Claims

1. An apparatus for mounting a transducer to a bond head of a wire bonder, the bond head of the wire bonder being operative to mechanically drive the transducer when forming electrical interconnections between separate locations within a semiconductor package, the apparatus comprising:

a flexural structure having a connector for connecting to the transducer, the flexural structure being configured to bend; and

at least one actuator attached to the flexural structure, the at least one actuator being operative to bend the flexural structure to thereby cause a displacement of the transducer connected thereto via the connector.

2. The apparatus of claim 1, wherein the transducer is configured to oscillate along its longitudinal axis and the at least one actuator is operative to bend the flexural structure, such that the transducer is displaced along a path that is different from the longitudinal axis along which the transducer is operative to oscillate when mechanically driven by the bond head of the wire bonder.

3. The apparatus of claim 2, wherein there are two actuators attached to different points on the flexural structure.

4. The apparatus of claim 3, wherein the two actuators are configured to be actuated out of phase with respect to each other.

5. The apparatus of claim 4, wherein the two actuators are configured to be actuated in linear motions in opposite directions with respect to each other.

6. The apparatus of claim 2, wherein there are at least three actuators attached to the flexural structure, the at least three actuators being actuatable to bend the flexural structure such that the transducer is displaced along a plurality of paths each of which is different from the longitudinal axis along which the transducer is operative to oscillate when mechanically driven by the bond head of the wire bonder.

7. The apparatus of claim 6 comprising three actuators, wherein two of the actuators are arranged on a plane and the third actuator is arranged outside the plane.

8. The apparatus of claim 7, wherein the two actuators arranged on the plane are configured to be actuated out of phase with respect to each other.

9. The apparatus of claim 8, wherein the two actuators arranged on the plane are configured to be actuated in linear motion in opposite directions with respect to each other.

10. The apparatus of claim 7, wherein the two actuators arranged on the plane are configured to be actuated in phase with respect to each other, but the third actuator arranged outside the plane is configured to be actuated out of phase with respect to the two actuators arranged on the plane.

11. The apparatus of claim 10, wherein the third actuator is configured to be actuated in linear motion in opposite directions to the two actuators arranged on the plane.

12. The apparatus of claim 6 comprising four actuators, wherein two of the actuators are arranged on a first plane and the other two actuators are arranged on a second plane orthogonal to the first plane.

13. The apparatus of claim 1, wherein the at least one actuator is operative to bend the flexural structure, such that the transducer is displaced along a path that corresponds to the longitudinal axis along which the transducer is operative to oscillate when mechanically driven by the bond head of the wire bonder.

14. The apparatus of claim 1, wherein the at least one actuator is a piezo-stack actuator configured to be actuated by an electrical source operative at a sub-ultrasonic frequency.

15. The apparatus of claim 1, wherein the at least one actuator is a magnetostrictive actuator configured to be actuated by an applied magnetic field.

16. A wire bonder for providing electrical interconnections between separate locations within a semiconductor package, the wire bonder comprising the apparatus of claim 1.

Claims

1. A wire bonder comprising:

an ultrasonic transducer configured to perform wire bonding;

a bond head; and

a mounting apparatus configured to mount the ultrasonic transducer to the bond head, the ultrasonic transducer being configured to be mechanically driven on a horizontal plane to form electrical interconnections between separate locations within a semiconductor package, the mounting apparatus comprising:

a flexural structure that is configured to bend, wherein the ultrasonic transducer is mounted to the flexural structure;

at least one actuator attached to the flexural structure, the at least one actuator being configured and operative to bend the flexural structure, thereby causing a displacement of the ultrasonic transducer on at least the horizontal plane; and

a plurality of connectors configured to connect the mounting apparatus to the ultrasonic transducer,

wherein the at least one actuator is attached to the flexural structure at a first end of the flexural structure and the ultrasonic transducer extends from a second end of the flexural structure, the second end of the flexural structure being on an opposite side of the flexural structure relative to the first end of the flexural structure.

2. A wire bonder comprising:

a transducer;

a bond head; and

a mounting apparatus configured to mount the transducer to the bond head, the transducer being configured to be mechanically driven on a horizontal plane to form electrical interconnections between separate locations within a semiconductor package, the mounting apparatus comprising:

a flexural structure that is configured to bend, wherein the transducer is mounted to the flexural structure;

at least one actuator attached to the flexural structure, the at least one actuator being configured and operative to bend the flexural structure, thereby causing a displacement of the transducer on at least the horizontal plane; and

a plurality of connectors configured to connect the mounting apparatus to the transducer,

each of the at least one actuator being arranged such its longitudinal axis is laterally offset from a longitudinal axis of the transducer.

3. A wire bonder comprising:

a transducer;

a bond head; and

a mounting apparatus configured to mount the transducer to the bond head, the transducer being configured to be mechanically driven on a horizontal plane to form electrical interconnections between separate locations within a semiconductor package, the mounting apparatus comprising:

a flexural structure that is configured to bend, wherein the transducer is mounted to the flexural structure;

at least one actuator attached to the flexural structure, the at least one actuator being configured and operative to bend the flexural structure, thereby causing a displacement of the transducer on at least the horizontal plane; and

a plurality of connectors configured to connect the mounting apparatus to the transducer,

the mounting apparatus extending between an end of the transducer and the bond head.

4. The wire bonder of claim 3, wherein the ultrasonic transducer is configured to oscillate along its longitudinal axis and the at least one actuator of the mounting apparatus is operative to bend the flexural structure, such that the ultrasonic transducer is displaced along a path that is different from the

longitudinal axis along which the ultrasonic transducer is operative to oscillate when mechanically driven by the bond head of the wire bonder.

5. The wire bonder of claim 4, wherein the mounting apparatus comprises two actuators attached to different points on the flexural structure.

6. The wire bonder of claim 4 or claim 5, wherein the two actuators of the mounting apparatus are configured to be actuated out of phase with respect to each other.

7. The wire bonder of claim 5 or claim 6, wherein the two actuators of the mounting apparatus are configured to be actuated in linear motions in opposite directions with respect to each other.

8. The wire bonder of any one of claims 4 to 7, wherein the mounting apparatus comprises at least three actuators attached to the flexural structure, the at least three actuators being actuatable to bend the flexural structure such that the ultrasonic transducer is displaced along a plurality of paths each of which is different from the longitudinal axis along which the ultrasonic transducer is operative to oscillate when mechanically driven by the bond head of the wire bonder.

9. The wire bonder of claim 8, wherein the mounting apparatus comprises three actuators, two of the actuators being arranged on a plane and the third actuator being arranged outside the plane.

10. The wire bonder of claim 9, wherein the two of the actuators arranged on the plane are configured to be actuated out of phase with respect to each other.

11. The wire bonder of claim 9 or claim 10, wherein the two of the actuators arranged on the plane are configured to be actuated in linear motion in opposite directions with respect to each other.

12. The wire bonder of any one of claims 9 to 11, wherein the two of the actuators arranged on the plane are configured to be actuated in phase with respect to each other, but the third actuator arranged outside the plane is configured to be actuated out of phase with respect to the two actuators arranged on the plane.

13. The wire bonder of any one of claims 9 to 12, wherein the third actuator arranged outside the plane is configured to be actuated in linear motion in opposite directions to the two of the actuators arranged on the plane.

14. The wire bonder of any one of claims 8 to 13, wherein the mounting apparatus comprises four actuators, two of the actuators being arranged on a first plane and the other two actuators being arranged on a second plane orthogonal to the first plane.

15. The wire bonder of any one of claims 3 to 14, wherein the at least one actuator of the mounting apparatus is configured and operative to bend the flexural structure, such that the ultrasonic transducer is displaced along a path that corresponds to the longitudinal axis along which the ultrasonic transducer is operative to oscillate when mechanically driven by the bond head of the wire bonder.

16. The wire bonder of any one of claims 3 to 15, wherein the at least one actuator of the mounting apparatus is a piezo-stack actuator configured and operative to be actuated by an electrical source operative at a sub-ultrasonic frequency.

17. The wire bonder of any one of claims 3 to 16, wherein the at least one actuator of the mounting apparatus is a magnetostrictive actuator configured and operative to be actuated by an applied magnetic field.