[0006] Additionally, various subsystems of wire bonding machines are used to provide the cover gas to the bond site area of the wire bonding machine to reduce the potential for oxidation of the bonding wire in the bond site area. Exemplary subsystems for providing a cover gas in the bond site area include U.S Patent Application Publication Nos. 2007/0284421; 2007/0251980; and U.S. Patent Nos. 5,265,788; 5,395,037; 6,866,182; and 7,182,793.

[0007] It would be desirable to provide improved structures for reducing oxidation in wire bonding.

SUMMARY OF THE INVENTION

~~[0008] According to an exemplary embodiment of the present invention, a wire~~ bonding machine is provided. The wire bonding machine includes a bonding tool and an electrode for forming a free air ball on an end of a wire extending through the bonding tool where the free air ball is formed at a free air ball formation area of the wire bonding machine. The wire bonding machine also includes a bond site area for holding a semiconductor device during a wire bonding operation. The wire bonding machine also includes a gas delivery mechanism/system (e.g., a gas delivery structure) configured to provide a cover gas to: (1) the bond site area whereby the cover gas is ejected through at least one aperture of the gas delivery mechanism to the bond site ~~area, and (2) the free air ball formation area.~~

[0008] According to an aspect of the present invention, there is provided a wire bonding machine comprising: a bonding tool; an electrode for forming a free air ball on an end of a wire extending through the bonding tool, the free air ball being formed at a free air ball formation area of the wire bonding machine; a bond site area for holding a semiconductor device during a wire bonding operation; and a gas delivery mechanism including a body portion defining a through hole extending from a top surface of the body portion to a bottom surface of the body portion, the body portion being configured to receive an electrode, the body portion defining an aperture on a sidewall of the through hole configured to receive a tip portion of the electrode, the gas delivery mechanism defining a cavity for receiving a cover gas from a gas inlet, the cavity including a gas outlet at the through hole, wherein a portion of the cavity adjacent the gas outlet follows a curved path inside the gas delivery mechanism, the through hole being continuously tapered along its entire length such that a diameter of the tapered through hole at the bottom surface is larger than a diameter of the tapered through hole at the top surface.

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 perspective view of a portion of a wire bonding system in accordance with an exemplary embodiment of the present invention;

FIG. 1B is a detailed view of a portion of FIG. 1A;

FIG. 1C is a perspective view of a gas delivery mechanism including a cover for covering a portion of a window of a device clamp in accordance with an exemplary embodiment of the present invention;

Claims:

1. A gas delivery mechanism configured to provide a cover gas in connection with a wire bonding operation, the gas delivery mechanism comprising:

a body portion defining a through hole extending from a top surface of the body portion to a bottom surface of the body portion, the body portion being configured to receive an electrode, the body portion defining an aperture coincident with the through hole configured to receive a tip portion of the electrode; and

a gas inlet for providing a cover gas to the body portion, the body portion defining a cavity for receiving the cover gas from the gas inlet, the cavity including a gas outlet at the through hole.

2. The gas delivery mechanism of claim 1 wherein the through hole is tapered between the top surface and the bottom surface.

3. The gas delivery mechanism of claim 2 wherein a diameter of the tapered through hole at the bottom surface is larger than a diameter of the tapered through hole at the top surface.

4. The gas delivery mechanism of claim 2 wherein a diameter of the tapered through hole at the top surface is larger than a diameter of the tapered through hole at the bottom surface.

5. The gas delivery mechanism of any one of the preceding claims wherein a portion of the cavity adjacent the gas outlet follows a curved path.

6. The gas delivery mechanism of any one of the preceding claims further comprising a second gas inlet, the second gas inlet configured to provide a cover gas to a second cavity defined by the gas delivery mechanism, the second cavity including a second gas outlet at the bottom surface of the body portion.

7. The gas delivery mechanism of claim 6 wherein a portion of the second cavity follows an angle from (1) an area of the body portion between the top surface and the bottom surface, and (2) the second gas outlet at the bottom surface.

8. The gas delivery mechanism of any one of the preceding claims wherein the body portion is formed of a polyimide material.

Claims:

1. A wire bonding machine comprising:

a bonding tool;

an electrode for forming a free air ball on an end of a wire extending through the bonding tool, the free air ball being formed at a free air ball formation area of the wire bonding machine;

a bond site area for holding a semiconductor device during a wire bonding operation; and

a gas delivery mechanism including a body portion defining a through hole extending from a top surface of the body portion to a bottom surface of the body portion, the body portion being configured to receive an electrode, the body portion defining an aperture on a sidewall of the through hole configured to receive a tip portion of the electrode, the gas delivery mechanism defining a cavity for receiving a cover gas from a gas inlet, the cavity including a gas outlet at the through hole, wherein a portion of the cavity adjacent the gas outlet follows a curved path inside the gas delivery mechanism,

the through hole being continuously tapered along its entire length such that a diameter of the tapered through hole at the bottom surface is larger than a diameter of the tapered through hole at the top surface.

2. The wire bonding machine of claim 1 further comprising a device clamp for securing the semiconductor device during the wire bonding operation, the device clamp defining a device aperture through which the bonding tool can access the semiconductor device to perform the wire bonding operation at the bond site area, the wire bonding machine further comprising a cover for covering at least a portion of the device aperture during the wire bonding operation.