Claims

~~What is claimed is:~~

1. A solder paste, consisting of:

~~10wt~~50wt% to 90wt% of a first solder alloy powder, the first solder alloy powder consisting of an SnSbCuAg solder alloy that has a wt% ratio of Sn:Sb of 0.75 to 1.1;

10wt% to ~~90wt~~50wt% of a second solder alloy powder, the second solder alloy powder consisting of an Sn solder alloy including at least 80wt% of Sn; and

a remainder of flux.

~~2. The solder paste of claim 1, wherein the solder paste consists of 50wt% to 90wt% of the first solder alloy powder, 10wt% to 50wt% of the second solder alloy powder, and a remainder of the flux.~~

~~3.~~2. ~~The solder paste of claim 2, wherein the solder paste consists of~~ 75wt% to 90wt% of the first solder alloy powder, 10wt% to 25wt% of the second solder alloy powder, and [[a]]the remainder of the flux.

~~4.~~3. The solder paste of claim ~~2~~1, wherein the solidus temperature of the first solder alloy powder is 300°C to 360°C, and wherein the solidus temperature of the second solder alloy powder is 200°C to 250°C.

~~5.~~4. The solder paste of claim ~~4~~3, wherein the solidus temperature of the second solder alloy powder is 215°C to 245°C.

~~6.~~5. The solder paste of claim ~~4~~3, wherein the liquidus temperature of the first solder alloy powder is no greater than 360°C.

6. The solder paste of claim 3, wherein the liquidus temperature of the second solder alloy powder is no greater than 250°C.

~~7. The solder paste of claim 4, wherein the liquidus temperature of the second solder alloy powder is no greater than 250°C.~~

~~8.~~7. ~~The solder paste of claim 5, wherein the liquidus temperature of the second solder alloy powder is no greater than~~ 245°C.

~~9.~~8. The solder paste of claim 1, wherein the first solder alloy powder consists of:

4wt% to 10wt% of Cu;

4wt% to 20wt% of Ag;

optionally, 0.5wt% or less of Bi, Co, In, Ge, Ni, P, or Zn; and

a remainder of Sn and Sb in the ratio of 0.75 to 1.1.

~~10.~~9. The solder paste of claim 1, wherein the second solder alloy powder is SnAg, SnCu, SnAgCu, SnSb, SnAgCuSb, SnAgY (Y= Bi, Co, Ge, In, Ni, P, Sb, or Zn), SnCuY(Y= Bi, Co, Ge, In, Ni, P, Sb, or Zn), SnAgCuY (Y= Bi, Co, Ge, In, Ni, P, Sb, or Zn), or SnAgCuSbY (Y= Bi, Co, Ge, In, Ni, P, Sb, or Zn).

10. The solder paste of claim 9, wherein the second solder alloy powder comprises 0.1 to 4 wt% Ag, 0.1 to 1 wt% Cu, or 0.1 to 11wt% Sb.

~~11.~~ The solder paste of claim 10, wherein the second solder alloy powder comprises 0.1 to 4 wt% Ag, 0.1 to 1 wt% Cu, ~~or 0.1 to 11wt% Sb.~~

~~12.~~11. ~~The solder paste of claim 11, wherein the second solder alloy powder comprises 0.1 to 4 wt% Ag, 0.1 to 1 wt% Cu,~~ and 0.1 to 11wt% Sb.

~~13.~~12. The solder paste of claim ~~12~~11, wherein the second solder alloy powder is doped with Bi, Co, Ge, In, Ni, P, Sb, or Zn.

~~14.~~13. The solder paste of claim 1, wherein a ratio of heat absorption from a first melting peak of the solder paste to heat absorption from a second melting peak of the solder paste is 0.15 or less.

~~15. The solder paste of claim 1, wherein the solder paste consists of less than 50wt% of the first solder alloy powder, greater than 50wt% of the second solder alloy powder, and a remainder of the flux.~~

~~16.~~14. A method, comprising:

applying a solder paste between a substrate and device to form an assembly, wherein the solder paste consists of: ~~10wt~~50wt% to 90wt% of a first solder alloy powder, the first solder alloy powder consisting of an SnSbCuAg solder alloy that has a wt% ratio of Sn:Sb of 0.75 to 1.1; 10wt% to ~~90wt~~50wt% of a second solder alloy powder, the second solder alloy powder consisting of an Sn solder alloy including at least 80wt% of Sn; and a remainder of flux;

performing a first reflow soldering process with the assembly at a peak temperature of greater than 320°C to form a solder joint from the solder paste; and

after forming the solder joint, performing a second reflow soldering process with the assembly at a peak temperature of 230°C to 270°C.

~~17.~~15. The method of claim ~~16~~14, wherein the device is a silicon die, the substrate comprises a Cu lead frame, and the solder paste is applied between the Cu lead frame and the silicon die.

~~18.~~ 16. The method of claim ~~16~~14, wherein:

~~the solder paste consists of 50wt% to 90wt% of the first solder alloy powder, 10wt% to 50wt% of the second solder alloy powder, and a remainder of the flux;~~

the solidus temperature of the first solder alloy powder is 300°C to 360°C; and

the solidus temperature of the second solder alloy powder is 200°C to 250°C.

17. The method of claim ~~16~~14, wherein during the second reflow soldering process, the solder joint maintains a bond shear strength greater than or equal to 10 MPa.

18. A solder joint formed by the process of:

applying a solder paste between a substrate and a device to form an assembly; and

reflow soldering the assembly to form the solder joint;

wherein the solder paste consists of:

~~10wt~~50wt% to 90wt% of a first solder alloy powder, the first solder alloy powder consisting of an SnSbCuAg solder alloy that has a wt% ratio of Sn:Sb of 0.75 to 1.1;

10wt% to ~~90wt~~50wt% of a second solder alloy powder, the second solder alloy powder consisting of an Sn solder alloy including at least 80wt% of Sn; and

a remainder of flux.