APPARATUS FOR ELIMINATING WAFER WARPAGE

CROSS-REFERENCE TO RELATED PATENT APPLICATION

This application claims the benefit of Korean Patent Application No. 10-2007-0003366, filed on January 11, 2007, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an apparatus for eliminating wafer warpage, and more particularly, to an apparatus for eliminating wafer warpage capable of processing a wafer to minimize warpage of the wafer to improve precision and quality of a manufacturing process of the wafer.

2. Description of the Related Art

In response to demands for compact and lightweight portable electronic devices, chip scale packaging technology has been developed and commercialized to embody a semiconductor chip package with almost the same size as a semiconductor chip. According to chip scale packaging, which is different from conventional packaging, product information of semiconductor chips are marked on the bottom surface of each of the semiconductor chips on a wafer, and then, the wafer is cut. Here, the size of a cut semiconductor chip is almost the same as the size of a semiconductor component in which the semiconductor chip is packaged. In this manner, a chip scale marking system is used to mark the entire surface of the wafer using a laser beam before the wafer is cut.

FIG. 1 shows a perspective view of a conventional wafer support member that supports a wafer in the chip scale marking system. Referring to FIG. 1, the conventional wafer support member 10 includes a wafer holder 11 in which the wafer W is stably fixed, a base 12 supporting the wafer holder 11, and a wafer holder support 13 partially surrounding the wafer holder 11. An opening 14 is formed in the center of the wafer holder 11, wherein a diameter of the opening 14 is less than that

of the wafer W. Thus, the central part of the bottom of the wafer W is exposed through the opening 14, and the rim of the wafer W is supported by the wafer holder 11. A laser unit (not shown) is disposed below the conventional wafer support member 10 such that a laser beam is irradiated from the laser unit onto the bottom surface of the wafer W that is exposed through the opening 14 so as to mark characters or numbers.

Recently, as electronic products, such as mobile phones, become thinner, semiconductor chips mounted inside the electronic products are required to be thinner, and thus, the bottom surface of the wafer W is ground. As wafers become larger and thinner so as to improve yield and reduce manufacturing costs, the wafers are uneven in terms of warpage in which parts of a wafer are distorted after the grinding.

In addition, in a chip scale package process in which a coating layer is directly formed on the bottom surface of the wafer, non-uniform stress generated between the coating layer and the bottom surface of the wafer during solidification of the coating layer results in further warpage of the wafer.

As described above, when a wafer having warpage is fixed on the conventional wafer support member 10 and marking is performed on the bottom surface of the wafer, precision and quality of the marking decline. That is, when height variation of the bottom surface of the wafer that is to be marked is caused by warpage, characters and numbers cannot be precisely marked at a desired position due to the height variation, and thus precision of the marked position is declined. In addition, when the height variation is out of a predetermined range of the depth of focus of a laser beam, the beam density of the laser beam that is irradiated onto the bottom surface of the wafer and the size of spots vary according to the positions of semiconductor chips formed on the wafer. Therefore, the quality of marking is not uniform depending on the positions of semiconductor chips formed on the wafer.

SUMMARY OF THE INVENTION

The present invention provides an apparatus for eliminating wafer warpage having an improved structure to improve precision and quality of marking characters and numbers on the bottom surface of a wafer by minimizing height variation of the bottom surface of the wafer on which characters and numbers are marked by eliminating warpage of the wafer caused by thinning of the wafer.

According to an aspect of the present invention, provided is an apparatus for eliminating wafer warpage comprising:

a wafer support member which contacts the rim of the bottom surface of a wafer that is to be marked and supports the wafer;

a press member which is disposed on the wafer support member and is installed to be able to move between a descended position in which the press member presses the wafer toward the wafer support member by pressing the rim of the upper surface of the wafer supported by the wafer support member and an ascended position in which the press member is upwardly apart from the wafer; and

a driving means which raises the press member to the ascended position.

In the apparatus for eliminating wafer warpage, the driving means comprising:

a plurality of link members including a first contact part which contacts a lower surface of the press member, wherein the link members are rotatably coupled to the wafer support member in a direction to raise the first contact part; and

a plurality of driving sources rotating the link members in a direction to raise the first contact part.

The driving source is a cylinder which operates by air pressure, the link member comprises a second contact part at the opposite side from the first contact part wherein a rotation axis is located between the both ends of the link member, a piston of the cylinder is connected to a cam member having a slope which contacts the second contact part, and the link member rotates in a direction to raise the first contact part since the second contact part is pressed by the slope of the cam member when the piston moves in one direction.

The link member comprises a link body which is rotatably coupled to the wafer support member, a first roller as the first contact part which is rotatably coupled to the link body, and a second roller as the second contact part which is rotatably coupled to the link body.

The apparatus for eliminating wafer warpage further comprises a spring that is elastically biased the second contact part of the link member in a direction to the slope of the cam member.

At least one of the press member and the wafer support member comprises a plurality of guide poles, and the other comprises a plurality of guide holes which are respectively inserted into one of the guide poles, wherein the press member is raised

straight from the wafer support member using the plurality of guide poles and the plurality of guide holes.

The press member comprises a frame and a press ring that is coupled to the frame and contacts the rim of the upper surface of the wafer supported by the wafer support member, wherein the press ring is formed of a material that can prevent static electricity generated when contacting the wafer.

The apparatus for eliminating wafer warpage further comprises a sensor that senses a position of the press member in terms of whether the press member is at the ascended position or the descended position.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features and advantages of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

FIG. 1 shows a perspective view of a conventional wafer support member;

FIG. 2 shows a perspective view of an apparatus for eliminating wafer warpage, according to an embodiment of the present invention;

FIG. 3 shows a cross-sectional view of the apparatus for eliminating wafer warpage of FIG. 2 in which a press member is in a descended position;

FIG. 4 shows a cross-sectional view of the apparatus for eliminating wafer warpage of FIG. 2 in which the press member is in an ascended position;

FIG. 5 shows a perspective view of the disassembled press member of the apparatus for eliminating wafer warpage of FIG. 2;

FIG. 6 shows a perspective view of a part of the apparatus for eliminating wafer warpage of FIG. 2;

FIG. 7 shows a cross-sectional view of the apparatus for eliminating wafer warpage of FIG. 2 in which a sensor senses an ascended position of the press member; and

FIG. 8 shows a cross-sectional view of the apparatus for eliminating wafer warpage of FIG. 2 in which a sensor senses a descended position of the press member.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, the present invention will now be described more fully with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown.

FIG. 2 shows a perspective view of an apparatus for eliminating wafer warpage according to an embodiment of the present invention. FIG. 3 shows a cross-sectional view of the apparatus for eliminating wafer warpage of FIG. 2 in which a press member is at a descended position. FIG. 4 shows a cross-sectional view of the apparatus for eliminating wafer warpage of FIG. 2 in which the press member is at an ascended position.

Referring to FIGS. 2 through 8, an apparatus 100 for eliminating wafer warpage according to an embodiment of the present invention is an apparatus capable of marking a wafer W having minimized warpage by eliminating the warpage of the wafer W, and includes a wafer support member 110, the press member 120, and a driving means 130.

A wafer support member 110, which contacts the rim of the bottom surface of the wafer W that is to be marked and supports the wafer W, includes a wafer holder 111, a wafer holder support 113, and a base 112. The wafer W that is to be marked is stably fixed on the wafer holder 111 that supports the rim of the bottom surface of the stably fixed wafer W. An opening 114 is formed through the center of the wafer holder 111 so as to pass through the apparatus 100, and a laser beam can be irradiated from a laser unit (not shown) disposed at a lower portion of the wafer support member 110 onto the bottom surface of the wafer W through the opening 114. The wafer holder 111 having various sizes of opening 114 can be used depending on the size of the wafer W. However, the external diameter of the wafer holder 111 may be maintained the same so as to commonly use the base 112 that supports the wafer holder 111 even though the diameter of the opening 114 can be varied.

The base 112 supports the wafer holder 111, and the wafer holder support 113 is disposed on the base 112 to surround the wafer holder 111. If the wafer holder 111 is replaced according to the size of the wafer W, the wafer holder 111 and the base 112 are easily coupled by the wafer holder support 113.

The press member 120 is disposed on the wafer support member 130, and presses a wafer W having warpage toward the wafer holder 111. Also, the press member 120 is installed so as to be moved between a descended position shown in

FIG. 3 in which the press member 120 presses the wafer W toward the wafer holder 111 by pressing the rim of the upper surface of the wafer W supported by the wafer holder 111, and an ascended position shown in FIG. 4 in which the press member 120 is upwardly apart from the wafer W. As shown in FIG. 5, the press member 120 includes a frame 121 having a hole 123a through the center of the press member 120 and formed of a metal alloy, for example an aluminum alloy, and a press ring 122 having a hole 123b through the center of the press ring 122 and fixed in a lower portion of the frame 121, wherein the hole 123b is formed to correspond with the hole 123a of the frame 121. The press ring 122 may be formed of a material, such as acetal, that can prevent static electricity generated when contacting the wafer W.

The driving means 130, which raises the press member 120 into the ascended position, includes a driving source, a link member 133, a cam member 132, and a spring 138.

The cylinder 131, which operates by air pressure and installed in the base 112, is used as a driving source in the present embodiment of the present invention. However, the present invention is not limited thereto, and thus, a motor that operates by electricity can also be used as the driving source in addition to the cylinder 131.

The link member 133, which rotatably moves in a direction to raise the press member 120 to the ascended position when a piston 131a of the cylinder 131 moves in a direction, includes a link body 134, a first contact part, and a second contact part. A plurality of the cylinders 131 and the link member 133 may be disposed around the wafer holder 111. In the present embodiment of the present invention, two press members 120 are disposed 180 degrees apart from each other, and two link members 133 respectively contact each of the cylinders 131.

The link body 134 is coupled to the base 112 such that the link body 134 can rotate around a hinge axis 137 that is a rotation axis.

The first contact part contacts a lower surface of the frame 121 and is located at one end of the link body 134. While the link member 133 rotates around the hinge axis 137, the first contact part of the link member 133 may include a first roller 135 to minimize friction between the first contact part and the frame 121. Since the first roller 135 is rotatably coupled at one end of the link body 134, a rolling contact may occur between the first roller 135 and the frame 121 while the link member 133 rotates.

The second contact part involves contact between the link body 134 and a slope 132a of the cam member 132, and the second contact part is located at the opposite side from the first contact part, wherein the hinge axis 137 is located between both the first and second contact parts. As described with respect to the first contact part, the second contact part of the link member 133 may include a second roller 136 to minimize friction between the second contact part and the slope 132a of the cam member 132 while the link member 133 rotates around the hinge axis 137. Since the second roller 136 is rotatably coupled at the other end of the link body 134, a rolling contact may occur between the second roller 136 and the cam member 132 while the link member 133 rotates.

The cam member 132 is installed at one end of the cylinder 131 and contacts the second roller 136. The cam member 132 has the slope 132a which contacts the second roller 136, wherein the slope is inclined from the upper part of the cam member 132 to the lower part of the cam member 132. Thus, the second roller 136 and the cam member 132 can always contact each other due to structure of the slope 132a while the piston 131a moves toward or away from the cam member 132. That is, when the piston 131a of the cylinder 131 compresses the cam member 132, the second roller 136 rolls along the slope 132a and stops at a lower portion of the slope 132a. On the other hand, when the piston 131a of the cylinder 131 de-compresses the cam member 132, the second roller 136 rolls along the slope 132a of the cam member 132 and stops at an upper portion of the slope 132a.

The spring 138 elastically biases the second roller 136 in a direction to the slope 132a of the cam member 132. As shown in FIG. 6, one end of the spring 138 is supported by a region close to the second roller 136 of the link body 134, and the other end of the spring 138 is supported by a lower surface of a bracket 115 fixed to the base 112. When the press member 120 moves from one of the ascended position and the descended position to the other position, the second roller 136 always contacts the slope 132a of the cam member 132 because of elastic resilience of the spring 138. Even when the press member 120 is in the descended position, the first roller 135 can be positioned lower than the upper surface of the wafer holder 111 because of the elastic resilience of the spring 138.

A guide pole 141 and a guide hole 142 are disposed to ascend straight from the wafer support member 110 while the press member 120 is raised by the driving means 130. In the present embodiment of the present invention, a plurality of the

guide poles 141 are attached on the bottom surface of the frame 121 along the circumference of the frame 121. A plurality of the guide holes 142 that penetrate the wafer holder 111 are formed along the circumference of the wafer holder 111 around the opening 114. Each of the guide holes 142 includes a ball bush 143 such that the guide pole 141 slides into the ball bush 143.

The apparatus 100 for eliminating wafer warpage according to an embodiment of the present invention may further include a sensor 150 that senses the position of the press member 120 in terms of whether the press member 120 is at the ascended position or the descended position. The sensor 150 also includes a light emitting unit that emits light and a light receiving unit that receives light reflected from a target. As shown in FIGS. 7 and 8, the sensor 150 includes a first sensor 150a which is disposed at a concave 112a formed on the base 112, and a second sensor 150b which is disposed at a concave 112b formed under the base 112. As shown in FIG. 7, when the press member 120 is at the ascended position, a detection distance is adjusted in order for the first sensor 150a to sense the frame 121 (Light emitted from the first sensor 150a and received by the first sensor 150a is shown as "1a" in FIG. 7). In addition, as shown in FIG. 8, when the press member 120 is at the descended position, the detection distance is adjusted in order for the second sensor 150b to sense the frame 121 (Light emitted from the second sensor 150b and received by the second sensor 150b is shown as "1b" in FIG. 8). The sensor 150 senses the ascended position or the descended position of the press member 120 so as to prevent the wafer W from being damaged by inhibiting the wafer W from moving toward the wafer holder 111 when the press member 120 is at the descended position.

Hereinafter, the principle of the operation of the apparatus for eliminating wafer warpage according to the present invention will now be described with reference to FIGS. 2 through 6.

First, when the piston 131a of the cylinder 131 de-compresses so as to move the cam member 132 in "A" direction, the second roller 136 is pressed down bythe slope 132a of the cam member 132. Since the link body 134 is coupled to the base 112 such that the link body 134 can rotate around the hinge axis 137, the link member 133 rotates in "C" direction by a force applied to the second roller 136. Then, the first roller 135 contacts with the lower surface of the press member 120, and thus the press member 120 is raised. Thereafter, the press member 120, which

contacts with the first roller 135, moves to the ascended position in which the press member 120 is separated from the wafer W that is stably fixed in the wafer holder 111 as shown in FIG. 4.

When the press member 120 moves to the descended position from the ascended position, the press member 120 moves to the ascended position, not by the driving force of the cylinder 131, however by the weight of the press member 120. When air supply into the cylinder 131 is stopped and air discharge is initiated from the inside, the force by the cam member 132 pressing against the second roller 136 is eliminated. While air in the cylinder 131 is discharged, the piston 131a of the cylinder 131 compresses the cam member 132 in a "B" direction. Then, the first roller 135 is pressed by the weight of the press member 120, and the link member 133 rotates around the hinge axis 137 in a "D" direction. Thus, the press member 120 moves to the descended position in which the wafer W that is supported by the wafer holder 111 is pressed toward the wafer holder 111. While the press member 120 is descending, a discharge port formed in the cylinder 131 functions as an orifice that reduces area of air discharge flow to reduce the descending speed, and thus application of a serious impact on the wafer W can be prevented when the press ring 122 contacts the wafer W.

As described, according to the apparatus for eliminating wafer warpage of the present invention, precision of a marking position can be improved by minimizing height variation of a surface of a wafer on which characters and numbers are marked by eliminating warpage caused by manufacturing processes by pressing the rim of the wafer.

In addition, the reduced height variation is within the range of the depth of focus of the laser beam, and thus beam density of the laser beam, which can be irradiated onto the bottom surface of the wafer and size of spots, can be constant regardless of positions. Therefore, the marked characters and numbers have very high visibility, and the quality of the markings can be uniform throughout the entire area of the wafer.

While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

What is claimed is:

1. An apparatus for eliminating wafer warpage comprising:

a wafer support member which contacts the rim of the bottom surface of a wafer that is to be marked and supports the wafer;

a press member which is disposed on the wafer support member and is installed to be able to move between a descended position in which the press member presses the wafer toward the wafer support member by pressing the rim of the upper surface of the wafer supported by the wafer support member and an ascended position in which the press member is upwardly apart from the wafer; and

a driving means which raises the press member to the ascended position,

wherein the driving means comprises:

a plurality of link members including a first contact part which contacts a lower surface of the press member, wherein the link members are rotatably coupled to the wafer support member in a direction to raise the first contact part; and

a plurality of driving sources rotating the link members in a direction to raise the first contact part.

2. The apparatus of claim 1,

wherein the driving source is a cylinder which operates by air pressure,

the link member comprises a second contact part at the opposite side from the first contact part wherein a rotation axis is located between the both ends of the link member,

a piston of the cylinder is connected to a cam member having a slope which contacts the second contact part, and

the link member rotates in a direction to raise the first contact part since the second contact part is pressed by the slope of the cam member when the piston moves in one direction.

3. The apparatus of claim 2, wherein the link member comprises a link body which is rotatably coupled to the wafer support member, a first roller as the first contact part which is rotatably coupled to the link body, and a second roller as the

second contact part which is rotatably coupled to the link body.

4. The apparatus of claim 2, further comprising a spring that is elastically biased the second contact part of the link member in a direction to the slope of the cam member.

5. An apparatus for eliminating wafer warpage comprising:

a wafer support member which contacts the rim of the bottom surface of a wafer that is to be marked and supports the wafer;

a press member which is disposed on the wafer support member and is installed to be able to move between a descended position in which the press member presses the wafer toward the wafer support member by pressing the rim of the upper surface of the wafer supported by the wafer support member and an ascended position in which the press member is upwardly apart from the wafer; and

a driving means which raises the press member to the ascended position,

wherein at least one of the press member and the wafer support member comprises a plurality of guide poles, and the other comprises a plurality of guide holes, which are respectively inserted into one of the guide poles,

wherein the press member is raised straight from the wafer support member using the plurality of guide poles and the plurality of guide holes.

6. An apparatus for eliminating wafer warpage comprising:

a wafer support member which contacts the rim of the bottom surface of a wafer that is to be marked and supports the wafer;

a press member which is disposed on the wafer support member and is installed to be able to move between a descended position in which the press member presses the wafer toward the wafer support member by pressing the rim of the upper surface of the wafer supported by the wafer support member and an ascended position in which the press member is upwardly apart from the wafer; and

a driving means which raises the press member to the ascended position,

wherein the press member comprises a frame and a press ring that is coupled to the frame and contacts the rim of the upper surface of the wafer supported by the

wafer support member,

wherein the press ring is formed of a material that can prevent static electricity generated when contacting the wafer.

7. An apparatus for eliminating wafer warpage comprising:

a wafer support member which contacts the rim of the bottom surface of a wafer that is to be marked and supports the wafer;

a press member which is disposed on the wafer support member and is installed to be able to move between a descended position in which the press member presses the wafer toward the wafer support member by pressing the rim of the upper surface of the wafer supported by the wafer support member and an ascended position in which the press member is upwardly apart from the wafer; and

a driving means which raises the press member to the ascended position,

wherein the apparatus further comprises a sensor that senses a position of the press member in terms of whether the press member is at the ascended position or the descended position.