CLAIMS

We claim:

1. A wire bonded structure comprising:

a bonding pad; and

a continuous length of wire mutually diffused with the bonding pad, the wire electrically coupling the bonding pad with a first electrical contact and a second electrical contact different from the first electrical contact,

wherein the continuous length of wire has a first portion for electrically coupling the bonding pad with the first electrical contact, a contact portion contacting the bonding pad and mutually diffused with the bonding pad, and a second portion for electrically coupling the bonding pad with the second electrical contact,

the contact portion of the wire has a flat shape with a substantially uniform thickness and the first and second portion of the wire have a line shape with a diameter larger than the thickness of the contact portion, and

the first portion of the wire has an angle of about 30° to 70° relative to a reference plane parallel to the bonding pad and the second portion of the wire has an angle of about 45° to 90° relative to the reference plane.

~~2. The wire bonded structure of claim 1, wherein the continuous length of wire has a first portion for electrically coupling the bonding pad with the first electrical contact, a contact portion contacting the bonding pad and mutually diffused with the bonding pad, and a second portion for electrically coupling the bonding pad with the second electrical contact~~

~~3. The wire bonded structure of claim 2, wherein the contact portion of the wire has a flat shape with a substantially uniform thickness and the first and second portion of the wire have a line shape with a diameter larger than the thickness of the contact portion~~

42. The wire bonded structure of claim ~~3~~1, wherein the diameter of the first portion

and second portion of the wire is in a range from about 12.7 μm to about 38.1 μm.

53. The wire bonded structure of claim 42, wherein the thickness of the contact portion of the wire is no less than 5 microns.

~~6 The wire bonded structure of claim 3, wherein the first portion of the wire has an angle of about 30° to 70° relative to a reference plane parallel to the bonding pad and the second portion of the wire has an angle of about 45° to 90° relative to the reference plane.~~

74. The wire bonded structure of claim 61, wherein projection of the first portion of the wire on the reference plane and projection of the second portion of the wire on the reference plane is not along a straight line.

85. The wire bonded structure of claim 61, wherein the contact portion of the wire has a substantially circular shape in the reference plane.

96. The wire bonded structure of claim 1, wherein the bonding pad comprises gold or aluminum.

107. The wire bonded structure of claim 1, wherein the wire comprises gold wire, copper wire, palladium wire, palladium plated copper wire or silver based alloy wire.

118. The wire bonded structure of claim 1, wherein the first and second electrical contact comprise die bonding pad, contact pad, conductive bump or bonding wire.

129. A semiconductor device, comprising:

a first semiconductor die including a first die bonding pad;

a second semiconductor die including a second die bonding pad, the first semiconductor die affixing to the second semiconductor die;

a component including an electrical contact, the second semiconductor die affixing to the component; and

a continuous length of wire mutually diffused with the second bonding pad, the wire electrically coupling the second die bonding pad of the second semiconductor die with the first die bonding pad of the first semiconductor die and the electrical contact of the component,

wherein the continuous length of wire has a first portion for electrically coupling the bonding pad with the first electrical contact, a contact portion contacting the bonding pad and mutually diffused with the bonding pad, and a second portion for electrically coupling the bonding pad with the second electrical contact,

the contact portion of the wire has a flat shape with a substantially uniform thickness and the first and second portion of the wire have a line shape with a diameter larger than the thickness of the contact portion, and

the first portion of the wire has an angle of about 30° to 70° relative to a reference plane parallel to the bonding pad and the second portion of the wire has an angle of about 45° to 90° relative to the reference plane.

~~13~~10. The semiconductor device of claim ~~12~~9, wherein the component is a substrate and the electrical contact is a contact pad.

~~14~~11. The semiconductor device of claim ~~13~~10, wherein the substrate comprises printed circuit board (PCB), leadframe and Tape Automated Bonding (TAB) tape.

~~15~~12. The semiconductor device of claim ~~12~~9, wherein the component is a third semiconductor die and the electrical contact is a third die bonding pad.

~~16~~13. The semiconductor device of claim ~~15~~12, wherein the continuous length of wire is mutually diffused with the third die bonding pad.

~~17 The semiconductor device of claim 12, wherein the continuous length of wire has a~~

~~first portion for electrically coupling the second die bonding pad with the first die bonding pad, a contact portion contacting the second die bonding pad and mutually diffused with the second die bonding pad, and a second portion for electrically coupling the second die bonding pad with the electrical contact.~~

~~18 The semiconductor device of claim 17, wherein the contact portion of the wire has a flat shape with a substantially uniform thickness and the first and second portion of the wire have a line shape with a diameter larger than the thickness of the contact portion.~~

~~19~~14. The semiconductor device of claim ~~18~~9, wherein the diameter of the first portion and second portion of the wire is in a range from about 12.7 μm to about 38.1 μm..

~~20~~15. The semiconductor device of claim ~~18~~9, wherein the thickness of the contact portion of the wire is no less than 5 microns.

~~21 The semiconductor device of claim 18, wherein the first portion of the wire has an angle of about 30° to 70° relative to a reference plane parallel to the second bonding pad and the second portion of the wire has an angle of about 45° to 90° relative to the reference plane.~~

~~22~~16. The semiconductor device of claim ~~21~~9, wherein projection of the first portion of the wire on the reference plane and projection of the second portion of the wire on the reference plane is not along a straight line.

~~23~~17. The semiconductor device of claim ~~21~~9, wherein the contact portion of the wire has a substantially circular shape in the reference plane.

~~24. A method of forming a wire bonded structure comprising:~~

~~pressing a continuous length of wire against a top surface of bonding pad with a force applied by a wire bonding device comprising a central cavity feeding the wire; and~~

~~mutually diffusing the continuous length of wire with the top surface of the bonding pad at an elevated temperature to thereby electrically couple the bonding pad with a first electrical contact and a second electrical contact different from the first electrical contact.~~

~~25. The method of claim 24, wherein the force is about 15-35 gram-force.~~

~~26. The method of claim 24, wherein the temperature is about 140-175 °C.~~

~~27. The method of claim 24, wherein during said step of mutually diffusing the continuous length of wire with the top surface of the bonding pad, an ultrasonic energy with a power of about 60-100 mW is applied.~~

~~28. The method of claim 24, wherein said step of mutually diffusing the continuous length of wire with the top surface of the bonding pad takes about 80-200 milliseconds.~~

~~29. The method of claim 24, wherein during said step of pressing a continuous length of wire against a top surface of bonding pad, the wire bonding device does not touch the top surface of the bonding pad.~~

~~30. A method of fabricating a semiconductor device comprising the steps of:~~

~~affixing a group of semiconductor dies to a substrate, the group of semiconductor dies including a top semiconductor die and one or more intermediate semiconductor dies between the top semiconductor die and the substrate, each semiconductor die in the group of semiconductor die including a die bonding pad, and the substrate including a contact pad; and~~

~~electrically coupling the die bonding pad of the top semiconductor die to the top surfaces of the die bonding pads of the one or more intermediate semiconductor dies and to the contact pad of the substrate by pressing a continuous length of wire against top surface of bonding pads of the one or more intermediate dies with a force applied by a wire bonding device comprising a central cavity feeding the wire and mutually diffusing the continuous length of wire on the top surfaces of the die bonding pad at an elevated temperature sequentially.~~

~~31. The method of claim 30, wherein the force is about 15-35 gram-force.~~

~~32. The method of claim 30, wherein the temperature is about 140-175 °C.~~

~~33. The method of claim 30, wherein during said step of mutually diffusing the continuous length of wire with the top surface of the bonding pad, an ultrasonic energy with a power of about 60-100 mW is applied.~~

~~34. The method of claim 30, wherein said step of mutually diffusing the continuous length of wire with the top surface of the bonding pad takes about 80-200 milliseconds.~~

~~35. The method of claim 30, wherein during said step of pressing a continuous length of wire against a top surface of bonding pad, the wire bonding device does not touch the top surface of the bonding pad.~~