

DICING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a dicing apparatus dividing a wafer supported by an annular frame through an adhesive tape into individual device chips.

Description of the Related Art

A wafer has, on a front surface thereof, a plurality of devices such as integrated circuits (ICs) and large-scale integrated circuits (LSIs) formed in a plurality of separate respective regions demarcated by a plurality of crossing division lines. The wafer is divided into individual device chips by using a dicing apparatus. The device chips thus divided are used in electrical equipment such as mobile phones and personal computers (refer to Japanese Patent Laid-open No. 2005-046979, for example).

Before being divided into individual device chips, the wafer is prepared as a wafer unit by attaching the wafer to an adhesive tape together with an annular frame having an opening for accommodating the wafer therein in such a condition that the wafer is positioned in the opening.

Thereafter, dicing processing is performed on the wafer to divide the wafer into individual device chips, and then the adhesive tape attached to the wafer is irradiated with ultraviolet rays in a region corresponding to the wafer, resulting in reduction of an adhesive force of the adhesive tape. The device chips thus divided are each picked up from the adhesive tape and bonded to a wiring board.

SUMMARY OF THE INVENTION

In related art, it is necessary to separately provide a dicing apparatus dividing a wafer into individual device chips and an ultraviolet irradiation apparatus irradiating an adhesive tape with ultraviolet rays, which requires an installation space large enough for the apparatuses and brings about a problem that the equipment cost is increased.

It is therefore an object of the present invention to provide a dicing apparatus that can save, in performing processing involving a dicing apparatus and an ultraviolet irradiation apparatus, an installation space for the apparatuses and suppress an increase in equipment cost.

In accordance with an aspect of the present

invention, there is provided a dicing apparatus dividing a wafer having a plurality of devices formed thereon into individual device chips, the wafer being supported by an annular frame through an adhesive tape. The dicing apparatus includes: a chuck table including a wafer support table that supports the wafer thereon, and a plurality of frame support portions which are disposed on an outer periphery of the wafer support table and support the annular frame; and cutting means performing cutting processing on the wafer supported on the wafer support table. The wafer support table includes ultraviolet irradiation means irradiating ultraviolet rays such that an adhesive force of the adhesive tape in a region corresponding to the wafer is reduced.

Preferably, the wafer support table includes a support substrate which has a front surface portion supporting the wafer thereon and through which ultraviolet rays pass, and the ultraviolet irradiation means includes an ultraviolet irradiation source disposed on a back surface side of the support substrate. Preferably, the dicing apparatus further includes cleaning means ejecting a cleaning water onto the wafer, the adhesive tape, and the annular frame supported on the chuck table for cleaning.

The present invention eliminates the need for installing an ultraviolet irradiation apparatus separately from a dicing apparatus, thereby saving an installation space for the apparatuses and suppressing the increase in equipment cost. In particular, when a wafer support table includes a support substrate that has a front surface portion supporting a wafer thereon and transmits ultraviolet rays and an ultraviolet irradiation source is disposed on a back surface side of the support substrate, the installation space for the apparatuses can be saved more efficiently.

The above and other objects, features and advantages of the present invention and the manner of realizing them will become more apparent, and the invention itself will best be understood from a study of the following description and appended claims with reference to the attached drawings showing a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an overall perspective view of a dicing apparatus according to an embodiment of the present invention;

FIG. 2 is a perspective view of an essential part

of the dicing apparatus illustrated in FIG. 1;

FIG. 3 is a perspective view of a chuck table in the essential part illustrated in FIG. 2 in an enlarged manner;

FIG. 4 is a partially enlarged cross-sectional view of a wafer support table constituting the chuck table illustrated in FIG. 3;

FIG. 5 is an overall perspective view of a wafer unit including a wafer as a workpiece, an adhesive tape supporting the wafer, and an annular frame;

FIG. 6 is a perspective view of an essential part of cutting means, the view illustrating a manner in which cutting processing according to the embodiment is performed;

FIG. 7 is a perspective view of the wafer after the cutting processing is performed and the wafer is divided into individual device chips;

FIG. 8 is a perspective view illustrating a manner in which cleaning is performed by using cleaning means;

FIG. 9 is a partially enlarged cross-sectional view illustrating a manner in which the wafer is irradiated with ultraviolet rays by using ultraviolet irradiation means; and

FIG. 10 is a perspective view illustrating a manner

in which the wafer is cleaned after the adhesive tape attached thereto is irradiated with ultraviolet rays.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A dicing apparatus according to an embodiment of the present invention will now be described in detail with reference to the attached drawings. FIG. 1 is an overall perspective view of a dicing apparatus 1 according to the present embodiment, and FIG. 2 is a perspective view of an essential part of the dicing apparatus 1 illustrated in FIG. 1.

The dicing apparatus 1 includes a chuck table 10 for holding a workpiece (a wafer W illustrated in FIG. 2) placed thereon, and cutting means 20 dividing the wafer W supported by an annular frame F through an adhesive tape T into individual device chips.

As illustrated in FIG. 1, the chuck table 10 moves in X-axis directions indicated by an arrow X so as to be positioned in an attaching/detaching region A where the wafer W is placed and held on the chuck table 10 and where the wafer W for which cutting processing has been performed is unloaded from the chuck table 10, and a processing region B where the cutting processing is performed on the wafer W held on the chuck table 10 by

using the cutting means 20. The entire dicing apparatus 1 is covered with a housing member 2, and the housing member 2 has an opening at a lateral position of each of the attaching/detaching region A and the processing region B. Although omitted in FIG. 1, a door is provided for each opening for the attaching/detaching region A and the processing region B, and each door is closed during processing such that an inside of the housing member 2 becomes a closed space. The chuck table 10 further includes a bellows-like cover member 30 covering moving means which moves the chuck table 10 described later. The housing member 2 has a touch panel M disposed above the attaching/detaching region A, and an operator can confirm information related to various operations on the dicing apparatus 1 or make instructions for the operations by using the touch panel M.

Above a boundary between the attaching/detaching region A and the processing region B, the housing member 2 has cleaning means 40 extending in Y-axis directions indicated by an arrow Y. The housing member 2 further has air blowing means 50 extending in the X-axis directions above the opening facing the attaching/detaching region A. The cleaning means 40 has a function of spraying a cleaning water downwardly under high pressure or a

pneumatic ejecting function of ejecting a cleaning water downwardly with high pressure air such that the cleaning water reaches the entire area of the chuck table 10 in the X-axis directions. While the chuck table 10 is moving from the processing region B to the attaching/detaching region A, the cleaning means 40 supplies the wafer W supported by the annular frame F through the adhesive tape T held on the chuck table 10 with the cleaning water. The air blowing means 50 is configured such that high pressure air is downwardly ejected from the air blowing means 50 to at least a range including an outer diameter of the annular frame F. When the operator takes out the wafer W together with the annular frame F from the chuck table 10 positioned in the attaching/detaching region A, high pressure air is blown from above the opening to the wafer W and so forth so as to remove the water left on the wafer W and so forth.

The essential part of the dicing apparatus 1 illustrated in FIG. 1 excluding the housing member 2 will be described in more detail with reference to FIG. 2. The chuck table 10 holds under suction the wafer W supported by the annular frame F through the adhesive tape T as illustrated. The chuck table 10 includes a plate-like cover member 11, a substantially columnar wafer support

table 12 disposed at a center of the cover member 11, and a plurality of frame support portions 13 disposed on an outer periphery of the wafer support table 12 at equal intervals for fixing the annular frame F holding the wafer W.

The moving means moving the chuck table 10 in the X-axis directions between the attaching/detaching region A and the processing region B includes a pedestal portion 15 fixing the wafer support table 12 through a support column 14, a pair of guide rails 17 disposed on a base 1a, a ball screw 18 disposed between the guide rails 17, a motor 16 driving the ball screw 18 for rotation. The pedestal portion 15 is slidable along the guide rails 17 described above and is engaged with the ball screw 18 through engaging means (not illustrated) suitably formed on a lower surface of a bottom portion of the pedestal portion 15. The motor 16 drives the ball screw 18 to rotate in a forward direction or a backward direction, so that the chuck table 10 is moved in the X-axis directions together with the pedestal portion 15. Position detecting means not illustrated is disposed between the guide rails 17 and the pedestal portion 15, and the position detecting means and the motor 16 are connected with control means not illustrated. Accordingly, the chuck

table 10 can be accurately positioned at a desired position.

The cutting means 20 will now be described. The cutting means 20 includes a cutting blade 21 fixed to a distal end portion of a rotary spindle 221, and the cutting blade 21 is supported by a spindle unit 22 through the rotary spindle 221. A spindle motor 23 is disposed on a rear end side of the spindle unit 22 and drives the cutting blade 21 to rotate at high speed through the rotary spindle 221. The spindle unit 22 is disposed on a sliding plate 25 in a sliding member 24, and a Z-axis direction moving motor 26 disposed on the sliding member 24 causes the sliding plate 25 to move in Z-axis directions indicated by an arrow Z along the sliding member 24 precisely.

The sliding member 24 is slidably moved in a horizontal direction (Y-axis directions) by slidable moving means disposed on a side surface, on this side in the drawing, of a wall portion 1b disposed vertically on the base 1a. The slidable moving means includes a pair of guide rails 27 disposed on the side surface of the wall portion 1b in parallel to the horizontal direction, a ball screw 28 disposed horizontally between the pair of guide rails 27, and a Y-axis direction moving motor 29

driving the ball screw 28 to rotate in a forward direction or a backward direction. The sliding member 24 is slidably suspended from the pair of guide rails 27 and engaged with the ball screw 28 through suitable engaging means on a back surface side of the sliding member 24. With the slidable moving means thus configured, the Y-axis direction moving motor 29 is rotated in the forward direction or the backward direction, resulting in precise movement of the sliding member 24 in the Y-axis directions.

As illustrated in FIG. 2, the wafer support table 12 disposed at the center of the cover member 11 of the chuck table 10 includes a front surface portion 120 having a disk-shaped support substrate 122 and a frame portion 121 surrounding the support substrate 122. As seen in FIG. 3 illustrating a state in which the support substrate 122 has been removed from the front surface portion 120, ultraviolet irradiation means 60 irradiating ultraviolet rays upwardly is disposed in a region surrounded by the frame portion 121 on a back surface side of the support substrate 122. The ultraviolet irradiation means 60 includes an ultraviolet irradiation substrate 62 disposed at a bottom portion of the frame portion 121, and a plurality of ultraviolet irradiation

sources 64, or ultraviolet light emitting diodes (LEDs), on the ultraviolet irradiation substrate 62 in a plurality of respective regions demarcated in a grid pattern. Further, as illustrated in FIG. 4, a communication hole 66 vertically extending (penetrating through the ultraviolet irradiation substrate 62 from a front surface to a back surface thereof) is defined in each region of the ultraviolet irradiation substrate 62 where no ultraviolet irradiation source 64 is disposed. Each of the ultraviolet irradiation sources 64 is connected with a power source 72 through a power source supply circuit 70 connected with a lower surface of the frame portion 121.

The support substrate 122 includes a transparent plate-like member having air permeability, for example, a porous glass. As illustrated in FIG. 3 and FIG. 4, the support substrate 122 is placed on the ultraviolet irradiation means 60 in the frame portion 121 described above, and an upper surface of the support substrate 122 is made flush with an upper surface of the frame portion 121. A suction passage 141 extending through the wafer support table 12 is connected with suction means (not illustrated) generating negative pressure in the suction passage 141, and the negative pressure acts on the wafer

W supported on the upper surface of the support substrate 122 through the adhesive tape T by way of the communication holes 66 of the ultraviolet irradiation substrate 62 and the support substrate 122 having air permeability. It is to be noted that the support substrate 122 does not necessarily include a porous glass having air permeability in its entirety, and can include a normal glass plate having a substantially planar disk shape. In this case, it is sufficient if there are defined a plurality of gaps vertically communicating upper and lower sides of the support substrate 122 in a boundary between an outer periphery portion of the support substrate 122 and the frame portion 121, thereby causing the negative pressure to act on the support substrate 122 through the gaps.

The dicing apparatus 1 according to the present embodiment is generally configured in the manner described above. The following describes a procedure for dividing the wafer W into individual device chips by using the dicing apparatus 1 described above.

Before cutting the wafer W by using the dicing apparatus 1, there is prepared the wafer W supported by the annular frame F having an opening through the adhesive tape T as illustrated in FIG. 5. The wafer W has,

on a front surface W_a thereof, a plurality of devices 4 formed in a plurality of separate respective regions demarcated by a plurality of crossing division lines 6. The adhesive tape T is a tape whose adhesive force is lowered by irradiation with ultraviolet rays and may be, for example, a tape obtained by applying a UV curable adhesive to an attachment surface (a surface to which the wafer W is to be attached) of a sheet-like base material including polyvinyl chloride (PVC), the UV curable adhesive including an acrylic base resin or the like whose adhesive force is lowered through curing by irradiation with ultraviolet rays. It is to be noted that a tape whose adhesive force is lowered by irradiation with ultraviolet rays is well-known, and any tape other than the adhesive tape T described above can be used as long as the tape is of the type whose adhesive force is lowered by irradiation with ultraviolet rays.

The wafer W supported by the annular frame F through the adhesive tape T is thus prepared. The wafer W is then placed on and held under suction by the front surface portion 120 of the wafer support table 12 of the chuck table 10 positioned in the attaching/detaching region A such that the adhesive tape T faces downward, and the annular frame F supporting the wafer W is fixed

by the frame support portions 13. After the wafer W is held on the chuck table 10, the chuck table 10 is moved to the processing region B.

As illustrated in FIG. 6, the spindle unit 22 of the cutting means 20 includes the cutting blade 21 fixed to the distal end portion of the rotary spindle 221 and having a cutting edge on an outer periphery thereof, and a blade cover 223 protecting the cutting blade 21. The cutting blade 21 is, for example, an electroformed grindstone having a diameter of 50 mm and a thickness of 30 μ m. The cutting blade 21 is driven by the spindle motor 23 so as to rotate at a speed of 20,000 rpm, for example. The blade cover 223 has cutting water supplying means 224 at a position adjacent to the cutting blade 21, and the cutting water supplying means 224 supplies a cutting water toward a cutting position to be cut by the cutting blade 21. Before the cutting processing is performed by using the cutting blade 21, alignment is performed in advance by using alignment means not illustrated between the cutting blade 21 and a position to be processed in the wafer W held on the chuck table 10. The alignment means at least includes illuminating means and imaging means both not illustrated such that the division lines 6 on the front surface Wa of the wafer W

can be imaged and detected from the front surface Wa side of the wafer W.

After the alignment is performed by using the alignment means, the cutting blade 21 rotated at high speed together with the rotary spindle 221 is positioned directly above a predetermined position to start processing on the wafer W. The cutting blade 21 is then lowered to cut into the wafer W to such a height position that a lower end of the cutting blade 21 fully cuts the wafer W and slightly reaches the adhesive tape T, and the chuck table 10 supporting the wafer W is moved in one of X-axis directions indicated by an arrow X (processing-feed direction) with respect to the cutting blade 21. The processing-feed speed at this time is, for example, set to 50 mm/sec. Accordingly, as illustrated in FIG. 6, a region in the wafer W corresponding to one of the division lines 6 is cut to form a cut groove 100. While the moving means described above suitably moves the chuck table 10 in the X-axis directions and a direction orthogonal to the X-axis directions, the wafer W is cut along all division lines 6 extending in a predetermined direction on the wafer W by the cutting blade 21 described above, thereby forming cut grooves 100. After the cut groove 100 is formed for all the division lines 6

extending in the predetermined direction on the wafer W, the wafer support table 12 is rotated by 90 degrees, and cut grooves 100 are similarly formed in regions corresponding to division lines 6 extending in a direction orthogonal to the predetermined direction. Accordingly, the cut grooves 100 are formed in the regions corresponding to all the division lines 6 on the wafer W. As a result, as illustrated in FIG. 7, the wafer W having the devices 4 formed on the front surface Wa thereof is divided into individual device chips 4'.

After the cutting processing for forming the cut grooves 100 by using the cutting means 20 is performed in the above described manner, the chuck table 10 is moved in one of the X-axis directions, that is, in a direction from the processing region B side to the attaching/detaching region A side while the cleaning means 40 downwardly ejects a cleaning water 42 at high pressure as illustrated in FIG. 8. The wafer W, the adhesive tape T, and the annular frame F are thereby cleaned, and cutting debris (not illustrated) scattered during the cutting processing is removed. It is to be noted that, as to the ejection of the cleaning water 42 from the cleaning means 40, preferably pneumatic ejection is adopted in which the cleaning water 42 is ejected with

high pressure air in order to increase the cleaning effect.

After the wafer W, the adhesive tape T, and the annular frame F are cleaned as described above, the chuck table 10 is stopped to be positioned in the attaching/detaching region A. After the chuck table 10 is stopped in the attaching/detaching region A, the ultraviolet irradiation sources 64 are operated for a predetermined time period (approximately 30 seconds, for example) as seen in FIG. 9 illustrating a partially enlarged cross-sectional view of the wafer support table 12 and the wafer W. The ultraviolet rays irradiated from the ultraviolet irradiation sources 64, indicated as UV in the drawing, are transmitted through the support substrate 122 including a porous glass, are irradiated to a region of the adhesive tape T corresponding to the wafer W, and reduces the adhesive force of the adhesive tape T in the region. In other words, the adhesive tape T is irradiated with the ultraviolet rays, and the UV curable adhesive coated on a front surface (a surface to which the wafer W is attached) of the adhesive tape T is cured and reduced in adhesive force. It is to be noted that the reduction in adhesive force in this case is to such an extent that the individual device chips 4' on the

adhesive tape T are still held, not such an extent that the adhesive tape T completely loses the adhesive force. Further, the irradiation with the ultraviolet rays is performed immediately after the cleaning by the cleaning means 40 described above, that is, in a state in which the cleaning water 42 remains on the wafer W and the adhesive tape T. In general, a UV curable adhesive whose adhesive force is lowered by irradiation with ultraviolet rays exhibits small reduction in adhesive force if the irradiation with ultraviolet rays is performed in an atmosphere including oxygen. Therefore, as described above, ultraviolet rays are irradiated from a lower surface side of the adhesive tape T with the cleaning water 42 left on the wafer W and the adhesive tape T, so that the adhesive tape T is isolated from the oxygen in the atmosphere and the adhesive force can be efficiently reduced.

After the ultraviolet rays are irradiated from the lower surface side of the adhesive tape T supporting the wafer W and the adhesive force of the adhesive tape T is reduced as described above, the operator holds with his/her hands (indicated as H in the drawing) the annular frame F held on the chuck table 10 positioned in the attaching/detaching region A as illustrated in FIG. 10,

and takes out the wafer W together with the annular frame F through the opening defined for the attaching/detaching region A. Meanwhile, the air blowing means 50 ejects a high pressure air 52 from a lower surface thereof and blows off the cleaning water 42 left on the wafer W, the adhesive tape T, and the annular frame F, obtaining a dry state with moisture removed. It is to be noted that, while FIG. 10 indicates an example in which the wafer W is taken out manually by the operator, it is not limitative and an automatic unloading apparatus including an arm or the like provided with attracting means may be used. The wafer W unloaded from the attaching/detaching region A in the manner described above is transported to a subsequent step (a picking-up step or a bonding step, for example) or transported to and accommodated in a storage cassette (not illustrated) for accommodating the wafer W together with the annular frame F.

As described above, the dicing apparatus 1 according to the present embodiment includes, in the wafer support table 12 configuring the chuck table 10, the ultraviolet irradiation means 60 irradiating ultraviolet rays and reducing the adhesive force of the region of the adhesive tape T corresponding to the wafer W. This eliminates the need for installing an ultraviolet

irradiation apparatus separately from the dicing apparatus 1, thereby saving an installation space for the apparatuses and suppressing the increase in equipment cost. In particular, when the wafer support table 12 includes the support substrate 122 which supports the wafer W and through which ultraviolet rays pass and the ultraviolet irradiation sources 64 are disposed on the back surface side of the support substrate 122, the installation space for the apparatuses can be saved more efficiently.

The present invention is not limited to the details of the above described preferred embodiment. The scope of the invention is defined by the appended claims and all changes and modifications as fall within the equivalence of the scope of the claims are therefore to be embraced by the invention.

WHAT IS CLAIMED IS:

1. A dicing apparatus dividing a wafer having a plurality of devices formed thereon into individual device chips, the wafer being supported by an annular frame through an adhesive tape, comprising:

a chuck table including a wafer support table that supports the wafer thereon, and a plurality of frame support portions which are disposed on an outer periphery of the wafer support table and support the annular frame; and

cutting means performing cutting processing on the wafer supported on the wafer support table;

the wafer support table including ultraviolet irradiation means irradiating ultraviolet rays such that an adhesive force of the adhesive tape in a region corresponding to the wafer is reduced.

2. The dicing apparatus according to claim 1, wherein the wafer support table includes a support substrate which has a front surface portion supporting the wafer thereon and through which ultraviolet rays pass, and

the ultraviolet irradiation means includes an ultraviolet irradiation source disposed on a back surface side of the support substrate.

3. The dicing apparatus according to claim 1,
further comprising:

cleaning means ejecting a cleaning water onto the
wafer, the adhesive tape, and the annular frame supported
on the chuck table for cleaning.