CLAIMS

[Claim 1]

A copper coating, which is formed on a metal lead frame, the copper coating comprising a particle aggregate coating having a specific surface area more than 1.6×10^{-3} m^2/g to 2.2×10^{-3} m^2/g or less,
wherein the particle aggregate coating comprises particle aggregates each having a size of 15 μm or less.

[Claim 2]

The copper coating according to claim 1 having an arithmetic mean height (Sa) of 1.3 μm to 3.0 μm.

[Claim 3]

A method of producing a copper coating on a lead frame using a copper plating solution by a PR pulse electrolysis method, the copper coating comprising a particle aggregate coating having a specific surface area of 1.3×10^{-3} m^2/g to 2.2×10^{-3} m^2/g, the particle aggregate coating comprising particle aggregates each having a size of 15 μm or less,
wherein

the copper plating solution contains a copper salt, an acid component, a halide ion, a sulfur-containing organic compound, and a non-ionic polyether polymer surfactant, and

the PR pulse electrolysis method uses the lead frame as a negative electrode or a cathode and comprises:

(1) a first film forming process in which a first current having a current density of 0.5 ASD to 200 ASD is applied using the lead frame as an electrode for a first period of 10 msec to 1,000 msec to form a coating on a surface of the lead frame using the plating solution;

(2) a dissolution process, subsequent to the first film forming process, in which a second current having a current density of 0.2 ASD to 100 ASD is applied

using the lead frame as an electrode for a second period of 0.1 msec to 100 msec to dissolve the coating; and

(3) repetition of the above processes a predetermined number of times to perform copper plating on the lead frame.

[Claim 4]

The method according to claim 3, wherein

the copper plating solution has

a copper(II) ion concentration derived from the copper salt of 50 g/L to 270 g/L,

an acid component concentration of 0 g/L to 100 g/L,

a halide ion concentration of 10 mg/L to 500 mg/L,

a sulfur-containing organic compound concentration of 0.5 mg/L to 50 mg/L, and

a non-ionic polyether polymer surfactant concentration of 0.01 g/L to 10 g/L.

[Claim 5]

The method according to claim 3, wherein in the copper plating solution,

the copper salt is copper sulfate,

the acid component is sulfuric acid,

the halide ion is a chloride ion,

the sulfur-containing organic compound is at least one component selected from the group consisting of bis(3-sulfopropyl) disulfide (SPS), 3-mercaptopropanesulfonic acid and its sodium salt, bis(3-sulfopropyl) disulfide and its disodium salt, N,N-dimethyldithiocarbamic acid (3-sulfopropyl) ester and its sodium salt, and

the non-ionic polyether polymer surfactant is at least one component selected from the group consisting of polyethylene glycol (PEG), polypropylene glycol,

polyethylene oxide, and polyoxyalkylene glycol.

[Claim 6]

The method according to claim 3,

wherein in the PR pulse electrolysis method,

the lead frame is used as a negative electrode or a cathode,

the first film forming process (1) includes application of the first current having a current density of 40 ASD to 200 ASD, and

the dissolution process (2) includes application of the second current having a current density of 0.2 ASD to 35 ASD.

[Claim 7]

Wire bonding comprising:

forming, on a lead frame, the copper coating as defined in claim 1 or a copper coating that is produced by the method as defined in claim 3; and

connecting wiring between the lead frame and a semiconductor device via a bonding wire.

[Claim 8]

An integrated circuit, a circuit board, or a semiconductor device, comprising a lead frame having the copper coating as defined in claim 1 formed thereon or a lead frame having a copper coating that is produced by the method as defined in claim 3 formed thereon.