SINTERING MATERIALS AND ATTACHMENT METHODS USING SAME

FIELD OF THE TECHNOLOGY

One or more aspects relate generally to methods for attachment of various components, and more specifically to sintering materials and techniques used for such attachment.

BACKGROUND OF THE INVENTION

Sintering has emerged as an alternative technology to conventional soldering. Sintering typically involves high temperature and high pressure processing to attach various components of an assembly.

BRIEF SUMMARY OF THE INVENTION

In one aspect, there is provided a sheet of sintering film, comprising a substrate; a release coating disposed on the substrate; and a layer of a dry sintering material having a thickness of about 5 to about 300 microns disposed on the release coating on the substrate; wherein the sintering material comprises, prior to drying,

(i) a metal powder having a d_{50} range of about 0.001 to about 10 micrometers, the metal powder comprising about 30 to about 95 wt % of the sintering material;

(ii) a binder having a softening point between about 50 and about 170° C., the binder comprising about 0.1 to about 5 wt % of the sintering material; and

(iii) a solvent in an amount sufficient to dissolve at least the binder;

wherein the substrate is configured to be removed during a lamination process; and wherein the layer of sintering material is applied in discrete shapes with respect to a surface of the substrate, and the discrete shapes have geometries corresponding to dimensions of a component to be attached using the layer of sintering material.

In accordance with one or more embodiments, a composition may include a metal powder having a d50 range of about 0.001 to about 10 micrometers, the metal powder comprising about 30 to about 95 wt% of the paste, a binder having a softening point between about 50 and about 170 °C, the binder comprising about 0.1 to about 5 wt% of the paste, and a solvent in an amount sufficient to dissolve at least the binder.

In some embodiments, the metal powder may comprise gold, palladium, silver, copper, aluminum, silver palladium alloy or gold palladium alloy. The metal powder may comprise silver particles. In at least some embodiments, the metal powder may comprise

nanoparticles. The metal powder may comprise coated metal particles. In some embodiments, the composition may further include one or more functional additives.

In accordance with one or more embodiments, a film may comprise a layer of a composition including a metal powder having a d50 range of about 0.001 to about 10 micrometers, the metal powder comprising about 30 to about 95 wt% of the paste, a binder having a softening point between about 50 and about 170 °C, the binder comprising about 0.1 to about 5 wt% of the paste, and a solvent in an amount sufficient to dissolve at least the binder. In some embodiments, the film may have a dry thickness of about 5 to about 300 microns.

In some embodiments, the layer of the composition is on a polymeric, glass, metal or ceramic substrate. A polymeric substrate may comprise polyester. A polymeric substrate may comprise a release coating.

CLAIMS

1. A sheet of sintering film, comprising:

   a substrate;

   a release coating disposed on the substrate; and

   a layer of a dry sintering material having a thickness of about 5 to about 300 microns disposed on the release coating on the substrate;

   wherein the sintering material comprises, prior to drying:

   (i) a metal powder having a d_{50} range of about 0.001 to about 10 micrometers, the metal powder comprising about 30 to about 95 wt % of the sintering material;

   (ii) a binder having a softening point between about 50 and about 170° C., the binder comprising about 0.1 to about 5 wt % of the sintering material; and

   (iii) a solvent in an amount sufficient to dissolve at least the binder;

   wherein the substrate is configured to be removed during a lamination process; and

   wherein the layer of sintering material is applied in discrete shapes with respect to a surface of the substrate, and the discrete shapes have geometries corresponding to dimensions of a component to be attached using the layer of sintering material.

2. The sheet of sintering film of claim 1, wherein the substrate is a polymeric, glass, metal, or ceramic substrate.

3. The sheet of sintering film of claim 1, wherein the sintering material further comprises one or more functional additives.

4. The sheet of sintering film of claim 3, wherein the one or more functional additives comprise chlorinated diols and/or metallorganic compounds.

5. The sheet of sintering film of claim 1, wherein the metal powder comprises gold, palladium, silver, copper, aluminum, silver palladium alloy, or gold palladium alloy.

6. The sheet of sintering film of claim 5, wherein the metal powder comprises silver particles.

7. The sheet of sintering film of claim 5, wherein the metal powder comprises nanoparticles.

8. The sheet of sintering film of claim 5, wherein the metal powder comprises coated metal particles.

9. The sheet of sintering film of claim 1, configured to provide a bond line characterized by a thermal conductivity of about 250 W/m° K.

10. The sheet of sintering film of claim 1, configured to provide a bond line characterized by a bond strength of at least about 40 MPa.

11. The sheet of sintering film of claim 1, configured for a sintering operation at a temperature of about 175° C. to about 400° C.

12. The sheet of sintering film of claim 11, configured for a sintering operation at a temperature of about 230° C. to about 260° C.

13. The sheet of sintering film of claim 1, configured for a sintering operation at a pressure of between about 0.5 MPa and 20 MPa.

14. The sheet of sintering film of claim 13, configured for a sintering operation at a pressure of between about 5 MPa and 10 MPa.

15. The sheet of sintering film of claim 1, configured to provide a bond line having a thickness in a range of about 2 microns to about 100 microns.

16. The sheet of sintering film of claim 1, wherein the discrete shapes are constructed and arranged to facilitate tape-and-reel dispensing of the film during an assembly operation.