic acid, and methyl paraben; and

the nickel solution has a pH of from 4.0 to 4.5.

7. The method of claim 6, wherein in step (d) the depleted additives A and B are replenished by the further addition of:

additive D in an amount of from 0.05 to 0.1%vv;

additive D, is a mixture of at least one compound mentioned in the list provided for additive A and at least one compound mentioned in the list provided for additive B.

8. The method of Claim 6, wherein the nickel plating process is conducted using a current density of from about 5.0 to about 6.5 A/dm^2, at a temperature of from 50 to 65°C, and with soluble nickel anodes operated with cathode movement or air agitation.

9. The method of any one of the preceding claims, wherein in step (e) the silver strike electroplating process uses a silver strike electrolyte solution that comprises:

ionic silver in an amount of from 1.0 to 2.0 g/L; and

KCN in an amount of from 100 to 300 g/L.

10. The method of Claim 9, wherein the silver strike electroplating process is conducted using a current density of around 2.0 A/dm^2 and a deposition time of from 20 to 60 seconds.

11. The method of any one of the preceding claims, wherein in step (f) bright silver plating process uses a bright silver plating electrolyte solution that comprises:

potassium silver cyanide salt at a concentration of from 50 to 100 g/L;

potassium cyanide at a concentration of from 100 to 150 g/L;

potassium hydroxide at a concentration of from about 6 to 20 g/L;

brightener A at a concentration of from 3 to 15 mL/L;

brightener B at a concentration of from 2 to 7mL/L; and

brightener C at a concentration of from 2 to 7mL/L, where

brightener A is a mixture of organic brightener compounds that contain a ketone group and/or organometallic compounds;

brightener B is a mixture of organic brighterner compounds that contain a ketone group, such as ketones that provide an aroma and/or organometallic compounds;

brightener C is one or more alkyl acrylates; and

the pH of the solution is over 11.5.

12. The method of Claim 11, wherein the bright silver plating process is conducted using a current density from about 5.0 to about 6.5 A/dm^2 and at a temperature of from 20 to 40ºC.

13. The method according to any one of the preceding claims, wherein after step (f) and before step (g), a second electrolytic cleaning process is conducted.

14. The method according to any one of the preceding claims, wherein the electrolytic cleaning process uses an electrolytic cleaning solutions that comprises:

an alkaline material selected from one or more of the group consisting of alkali metal hydroxides, alkali metal carbonates, alkali metal silicates and alkali metal phosphates; and

a sequestering agent selected from one or more of the group consisting of sodium tripolyphosphate, tetrapotassium pyrophosphate, and tetrasodium pyrophosphate, optionally wherein

the alkaline material is present in an amount of from 12 to 25 g/L.

15. The method of Claim 14, wherein the alkaline material is sodium silicate.

16. The method of Claim 14 or Claim 15, wherein the electrolytic cleaning is conducted using the leadframe or FPC as the cathode and a direct current of from 1 to 5 A/dm^2 at a temperature of from 50 to 60ºC.