large wire and ribbon bonding, a semiconductor device can be driven to high velocities similar in amplitude to the bonding tool's tip velocity during the bonding process. That is, the semiconductor device (including the die supported by the leadframe), may move (at least partially) with the vibrating bonding tool. When this occurs, the relative displacement between the tip of the bonding tool and the semiconductor die is decreased which may lead to poor quality bonds. Conventional structures and methods use clamping materials with low rates of wear under repeated ultrasonic bonding to increase their useful life. Such materials generally exhibit relatively low resistance to the velocity of the tool during bonding.

[0006] As illustrated in FIG. 3, support or retention structures (such as anvil 308 and finger clamps 328 are employed to clamp or retain semiconductor device 306 during a bonding operation. Clamps (e.g., finger clamps 328 or window clamps) are typically used to secure semiconductor device 306 (including leadframe 300 carrying semiconductor die 302) against support structure 308 during a bonding operation. Such clamping and/or retention of semiconductor device 306 is intended to minimize induced movement of semiconductor device 306 during ultrasonic bonding. Unfortunately, poor clamping (which may result from the density and arrangement of the components) tends to lead to an unreliable bonding process, and therefore bonded components of a poor quality. Further, movement of such clamps 328 relative to leadframe 300 during bonding may damage and/or mark leadframe 300.

[0007] Thus, it would be desirable to provide improved bonding support systems to minimize or eliminate movement of semiconductor devices relative to the support systems during bonding to improve bond quality.

SUMMARY OF THE INVENTION

[0008] According to an ~~exemplary embodiment~~aspect of the present invention, a support system for a semiconductor device during a wire or ribbon bonding operation is provided. The support system includes a body portion defining an upper surface that includes an upper surface contact region configured to support at least a portion of a lower surface of a semiconductor device at a lower surface contact region during the wire or ribbon bonding operation. The support system also includes a plurality of protrusions on the upper surface contact region, the plurality of protrusions including abrasive particles attached to the upper surface contact region.

[0009] According to another ~~exemplary embodiment~~aspect of the present invention, a support system for a semiconductor device during a wire or ribbon bonding operation is provided. The support system includes a lower body portion defining an upper surface, the upper surface being configured to support at least a portion of a bottom surface of

a semiconductor device during the wire or ribbon bonding operation. The support system also includes an upper body portion defining a lower surface configured to contact at least a portion of a top surface of the semiconductor device at a contact region of the semiconductor device during the wire or ribbon bonding operation. The support system further includes a plurality of protrusions on the lower surface, the plurality of protrusions including abrasive particles attached to the lower surface.

[0010] According to ~~yet~~ another ~~exemplary embodiment~~aspect of the present invention, a method of supporting a semiconductor device during a wire or ribbon bonding operation is provided. The method includes the step of providing a body portion that defines an upper surface including an upper surface contact region having a plurality of protrusions, the plurality of protrusions including abrasive particles attached to the upper surface contact region. The upper surface contact region is configured to support at least a portion of a lower surface of the semiconductor device at a lower surface contact region during the wire or ribbon bonding operation. The method further includes the step of supporting at least the portion of the lower surface of the semiconductor device at the lower surface contact region with the upper surface contact region such that the lower surface contact region is deformed by the plurality of protrusions.

[0011] According to ~~yet~~ another ~~exemplary embodiment~~aspect of the present invention, a method for supporting a semiconductor device during a wire or ribbon bonding operation is provided. The method includes the step of providing a lower body portion that defines an upper surface configured to support at least a portion of a bottom surface of the semiconductor device during the wire or ribbon bonding operation. The method also includes the step of providing an upper body portion that defines a lower surface configured to contact at least a portion of a top surface of the semiconductor device at a contact region during the wire or ribbon bonding operation. The lower surface includes a plurality of protrusions, the plurality of protrusions including abrasive particles attached to the lower surface. The method further includes the step of deforming the top surface with the plurality of protrusions during the wire or ribbon bonding operation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] 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: