BONDING TOOL WITH IMPROVED FINISH

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 60/806,503, filed July 3, 2006, and of U.S. Provisional Application No. 60/884,920, filed January 15, 2007, the contents of both of which are incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to the bonding tools used in the formation of wire loops, and more particularly, to bonding tools having an improved finish.

BACKGROUND OF THE INVENTION

[0003] In the processing and packaging of semiconductor devices, wire bonding continues to be the primary method of providing electrical interconnection between two locations within a package (e.g., between a die pad of a semiconductor die and a lead of a leadframe). To form wire loops to provide this interconnection, bonding tools (e.g., capillary tools, wedge bonding tools, etc.) are typically used.

[0004] Conventional bonding tools typically have a polished surface. This polished surface includes the tip portion of the bonding tool. Certain bonding tool manufacturers also offer a "matte" finish bonding tool, where the matte finish is a roughened surface.

[0005] In the wire bonding industry there is continuous pressure for developments which provide improved results such as increased wire bond strength (e.g., first bond strength, second bond strength, etc.), reduced assist rates for the bonding operation, reduced variability among wire loops, etc.

[0006] Thus, it would be desirable to provide improved bonding tools to provide improved wire bonding operation results.

SUMMARY OF THE INVENTION

[0007] ~~According to an exemplary embodiment of the present invention, a bonding tool including a body portion terminating at a tip portion is provided. The tip portion is formed from a material, wherein a grain structure of the material is exposed for at least a portion of the tip portion.~~ According to an aspect of the present invention, there is provided a capillary bonding tool for use in a ball bonding operation, the capillary bonding tool comprising a body portion having a tip portion at which the body portion terminates, and an engagement portion configured for engagement with a transducer of a wire bonding machine, the tip portion and the engagement portion being

formed from a material, wherein a grain structure of the material is exposed for at least a face portion of the tip portion and the engagement portion by the surface layer of the material being removed from the material, the material being a ceramic material,

wherein a surface of the portion of the tip portion with an exposed grain structure defines a plurality of asperities, wherein a density of the asperities is at least 15 microns^-2, and wherein a surface roughness average at the portion of the tip portion and the engagement portion defining the plurality of asperities is at least 0.03 microns.

[0008] ~~According to another exemplary embodiment of the present invention, a bonding tool including a body portion terminating at a tip portion is provided. A~~

~~surface of at least a portion of the tip portion defines a plurality of asperities, wherein a density of the asperities is at least 15 microns^-2, and wherein a surface roughness average at the portion of the tip portion defining the plurality of asperities is at least 0.03 microns.~~

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The invention is best understood from the following detailed description when read in connection with the accompanying drawing. It is emphasized that, according to common practice, the various features of the drawing are not to scale. On the contrary, the dimensions of the various features are arbitrarily expanded or reduced for clarity. Included in the drawing are the following figures:

Fig. 1A is a side sectional view of a bonding tool that may be provided with an improved surface in accordance with an exemplary embodiment of the present invention;

Fig. 1B is a detailed view of a portion of the bonding tool of Fig. 1A;

Fig. 2A is a side sectional view of another bonding tool that may be provided with an improved surface in accordance with an exemplary embodiment of the present invention;

Fig. 2B is a detailed view of a portion of the bonding tool of Fig. 2A;

Fig. 2C is a perspective view of a portion of the bonding tool of Fig. 2A;

Fig. 3 is a perspective view of a tip portion of a bonding tool in accordance with an exemplary embodiment of the present invention;

Fig. 4A is a detailed view of a portion of a tip portion of a bonding tool in accordance with an exemplary embodiment of the present invention;

Fig. 4B is a detailed view of a portion of a tip portion of a bonding tool in accordance with another exemplary embodiment of the present invention;

Fig. 4C is a detailed view of a portion of a tip portion of a bonding tool in accordance with yet another exemplary embodiment of the present invention;

Fig. 5 is a diagram of a contact model of rough surfaces useful for understanding exemplary bonding tool surfaces in accordance with the present invention;