[Document Name] Claims

[Claim 1]

A metal material for ~~an~~ electronic component, having low whisker formability and high durability, comprising:

a base material;

an A layer constituting a surface layer on the base material and formed of Sn, In or an alloy thereof; and

a B layer constituting a middle layer provided between the base material and the A layer and formed of Ag, Au, Pt, Pd, Ru, Rh, Os, Ir or an alloy thereof,

wherein the surface layer (A layer) has the following constituents (i) or (ii),

(i) a thickness of 0.002 to 0.2 μm,

(ii) a deposition amount of Sn, In of 1 to 150 $\mu g/cm^2$; and

the middle layer (B layer) has the following constituents (iii) or (iv),

(iii) a thickness of 0.001 to 0.3 μm,

(iv) a deposition amount of Ag, Au, Pt, Pd, Ru, Rh, Os, Ir of 1 to 330 $\mu g/cm^2$.

~~[Claim 2]~~

~~A metal material for electronic component having low whisker formability and high durability, comprising:~~

~~a base material;~~

~~an A layer constituting a surface layer layer on the base material and formed of Sn, In or an alloy thereof; and~~

~~a B layer constituting a middle layer provided between the base material and the A layer and formed of Ag, Au, Pt, Pd, Ru, Rh, Os, Ir or an alloy thereof,~~

~~wherein the surface layer (A layer) has a deposition amount of Sn, In of 1 to 150 μg/cm^2; and~~

~~the middle layer (B layer) has a deposition amount of Ag, Au, Pt, Pd, Ru, Rh, Os, Ir of 1 to 330 μg/cm^2.~~

[Claim ~~3~~2]

The metal material for electronic component according to claim 1~~ or 2~~, wherein the surface layer (A layer) has an alloy composition comprising 50 mass% or more of Sn, In or a total of Sn and In, and the other alloy component(s) comprising one or two or more elements selected from the group consisting of Ag, As, Au, Bi, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sb, W, Zn.

[Claim ~~4~~3]

The metal material for electronic component according to any one of claims 1 to ~~3~~2, wherein the middle layer (B layer) has an alloy composition comprising 50 mass% or more of Ag, Au, Pt, Pd, Ru, Rh, Os, Ir or a total of Ag, Au, Pt, Pd, Ru, Rh, Os and Ir, and the other alloy component(s) comprising one or two or

more elements selected from the group consisting of Bi, Cd, Co, Cu, Fe, In, Mn, Mo, Ni, Pb, Sb, Se, Sn, W, Tl, Zn.

~~[Claim 5]~~

~~The metal material for electronic component according to any one of claims 1 to 4, wherein the surface layer (A layer) has a surface Vickers hardness of Hv300 or higher.~~

~~[Claim 6]~~

~~The metal material for electronic component according to any one of claims 1 to 5, wherein the surface layer (A layer) has a surface indentation hardness of 2,500 MPa or higher, the indentation hardness being a hardness acquired by measuring an impression made on the surface of the surface layer (A layer) by a load of 0.1 mN in an ultrafine hardness test.~~

~~[Claim 7]~~

~~The metal material for electronic component according to any one of claims 1 to 6, wherein the surface layer (A layer) has a surface Vickers hardness of Hv1,000 or lower, and the metal material has high bending workability.~~

~~[Claim 8]~~

~~The metal material for electronic component according to any one of claims 1 to 7, wherein the surface layer (A layer) has a surface indentation hardness of 10,000 MPa or lower, the indentation hardness~~

~~being a hardness acquired by measuring an impression made on the surface of the surface layer (A layer) by a load of 0.1 mN in an ultrafine hardness test, and the metal material has high bending workability.~~

~~[Claim 9]~~

~~The metal material for electronic component according to any one of claims 1 to 8, wherein the surface layer (A layer) has a surface arithmetic mean deviation (Ra) of 0.1 μm or lower, and the metal material has better gas corrosion resistance.~~

~~[Claim 10]~~

~~The metal material for electronic component according to any one of claims 1 to 9, wherein the surface layer (A layer) has a surface maximum height (Rz) of 1 μm or lower, and the metal material has better gas corrosion resistance.~~

~~[Claim 11]~~

~~The metal material for electronic component according to any one of claims 1 to 10, wherein the surface layer (A layer) has a surface reflection density of 0.3 or higher, and the metal material has better gas corrosion resistance.~~

[Claim ~~12~~4]

The metal material for electronic component according to any one of claims 1 to ~~11~~3, wherein when a depth analysis by XPS (X-ray photoelectron spectroscopy) is carried out, a position (D_1) where an atomic

concentration (at%) of Sn or In of the surface layer (A layer) is a maximum value and a position (D_2) where an atomic concentration (at%) of Ag, Au, Pt, Pd, Ru, Rh, Os or Ir of the middle layer (B layer) is a maximum value are present in the order of D_1 and D_2 from the surface.

[Claim ~~13~~5]

The metal material for electronic component according to any one of claims 1 to ~~12~~4, wherein when a depth analysis by XPS (X-ray photoelectron spectroscopy) is carried out, the surface layer (A layer) has a maximum value of an atomic concentration (at%) of Sn or In of 10 at% or higher.

[Claim ~~14~~6]

The metal material for electronic component according to any one of claims 1 to ~~13~~5, wherein when a depth analysis by XPS (X-ray photoelectron spectroscopy) is carried out, the middle layer (B layer) has a maximum value of an atomic concentration (at%) of Ag, Au, Pt, Pd, Ru, Rh, Os or Ir of 10 at% or higher.

[Claim ~~15~~7]

The metal material for electronic component according to any one of claims 1 to ~~14~~6, wherein the surface layer (A layer) has a thickness of 0.01 to 0.1 μm, the surface layer (A layer) has a deposition amount of Sn,

In of 7 to 75 μg/cm^2, and the metal material is whisker-free.

~~[Claim 16]~~

~~The metal material for electronic component according to any one of claims 1 to 15, wherein the surface layer (A layer) has a deposition amount of Sn, In of 7 to 75 μg/cm^2, and the metal material is whisker-free.~~

[Claim ~~17~~8]

The metal material for electronic component according to any one of claims 1 to ~~16~~7, wherein the middle layer (B layer) has a thickness of 0.005 to 0.1 μm, and the middle layer (B layer) has a deposition amount of Ag, Au, Pt, Pd, Ru, Rh, Os, Ir of 4 to 120 μg/cm^2.

~~[Claim 18]~~

~~The metal material for electronic component according to any one of claims 1 to 17, wherein the middle layer (B layer) has a deposition amount of Ag, Au, Pt, Pd, Ru, Rh, Os, Ir of 4 to 120 μg/cm^2.~~

[Claim ~~19~~9]

The metal material for electronic component according to any one of claims 1 to ~~18~~8, further comprising a C layer provided between the base material and the B layer and constituting an underlayer, and formed of one or two or more selected from the group consisting of Ni, Cr, Mn, Fe, Co, Cu.

[Claim ~~20~~10]

The metal material for electronic component according to claim ~~19~~9, wherein the underlayer (C layer) has an alloy composition comprising 50 mass% or more of a total of Ni, Cr, Mn, Fe, Co, Cu, and further comprising one or two or more selected from the group consisting of B, P, Sn, Zn.

[Claim ~~21~~11]

The metal material for electronic component according to claim ~~19~~ 9 or ~~20~~10, wherein when a depth analysis by XPS (X-ray photoelectron spectroscopy) is carried out, a position (D_1) where an atomic concentration (at%) of Sn or In of the surface layer (A layer) is a maximum value, a position (D_2) where an atomic concentration (at%) of Ag, Au, Pt, Pd, Ru, Rh, Os or Ir of the middle layer (B layer) is a maximum value and a position (D_3) where an atomic concentration (at%) of Ni, Cr, Mn, Fe, Co or Cu of the underlayer (C layer) is a maximum value are present in the order of D_1, D_2 and D_3 from the surface.

[Claim ~~22~~12]

The metal material for electronic component according to any one of claims ~~19~~ 9 to ~~21~~11, wherein when a depth analysis by XPS (X-ray photoelectron

spectroscopy) is carried out, the surface layer (A layer) has a maximum value of an atomic concentration (at%) of Sn or In of 10 at% or higher, and the middle layer (B layer) has a maximum value of an atomic concentration (at%) of Ag, Au, Pt, Pd, Ru, Rh, Os or Ir of 10 at% or higher; and a depth where the underlayer (C layer) has an atomic concentration (at%) of Ni, Cr, Mn, Fe, Co or Cu of 25% or higher is 50 nm or more.

[Claim ~~23~~13]

The metal material for electronic component according to any one of claims ~~19~~ 9 to ~~22~~12, wherein the underlayer (C layer) has a thickness of 0.05 μm or larger, and the underlayer (C layer) has a deposition amount of Ni, Cr, Mn, Fe, Co, Cu of 0.03 mg/cm^2 or larger.

~~[Claim 24]~~

~~The metal material for electronic component according to any one of claims 19 to 23, wherein the underlayer (C layer) has a deposition amount of Ni, Cr, Mn, Fe, Co, Cu of 0.03 mg/cm^2 or larger.~~

~~[Claim 25]~~

~~The metal material for electronic component according to any one of claims 19 to 24, wherein the underlayer (C layer) has a surface Vickers hardness of Hv300 or higher.~~

~~[Claim 26]~~

~~The metal material for electronic component according to any one of claims 19 to 25, wherein the surface Vickers hardness and the thickness of the underlayer (C layer) satisfy the following expression:~~

~~Vickers hardness (Hv) ≥ -376.22Ln (thickness: μm) + 86.411.~~

~~[Claim 27]~~

~~The metal material for electronic component according to any one of claims 19 to 26, wherein the underlayer (C layer) has a surface indentation hardness of 2,500 MPa or higher, the indentation hardness being a hardness acquired by measuring an impression made on the surface of the underlayer (C layer) by a load of 0.1 mN in an ultrafine hardness test.~~

~~[Claim 28]~~

~~The metal material for electronic component according to any one of claims 19 to 27, wherein the surface indentation hardness, which is a hardness acquired by measuring an impression made on a surface of the underlayer (C layer) by a load of 0.1 mN in an ultrafine hardness test, and the thickness of the underlayer (C layer) satisfy the following expression:~~

~~Indentation hardness (MPa) ≥ -3998.4Ln (thickness: μm) + 1178.9.~~

~~[Claim 29]~~

~~The metal material for electronic component according to any one of claims 19 to 28, wherein the~~

~~underlayer (C layer) has a surface Vickers hardness of Hv1,000 or lower, and the metal material has high bending workability.~~

~~[Claim 30]~~

~~The metal material for electronic component according to any one of claims 19 to 29, wherein the underlayer (C layer) has a surface indentation hardness of 10,000 MPa or lower, the indentation hardness being a hardness acquired by measuring an impression made on the surface of the underlayer (C layer) by a load of 0.1 mN in an ultrafine hardness test, and the metal material has high bending workability.~~

~~[Claim 31]~~

~~The metal material for electronic component according to any one of claims 1 to 30, wherein the base material is a metal base material, and the metal base material has a surface Vickers hardness of Hv90 or higher.~~

~~[Claim 32]~~

~~The metal material for electronic component according to any one of claims 1 to 31, wherein the base material is a metal base material, and the metal base material has a surface indentation hardness of 1,000 MPa or higher, the indentation hardness being a hardness acquired by measuring an impression made on the surface of the metal base material by a load of 0.1 mN in an ultrafine hardness test.~~

~~[Claim 33]~~

~~The metal material for electronic component according to any one of claims 1 to 32, wherein the base material is a metal base material, and the metal base material has an elongation of 5% or higher, the elongation being an elongation measured by carrying out a tensile test at a tension rate of 50 mm/min in the rolling-parallel direction of the metal base material according to JIS C 6511, and the metal material has high bending workability.~~

~~[Claim 34]~~

~~The metal material for electronic component according to any one of claims 1 to 33, wherein the base material is a metal base material, and when a 90° bending test of the metal base material is carried out under a condition that a ratio of a thickness and a bending radius of the metal base material becomes 1 by using a letter W shape die, the metal base material has a minimum bending radius ratio (MBR/t) of 3 or lower, the minimum bending radius ratio being a minimum bending radius/the thickness of the metal base material at which no crack is generated in the metal base material, and the metal material has high bending workability.~~

[Claim ~~35~~14]

The metal material for electronic component according to any one of claims ~~19~~ 9 to ~~34~~13, wherein when a depth analysis by XPS (X-ray photoelectron spectroscopy) is carried out, between a position (D_1)

where an atomic concentration (at%) of Sn or In of the surface layer (A layer) is a maximum value and a position (D_3) where an atomic concentration (at%) of Ni, Cr, Mn, Fe, Co, Cu or Zn of the underlayer (C layer) is a maximum value, a region having 40 at% or more of Ag, Au, Pt, Pd, Ru, Rh, Os or Ir is present in a thickness of 1 nm or larger.

[Claim ~~36~~15]

The metal material for electronic component according to any one of claims 1 to ~~35~~14, wherein when an elemental analysis of a surface of the surface layer (A layer) is carried out by a survey measurement by XPS (X-ray photoelectron spectroscopy), a content of Sn, In is 2 at% or higher.

[Claim ~~37~~16]

The metal material for electronic component according to any one of claims 1 to ~~36~~15, wherein when an elemental analysis of a surface of the surface layer (A layer) is carried out by a survey measurement by XPS (X-ray photoelectron spectroscopy), a content of Ag, Au, Pt, Pd, Ru, Rh, Os or Ir is lower than 7 at%.

[Claim ~~38~~17]

The metal material for electronic component according to any one of claims 1 to ~~37~~16, wherein when an

elemental analysis of a surface of the surface layer (A layer) is carried out by a survey measurement by XPS (X-ray photoelectron spectroscopy), a content of O is lower than 50 at%.

[Claim ~~39~~18]

A connector terminal, wherein a metal material for electronic component according to any one of claims 1 to ~~38~~ 17 is used for a contact portion.

~~[Claim 40]~~

~~A connector, wherein a connector terminal according to claim 39 is used.~~

[Claim ~~41~~19]

An FFC terminal, wherein a metal material for electronic component according to any one of claims 1 to ~~38~~ 17 is used for a contact portion.

[Claim ~~42~~20]

An FPC terminal, wherein a metal material for electronic component according to any one of claims 1 to ~~38~~ 17 is used for a contact portion.

~~[Claim 43]~~

~~An FFC, wherein an FFC terminal according to claim 41 is used.~~

~~[Claim 44]~~

~~An FPC, wherein an FPC terminal according to claim 42 is used.~~

[Claim ~~45~~21]

An electronic component, wherein a metal material for electronic component according to any one of claims 1 to ~~38~~ 17 is used for an electrode for external connection of the electronic component.

~~[Claim 46]~~

~~A method for manufacturing a metal material for electronic component according to any one of claims 1 to 38, comprising steps of forming the surface layer (A layer) and the middle layer (B layer) by surface treatments using wet plating, respectively.~~

~~[Claim 47]~~

~~The method for manufacturing a metal material for electronic component according to claim 46, wherein the wet plating is electroplating.~~

~~[Claim 48]~~

~~The method for manufacturing a metal material for electronic component according to claim 46 or 47, comprising forming the surface layer (A layer) by a plating treatment using an acidic plating liquid.~~

~~[Claim 49]~~

~~The method for manufacturing a metal material for electronic component according to any one of claims 46 to 48, comprising forming the middle layer (B layer) by a~~

~~plating treatment using a cyanide containing plating liquid.~~

~~[Claim 50]~~

~~A method for manufacturing a metal material for electronic component according to any one of claims 19 to 30, comprising a step of forming the underlayer (C layer) by a plating treatment using a sulfamic acid bath or a Watts bath.~~

~~[Claim 51]~~

~~The method for manufacturing a metal material for electronic component according to claim 50, wherein a plating liquid used in the sulfamic acid bath and the Watts bath is a bright Ni plating liquid.~~

~~[Claim 52]~~

~~The method for manufacturing a metal material for electronic component according to claim 50 or 51, wherein the plating liquid to form the underlayer (C layer) comprises saccharin as an additive.~~