Claims

1. A paste for firing comprising:

between 20 wt% and 70 wt% precious metal particles;

at least 10 wt% intercalating particles; and

organic vehicle;

wherein the intercalating particles have a melting point below 450°C and comprise low temperature base metal particles having a melting point below 450°C

wherein the paste is configured to be fired at temperatures greater than 600°C.

2. The paste of Claim 1, wherein a weight ratio of the intercalating particles to the precious metal particles is at least 1:5.

3. The paste of Claim 1, wherein the precious metal particles comprise at least one material selected from the group consisting of gold, silver, platinum, palladium, rhodium, and alloys, composites, and other combinations thereof.

4. The paste of Claim 1, wherein the precious metal particles have a D50 between 100 nm and 50 μm.

5. The paste of Claim 1, wherein the precious metal particles have a specific surface area between 0.4 and 7.0 m^2/g.

6. The paste of Claim 1, wherein a portion of the precious metal particles has a shape selected from the group consisting of spherical shapes, flake shapes, and elongated shapes.

7. The paste of Claim 1, wherein at least some of the precious metal particles are silver and have a D50 between 300 nm and 2.5 μm and a specific surface area between 1.0 and 3.0 m^2/g.

8. The paste of Claim 1, wherein the intercalating particles have a D50 between 100 nm and 50 μm.

9. The paste of Claim 1, wherein the intercalating particles have a specific surface area between 0.1 and 6.0 m^2/g.

10. The paste of Claim 1, wherein a portion of the intercalating particles has a shape selected from the group consisting of spherical shapes, flake shapes, and elongated shapes.

11. The paste of Claim 1, wherein the low temperature base metal particles comprise a material selected from the group consisting of bismuth, tin, tellurium, antimony, lead, and alloys, composites, and other combinations thereof.

12. The paste of Claim 11, wherein the low temperature base metal particles comprise bismuth and have a D50 between 1.5 and 4.0 μm and a specific surface area between 1.0 and 2.0 m^2/g.

13. The paste of Claim 1, wherein the intercalating particles further comprise crystalline metal oxide particles comprising a combination of oxygen and a metal selected from the group consisting of bismuth, tin, tellurium, antimony, lead, vanadium, chromium, molybdenum, boron, manganese, cobalt, and alloys, composites and other combinations thereof.

14. The paste of Claim 1, further comprising glass frit particles, wherein the glass frit particles comprise a combination of oxygen and an element selected from a group consisting of antimony, arsenic, barium, bismuth, boron, cadmium, calcium, cerium, cesium, chromium, cobalt, fluorine, gallium, germanium, hafnium, indium, iodine, iron, lanthanum, lead, lithium, magnesium, manganese, molybdenum, niobium, potassium, rhenium, selenium, silicon, sodium, strontium, tellurium, tin, vanadium, zinc, zirconium, alloys thereof, and other combinations thereof.

15. The paste of Claim 1, wherein the paste has a solids loading between 30 wt% and 80 wt%.

16. The paste of Claim 1, wherein the intercalating particles comprise at least 15 wt% of the paste.

17. The paste of Claim 1, wherein the paste comprises 45 wt% Ag particles, 30 wt% bismuth particles, and 25 wt% organic vehicle.

18. The paste of Claim 1, wherein the paste comprises 30 wt% Ag particles, 20 wt% bismuth particles, and 50 wt% organic vehicle.

19. A paste for firing comprising:

between 20wt% and 70 wt% silver particles;
at least 10 wt% bismuth metal particles; and
organic vehicle;

wherein the paste is configured to be fired at temperatures greater than 600°C.

20. The paste of Claim 1 or Claim 19, further comprising glass frit particles.