METHOD FOR ATTACHING SOLDER BALLS ONTO WAFER AND APPARATUS THEREFOR

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to a method for attaching solder balls onto a wafer and apparatus therefor, and more particularly to a method for attaching solder balls onto a wafer and apparatus therefor, which is capable of preliminarily inspecting the surface of the wafer and capable of performing its attachment process section-by-section on a single wafer. Accordingly, defective sections are detected, solder balls are not supplied to the defective sections and solder balls are correctly supplied to the wafer by not a blowing fashion but a pushing fashion, so that the defective ratio of the wafers due to the non-flatness of the wafer and incorrect solder ball supply is minimized, the productivity of the apparatus is considerably improved and the costs of manufacture is decreased.

Description of the Prior Art

Generally, in the manufacture of semiconductors, there is included an attachment process in which a plurality of solder balls are provided onto a wafer to form electrodes.

In the attachment process, a wafer is fixed on a support surface, a plurality of solder balls are sucked into a plurality of sucking holes regularly formed in an attachment plate, and the attachment plate containing solder balls is disposed on the upper surface of the wafer, thereby providing the solder balls to the upper surface of the wafer all at one time. In this case, the solder balls are discharged from the sucking holes by compressed air and provided to the wafer.

In the conventional attachment method and apparatus, an attachment process is performed on the entire upper surface of a single wafer without surface inspection. As a result, solder balls are supplied to detective portions, so the unnecessary loss of solder balls occurs. The solder balls are supplied from the sucking holes of the attachment plate to the wafer by compressed air, the solder balls are not supplied to correct positions, thereby increasing a defective ratio. An attachment process is performed over the entire surface of the wafer at one time, so when the surface of the wafer is non-flat, solder balls supplied from the sucking holes by compressed air are not supplied to correct positions, thereby producing a defective wafer. Accordingly, the productivity of the conventional method and apparatus is deteriorated, the costs of manufacture are increased, and the reliability of the products is lowered.

SUMMARY OF THE INVENTION

Accordingly, the present invention has been made keeping in mind the above problems occurring in the prior art, and an object of the present invention is to provide a method for attaching solder balls onto a wafer, which is capable of preliminarily inspecting the surface of the wafer and capable of performing its attachment process section-by-section on a single wafer and, so that defective sections are detected, solder balls are not supplied to the defective sections and solder balls are correctly supplied to the wafer by not a blowing fashion but a pushing fashion, thereby minimizing the defective ratio of the wafers due to the non-flatness of the wafer and incorrect solder ball supply, improving the productivity of the apparatus and reducing the costs of manufacture.

Another object of the present invention is to provide an apparatus for attaching solder balls onto a wafer, which is capable of performing the attachment process of the solder balls onto the wafer by the wafer attachment method of the present invention.

In order to accomplish the above object, the present invention provides a method for attaching solder balls onto a wafer, comprising: a preliminary surface inspection step in which a surface of a wafer onto which solder balls are

attached is preliminary inspected and data obtained by the inspection is transmitted to a control unit; a solder ball suction step in which a plurality of solder balls are sucked into a plurality of sucking holes formed in a sucking plate; and a solder ball attachment step in which solder balls in the sucking holes of the attachment plate are supplied onto the wafer; wherein the solder ball suction step and the solder ball attachment step are alternately repeated section-by-section on a single wafer.

In addition, the present invention provides an apparatus for attaching solder balls onto a wafer, comprising: an attachment plate shaped in the form of a plate having a certain size, the attachment plate being provided with a pusher pin block accommodating depression formed on the upper surface of the attachment plate to have a predetermined size, a plurality of sucking holes formed under the pusher pin block accommodating depression to have a predetermined pattern and be regularly spaced apart from one another, a plurality of first connecting holes formed along the peripheral edge of the attachment plate to be regularly spaced apart from one another; a plurality of pusher pin blocks each shaped in the form of a hexahedron having a certain size, and accommodated in the pusher pin block accommodating depression of the attachment plate to be vertically moved, the pusher pin blocks discharging the solder balls accommodated in the sucking

holes; an intermediate plate shaped in the form of a plate having a certain size, the intermediate being provided with a plurality of assembly holes formed through the intermediate plate to be regularly spaced apart from one another and coaxial with the connecting holes of the pusher pin blocks, a plurality of second connecting holes formed through the peripheral edge of the intermediate plate to be regularly spaced apart from one another and coaxial with the first connecting holes of the attachment plate, and a plurality of through holes formed through the intermediate plate at certain positions; an upper support plate shaped in the form of a plate having a predetermined size and horizontally secured to a bracket, the upper support plate being provided with a plurality of vacuum tube assembly holes formed through the upper support plate to have a predetermined diameter and to be coaxial with the assembly holes of the intermediate plate, a plurality of third connecting holes formed through the peripheral edge of the upper support plate to be regularly spaced apart from one another and coaxial with the second connecting holes of the intermediate plate, and a plurality of main vacuum tube assembly holes formed through the intermediate plate to communicate with the through holes of the intermediate plate; a plurality of connecting bolts inserted into the first, second and third connecting holes of the attachment plate, the intermediate plate and the upper

support plate to connect the attachment plate, the intermediate plate and the upper support plate to one another with one on top of another; a plurality of pusher pin block actuating units inserted into the assembly holes of the intermediate plate and the vacuum tube assembly holes of the upper support plate so as to move the pusher pin blocks vertically; a plurality of actuating vacuum tubes inserted into the vacuum tube assembly holes of the upper support plate so as to discharge the solder balls by vertically moving the pusher pin actuating units using air pressure and to selectively block the sucking holes; and a plurality of main vacuum tubes inserted into the main vacuum tube assembly holes of the upper support plate to suck solder balls into the sucking holes of the attachment plate.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a block diagram showing a method for attaching solder balls onto a wafer in accordance with the present invention;

Fig. 2 is a plan view showing a state in which the wafer

is divided into a plurality of sections;

Fig. 3 is an exploded perspective view showing an apparatus for attaching solder balls onto a wafer in accordance with the present invention;

Fig. 4 is a partially sectioned plan view showing the attachment apparatus of the present invention;

Fig. 5 is a partially sectioned front view showing the attachment apparatus of the present invention;

Fig. 6 is a partially sectioned side view showing the attachment apparatus of the present invention;

Fig. 7 is a partially cut-away, detailed view of a pusher pin block actuating unit;

Fig. 8 is a view showing the arrangement of sucking holes formed on an attachment plate and a state in which solder balls are discharged by the pusher pins; and

Fig. 9 is a view showing an arrangement in which the sucking holes of an attachment plate are formed in a predetermined pattern.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to Figs. 1 to 9, the attachment method of the present invention includes a preliminary surface inspection step 100, a solder ball suction step 101, and a solder ball attachment step 102.

In the preliminary surface inspection step 100, the surface of a wafer onto which solder balls are attached is preliminary inspected and data obtained by the inspection is transmitted to a control unit.

In the solder ball suction step 101, a plurality of solder balls are sucked into a plurality of sucking holes formed in a sucking plate.

Thereafter, in the solder ball attachment step 102, solder balls are attached onto the wafer using an attachment plate loaded with the solder balls.

The solder ball suction step 101 and the solder ball attachment step 102 are alternately performed several times section-by-section on a single wafer. The surface of the single wafer is divided into a plurality of sections. An attachment plate having a size corresponding to the size of a single section is provided. The solder ball suction step 101 in which solder balls are sucked into the sucking holes of the attachment plate and the solder ball attachment step 102 in which the solder balls in the sucking holes are discharged onto the wafer are alternately repeated till solder balls are attached to all the sections of the wafer. The fashion in which the solder balls are discharged from the sucking holes is not a blowing fashion in which the solder balls are discharged by comprised air but a pushing fashion in which the solder balls are discharged by the downward pushing of the

pusher pins out of the sucking holes. As a result of the change of discharging fashion, solder balls can be correctly supplied to their positions in comparison with the conventional method and apparatus.

The attachment method further comprises a sucking hole blocking step 103.

In the sucking hole blocking step 103, sucking holes corresponding to the defective section of the upper surface of the wafer are blocked with pusher pins so that solder balls are prevented from being sucked into the sucking holes corresponding to the defective section. Additionally, not only the sucking holes corresponding to a defective section but also the sucking holes outside of the effective region of a wafer are blocked, so the unnecessary loss of solder balls can be prevented even when the attachment step is performed for a corner section.

In the attachment method for wafers in accordance with the present invention, a wafer is divided into a plurality of relatively small sections and the attaching step 102 is performed by sections. Accordingly, solder balls are supplied to proper positions to minimize a defective ratio, even though the external surface of the wafer is not flat. Additionally, since the solder balls are removed from the sucking holes by pusher pin and supplied onto the wafer, the solder balls are prevented from being removed from desirable positions, thereby

minimizing a defective ratio caused by the incorrect supply of solder balls.

Hereinafter, the construction of an attachment apparatus used to perform the attachment method for wafers is described in detail.

The attachment apparatus 10 of the present invention comprises an attachment plate 14, a plurality of pusher pin blocks 15, an intermediate plate 19, an upper support plate 23, a plurality of connecting bolts 24, a pusher pin block actuating unit 25, a plurality of actuating vacuum tubes 26, and a plurality of main vacuum tubes 27.

The attachment plate 14 is a plate having a predetermined size, and provided with a pusher pin block accommodating depression 11, a plurality of sucking holes 12, and a plurality of connecting holes 13.

The pusher pin block accommodating depression 11 is formed on the upper surface of the attachment plate 14 to have a predetermined size. The sucking holes 12 are formed through the lower surface of the pusher pin block accommodating depression 11 to have a predetermined pattern and be regularly spaced apart from one another. The connecting holes 13 are formed along the peripheral edge of the attachment plate 14 to be regularly spaced apart from one another.

The pusher pin blocks 15 each are a hexahedron having a certain size. The pusher pin blocks 15 are accommodated in

the pusher pin block accommodating depression 11 of the attachment plate 14 to be vertically moved. The pusher pin blocks 15 serve to discharge the solder balls accommodated in the sucking holes 12. The pusher pin blocks 15 are each provided with a plurality of pusher pins 15a, a connecting hole 15b and two vent grooves 15c.

The pusher pins 15a are downwardly projected from each of the pusher pin blocks 15 to have a predetermined pattern and be spaced apart from one another, and removably fitted into the sucking holes 12. The connecting hole 15b is formed at the center of the upper surface of the pusher pin block 15. The vent grooves 15c are formed on the central portions of opposite sides of the pusher pin block 15.

The intermediate plate 19 is a plate having a certain size. The intermediate plate 19 is provided with a plurality of assembly holes 16, a plurality of connecting holes 17, and a plurality of through holes 18. The intermediate plate 19 is laid on and secured to the attachment plate 14.

The assembly holes 16 each having a certain size are formed through the intermediate plate 19 to be regularly spaced apart from one another and coaxial with the connecting holes 15b of the pusher pin blocks 15. The connecting holes 17 are formed through the peripheral edge of the intermediate plate 19 to be regularly spaced apart from one another and coaxial with the connecting holes 13 of the attachment plate

14. The through holes 18 are formed through the intermediate plate 19 at certain positions.

The upper support plate 23 is a plate having a predetermined size. The upper support plate 23 is provided with a plurality of vacuum tube assembly holes 20, a plurality of connecting holes 21, and a plurality of main vacuum tube assembly holes 22. The upper support plate 23 is horizontally secured to a bracket 51.

The vacuum tube assembly holes 20 are formed through the upper support plate 23 to have a predetermined diameter and be arranged to be coaxial with the assembly holes 16 of the intermediate plate 19. The connecting holes 21 are formed through the peripheral edge of the upper support plate 23 to be regularly spaced apart from one another and coaxial with the connecting holes 17 of the intermediate plate 19. The main vacuum tube assembly holes 22 are formed through the intermediate plate 19 to communicate with the through holes 18 of the intermediate plate 19.

The connecting bolts 24 are inserted into the connecting holes 13, 17 and 21 of the attachment plate 14, the intermediate plate 19 and the upper support plate 23, and serve to connect the attachment plate 14, the intermediate plate 19 and the upper support plate 23 to one another with one on top of another.

The pusher pin block actuating units 25 are inserted into

the assembly holes 16 of the intermediate plate 19 and the vacuum tube assembly holes 20 of the upper support plate 23, and serve to move the pusher pin blocks 15 vertically. The pusher pin block actuating units 25 is each comprised of a body 25a, a cap 25b, a plurality of elastic members 25c and 25e, an upper member 25d, and a link member 25f.

The unit body 25a is a tube having a predetermined diameter and length. The unit body 25a is provided at a position of its exterior surface with a support protrusion, and downwardly inserted into the through hole 18 of the intermediate plate 19. The cap 25b is provided with a through hole 25b' having opposite assembly slits, and fitted on the upper end of the unit body 25a. The elastic member 25c is positioned under and elastically supports the unit body 25a. The upper member 25d is a tubular rod having a predetermined diameter and length. The upper end of the upper member 25d is inserted into the vacuum tube assembly hole 20 of the upper support plate 23 and the lower end of the upper member 25d is inserted into the through hole of the cap 25b. The elastic member 25e is positioned under the upper member 25d, and serves to upwardly and elastically support the upper member 25d. The link member 25f is a tubular rod having a predetermined diameter and length, and is provided at the central portion of its external surface with a protrusion 25f'. The upper end of the link member 25f is inserted into

the through hole 18 of the intermediate plate 19, and the lower end of the link member 25f is inserted into the connecting hole 15b of each of the pusher pin blocks 15b, thereby allowing the link member 25f to connect each of the pusher pin blocks 15 and each of the pusher pin block actuating units 25.

The actuating vacuum tubes 26 are inserted into the vacuum tube assembly holes 20 of the upper support plate 23. The actuating vacuum tubes 26 function to discharge the solder balls 50 by vertically moving the pusher pin actuating units 25 using air pressure, and selectively block the sucking holes 12.

The main vacuum tubes 27 are inserted into the main vacuum tube assembly holes 22 of the upper support plate 22, and serve to suck the solder balls 50 into the sucking holes 12 of the attachment plate 14.

As described above, the present invention provides a method for attaching solder balls onto a wafer and apparatus therefor, which is capable of preliminarily inspecting the surface of the wafer and capable of performing its attachment process section-by-section on a single wafer. Accordingly, defective sections are detected, solder balls are not supplied to the defective sections and solder balls are correctly supplied to the wafer by not a blowing fashion but a pushing fashion, so that the defective ratio of the wafers due to the

non-flatness of the wafer and incorrect solder ball supply is minimized, the productivity of the apparatus is considerably improved and the costs of manufacture is decreased.

Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.



WHAT IS CLAIMED IS:

1. A method for attaching solder balls onto a wafer, comprising:

a preliminary surface inspection step in which a surface of a wafer onto which solder balls are attached is preliminary inspected and data obtained by the inspection is transmitted to a control unit;

a solder ball suction step in which a plurality of solder balls are sucked into a plurality of sucking holes formed in a sucking plate; and

a solder ball attachment step in which solder balls in the sucking holes of the attachment plate are supplied onto the wafer;

wherein said solder ball suction step and said solder ball attachment step are alternately repeated section-by-section on a single wafer.

2. The method according to claim 1, further comprising a sucking hole blocking step after said preliminary surface inspection step, in which sucking holes corresponding to a defective section of the upper surface of the wafer are blocked so that solder balls are prevented from being sucked into the sucking holes corresponding to the defective section.



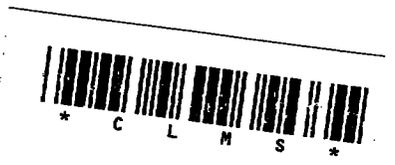
3. The method according to claim 1, wherein said solder ball attachment step is performed by pushing solder balls with pusher pins.

4. The according to claim 1, wherein said solder ball suction step and said solder ball attachment step are performed section-by-section on a single wafer.

5. The according to claim 2, wherein said sucking hole blocking step is performed on the sucking holes of the attachment plate that are positioned outside the effective surface of the wafer.

6. Apparatus for attaching solder balls onto a wafer, comprising:

an attachment plate shaped in the form of a plate having a certain size, said attachment plate being provided with a pusher pin block accommodating depression formed on the upper surface of the attachment plate to have a predetermined size, a plurality of sucking holes formed under the pusher pin block accommodating depression to have a predetermined pattern and be regularly spaced apart from one another, a plurality of first connecting holes formed along the peripheral edge of the attachment plate to be regularly spaced apart from one another;



a plurality of pusher pin blocks each shaped in the form of a hexahedron having a certain size, and accommodated in the pusher pin block accommodating depression of the attachment plate to be vertically moved, said pusher pin blocks discharging the solder balls accommodated in the sucking holes;

an intermediate plate shaped in the form of a plate having a certain size, said intermediate being provided with a plurality of assembly holes formed through the intermediate plate to be regularly spaced apart from one another and coaxial with the connecting holes of the pusher pin blocks, a plurality of second connecting holes formed through the peripheral edge of the intermediate plate to be regularly spaced apart from one another and coaxial with the first connecting holes of the attachment plate, and a plurality of through holes formed through the intermediate plate at certain positions;

an upper support plate shaped in the form of a plate having a predetermined size and horizontally secured to a bracket, said upper support plate being provided with a plurality of vacuum tube assembly holes formed through the upper support plate to have a predetermined diameter and to be coaxial with the assembly holes of the intermediate plate, a plurality of third connecting holes formed through the peripheral edge of the upper support plate to be regularly



spaced apart from one another and coaxial with the second connecting holes of the intermediate plate, and a plurality of main vacuum tube assembly holes formed through the intermediate plate to communicate with the through holes of the intermediate plate;

a plurality of connecting bolts inserted into the first, second and third connecting holes of the attachment plate, the intermediate plate and the upper support plate to connect the attachment plate, the intermediate plate and the upper support plate to one another with one on top of another;

a plurality of pusher pin block actuating units inserted into the assembly holes of the intermediate plate and the vacuum tube assembly holes of the upper support plate so as to move the pusher pin blocks vertically;

a plurality of actuating vacuum tubes inserted into the vacuum tube assembly holes of the upper support plate so as to discharge the solder balls by vertically moving the pusher pin actuating units using air pressure and to selectively block the sucking holes; and

a plurality of main vacuum tubes inserted into the main vacuum tube assembly holes of the upper support plate to suck solder balls into the sucking holes of the attachment plate.

8. The apparatus according to claim 6, wherein said sucking holes of the attachment plate are each formed to have

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a predetermined diameter, and each and integrally provided at its upper end portion with a discharge preventing projection, which has a predetermined width and is inwardly projected.

9. The apparatus according to claim 6, wherein said pusher pin block actuating units is comprised of:

a unit body provided at its exterior surface with a support protrusion, and downwardly inserted into the through hole of the intermediate plate;

a cap provided with a through hole having opposite assembly slits, and fitted around the upper end of the unit body;

a first elastic member positioned under the unit body to upwardly and elastically support the unit body;

an upper member shaped in the form of a tubular rod having a predetermined diameter and length, the upper end of the upper member being movably inserted into the vacuum tube assembly hole of the upper support plate and the lower end of the upper member being movably inserted into the through hole of the cap;

a second elastic member positioned under the upper member to upwardly and elastically support the upper member; and

a link member shaped in the form of a tubular rod having a predetermined diameter and length, and provided at the central portion of its external surface with a protrusion, the



upper end of the link member being inserted into the through hole of the intermediate plate and the lower end of the link member being inserted into the connecting hole of each of the pusher pin blocks, thereby allowing the link member to connect each of the pusher pin blocks and each of the pusher pin block actuating units.