CLAIMS

1. A semiconductor device comprising:

a common wire that sequentially connects three or more electrodes;

a plurality of bonding portions that bonds the electrodes with a side surface of the common wire; and

a plurality of looping portions that loops the common wire from the bonding portions onto the other electrodes, the bonding portions and the looping portions being formed alternately.

2. The semiconductor device according to claim 1, wherein the electrodes are pads on semiconductor chips.

3. The semiconductor device according to claim 2, wherein

the semiconductor device has a stacked body with the semiconductor chips stacked in layers, and

the common wire sequentially connects the electrodes on the semiconductor chips in adjacent layers to each other.

4. The semiconductor device according to claim 1, wherein

the bonding portions have a flat shape crushed to a thickness of 1/4 to 1/2 of the diameter of the common wire, and

the looping portions have a heel portion bending and extending obliquely upward from the bonding portions, and the thickness of the heel portion is a thickness of 1/2 to 4/5 of the diameter of the common wire.

5. The semiconductor device according to claim 2, wherein

the bonding portions have a flat shape crushed to a thickness of 1/4 to 1/2 of the diameter of the common wire, and

the looping portions have a heel portion bending and extending obliquely upward from the bonding portions, and the thickness of the heel portion is a thickness of 1/2 to 4/5 of the diameter of the common wire.

6. The semiconductor device according to claim 3, wherein

the bonding portions have a flat shape crushed to a thickness of 1/4 to 1/2 of the diameter of the common wire, and

the looping portions have a heel portion bending and extending obliquely upward from the bonding portions, and the thickness of the heel portion is a thickness of 1/2 to 4/5 of the diameter of the common wire.

7. The semiconductor device according to claim 2, wherein

the electrodes are recessed from the surface of the semiconductor chips, and

the thickness of the bonding portions is greater than the recess depth of the electrodes.

8. The semiconductor device according to claim 3, wherein

the electrodes are recessed from the surface of the semiconductor chips, and

the thickness of the bonding portions is greater than the recess depth of the electrodes.

9. The semiconductor device according to claim 4, wherein

the electrodes are recessed from the surface of the semiconductor chips, and

the thickness of the bonding portions is greater than the recess depth of the electrodes.

10. A method of manufacturing a semiconductor device in which three or more electrodes on semiconductor chips and a substrate are sequentially connected with a common wire, the method comprising:

a bonding step of pressing a side surface of the wire against a first electrode with a capillary and bonding the side surface of the wire to the first electrode; and

a looping step of looping the wire onto a second electrode with the capillary after the bonding step,

the bonding step and the looping step being repeated alternately to sequentially connect the three or more electrodes with the common wire.

11. The method of manufacturing the semiconductor device according to claim 10 wherein,

in the bonding step, the common wire is crushed to a thickness of 1/4 to 1/2 of its diameter with the capillary to be made into a flat shape, and at the same time the common wire is ultrasonically vibrated to be bonded to each of the electrodes.

12. The method of manufacturing the semiconductor device according to claim 10 wherein,

the looping step comprises:

a first raising step of raising the capillary vertically from the first electrode after the bonding step;

a first obliquely moving step of moving the capillary obliquely downward toward the second electrode after the first raising step;

a second raising step of raising the capillary vertically again after the first obliquely moving step;

a reverse step of moving the capillary obliquely downward in a direction opposite to the second electrode after the second raising step;

a second obliquely moving step of moving the capillary obliquely upward to directly above the first electrode after the reverse step;

a third raising step of raising the capillary vertically again after the second obliquely moving step; and

an arcuately moving step of moving the capillary in an arc to directly above the second electrode after the third raising step.

13. The method of manufacturing the semiconductor device according to claim 11 wherein,

the looping step comprises:

a first raising step of raising the capillary vertically from the first electrode after the bonding step;

a first obliquely moving step of moving the capillary obliquely downward toward the second electrode after the first raising step;

a second raising step of raising the capillary vertically again after the first obliquely moving step;

a reverse step of moving the capillary obliquely downward in a direction opposite to the second electrode after the second raising step;

a second obliquely moving step of moving the capillary obliquely upward to directly above the first electrode after the reverse step;

a third raising step of raising the capillary vertically again after the second obliquely moving step; and

an arcuately moving step of moving the capillary in an arc to directly above the second electrode after the third raising step.

14. The method of manufacturing the semiconductor device according to claim 12, wherein in the reverse step, the capillary is moved to a point at which an angle with respect to a line perpendicular to the electrode and passing through the bonding portion becomes 10 to 20°.

15. The method of manufacturing the semiconductor device according to claim 13, wherein in the reverse step, the capillary is moved to a point at which an angle with respect to a line perpendicular to the electrode and passing through the bonding portion becomes 10 to 20°.

16. The method of manufacturing the semiconductor device according to claim 10, wherein

at least one of the electrodes is a pad recessed from the surface of the semiconductor chip, and

in the bonding step, the common wire is crushed with the capillary to a thickness greater than the recess depth of the pad to be made into a flat shape, and at the same time, the common wire is ultrasonically vibrated to be bonded to the pad.

CLAIMS

1. A method of manufacturing a semiconductor device:

a bonding step of pressing a side surface of a wire against a first electrode with a capillary and bonding the side surface of the wire to the first electrode; and

a looping step of looping the wire onto a second electrode with the capillary after the bonding step,

the bonding step and the looping step being repeated alternately to sequentially connect three or more electrodes on semiconductor chips and a substrate with the common wire,

the looping step comprising:

a first raising step of raising the capillary vertically from the first electrode after the bonding step;

a first obliquely moving step of moving the capillary obliquely downward toward the second electrode after the first raising step;

a second raising step of raising the capillary vertically again after the first obliquely moving step;

a reverse step of moving the capillary obliquely downward in a direction opposite to the second electrode after the second raising step;

a second obliquely moving step of moving the capillary obliquely upward to directly above the first electrode after the reverse step;

a third raising step of raising the capillary vertically again after the second obliquely moving step; and

an arcuately moving step of moving the capillary in an arc to directly above the second electrode after the third raising step.

2. The method of manufacturing the semiconductor device according to claim 1 wherein,

in the bonding step, the common wire is crushed to a thickness of 1/4 to 1/2 of its diameter with the capillary to be made into a flat shape, and at the same time the common wire is ultrasonically vibrated to be bonded to each of the electrodes.

3. The method of manufacturing the semiconductor device according to claim 1, wherein in the reverse step, the capillary is moved to a point at which an angle with respect to a line perpendicular to the electrode and passing through the bonded portion becomes 10 to 20°.

4. The method of manufacturing the semiconductor device according to claim 1, wherein

at least one of the electrodes is a pad recessed from the surface of the semiconductor chip, and

in the bonding step, the common wire is crushed with the capillary to a thickness greater than the recess depth of the pad to be made into in a flat shape, and at the same time, the common wire is ultrasonically vibrated to be bonded to the pad.