

TAPE MOUNTER

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a tape mouter.

Description of the Related Art

A tape mouter affixes a circular dicing tape to a ring frame having an opening of a diameter larger than the diameter of a wafer and to the wafer positioned in the opening of the ring frame, and thereby integrates the ring frame and the wafer with each other. The wafer is thus set in a state of being able to be handled via the ring frame.

A ring frame holding unit of the tape mouter sucks and holds the lower surface of the ring frame. A wafer holding unit of the tape mouter sucks and holds the lower surface of the wafer within the opening of the ring frame. An affixing unit such as a rolling roller or the like affixes the circular dicing tape to the upper surface of the ring frame and the upper surface of the wafer.

In addition, two first flat surfaces parallel with each other and two second flat surfaces parallel with each other in a direction orthogonal to the first flat

surfaces are formed in the outer circumferential side surface of the ring frame. As disclosed in Japanese Patent Laid-Open No. 2013-082045 or Japanese Patent Laid-Open No. 2011-036968, in order to make the center of the wafer and the center of the opening of the ring frame coincide with each other, the ring frame holding unit pinches the pair of first flat surfaces and the pair of second flat surfaces of the ring frame from the outer circumference side of the ring frame, and thereby positions (centers) the ring frame at a target position.

The diameter of the dicing tape affixed to the wafer and the ring frame positioned as described above is larger than the inside diameter of the ring frame (the diameter of the opening of the ring frame) and is equal to or less than the outside diameter of the ring frame. The dicing tape is affixed to the ring frame such that the center of the dicing tape and the center of the opening of the ring frame coincide with each other, and further the center of the dicing tape coincides also with the center of the wafer within the opening of the ring frame (see Japanese Patent Laid-Open No. 2016-008104, for example).

SUMMARY OF THE INVENTION

A dicing apparatus that dices the wafer by a cutting blade lowers and holds the ring frame such that the upper surface of the ring frame is lower than the holding surface of a chuck table holding the wafer. The cutting blade is thus prevented from coming into contact with the ring frame. Here, when the dicing tape is affixed in a state in which the center of the dicing tape and the center of the ring frame are displaced from each other, the dicing tape is peeled off the ring frame at a time that the ring frame is lowered and held.

It is accordingly an object of the present invention to provide a tape mounter that can check whether or not the dicing tape is affixed such that the center of the dicing tape coincides with the center of the ring frame after the dicing tape is affixed to the ring frame.

In accordance with an aspect of the present invention, there is provided a tape mounter including a ring frame holding table configured to hold a ring frame, a wafer holding table configured to hold a wafer within an opening of the ring frame, an affixing unit configured to affix a circular tape to an upper surface of the ring frame held on the ring frame holding table and an upper surface of the wafer held on the wafer holding table, a

sensor including a light emitting unit configured to emit measurement light to a measurement point in a region in which the tape is to be affixed on the upper surface of the ring frame and a light receiving unit configured to receive reflected light reflected at the measurement point, a setting section configured to set a reference value for a received light amount received by the light receiving unit, and a determining section configured to determine that the tape is affixed to the measurement point when the received light amount received by the light receiving unit is smaller than the reference value, and determine that the tape is not affixed to the measurement point when the received light amount received by the light receiving unit is equal to or more than the reference value.

The tape mounter may further include a storage section configured to store a value of the received light amount when the light receiving unit receives reflected light formed by reflecting the measurement light by the upper surface of the ring frame, and the setting section may set the value stored in the storage section as the reference value.

The sensor may include the light emitting unit configured to emit the measurement light to the

measurement point from an obliquely upward direction with respect to the upper surface of the ring frame, a retroreflective plate disposed at a position symmetric to the light emitting unit with respect to the measurement point and configured to reflect the measurement light reflected at the measurement point to the measurement point, and the light receiving unit configured to receive, in a vicinity of the light emitting unit, reflected light formed by further reflecting, at the measurement point, the reflected light reflected by the retroreflective plate.

The sensor may include the light emitting unit configured to emit the measurement light to the measurement point from an obliquely upward direction with respect to the upper surface of the ring frame, and the light receiving unit disposed at a position symmetric to the light emitting unit with respect to the measurement point and configured to receive the reflected light reflected at the measurement point.

The tape mounter according to one aspect of the present invention includes the sensor including the light emitting unit configured to emit the measurement light to the measurement point in the region in which the tape is to be affixed on the upper surface of the ring frame and

the light receiving unit configured to receive the reflected light reflected at the measurement point, the setting section configured to set the reference value for the received light amount received by the light receiving unit, and the determining section. The determining section determines that the tape (for example a dicing tape) is affixed to the measurement point when the received light amount received by the light receiving unit is smaller than the reference value. The determining section determines that the tape is not affixed to the measurement point when the received light amount received by the light receiving unit is equal to or more than the reference value. The tape mouter can therefore check whether or not the tape is affixed such that the center of the tape coincides with the center of the ring frame.

Conventionally, a part of the ring frame to which part the tape is not affixed can be checked by a transmission type sensor, but it is not possible to check whether or not the tape is affixed such that the center of the tape coincides with the center of the ring frame, or in other words, whether or not there is a part in which the affixation area of the tape is partly decreased on the periphery of the opening of the ring frame. However, the tape mouter according to one aspect of the

present invention, for example, sets the measurement point to be measured by the sensor within a region slightly outward of the opening of the ring frame (region in which the tape is to be affixed). Thus, when there is a part in which the affixation area of the tape affixed to the ring frame is decreased (a part in which the tape is not affixed to the measurement point), the received light amount of the reflected light received from the ring frame by the light receiving unit is equal to or more than the reference value. The determining section can therefore determine that there is a part in which the affixation area of the tape is partly decreased, and that there is a part in which the tape may be easily peeled off the ring frame.

In the case where the tape mounter further includes the storage section configured to store a value of the received light amount when the light receiving unit receives reflected light formed by reflecting the measurement light by the upper surface of the ring frame, and the setting section sets the value stored in the storage section as a reference value, it is possible to appropriately set, in the tape mounter, the reference value for the determining section to determine whether or not the dicing tape is affixed such that the center of

the dicing tape coincides with the center of the ring frame.

In the case where the sensor includes the light emitting unit configured to emit the measurement light to the measurement point from an obliquely upward direction with respect to the upper surface of the ring frame, the retroreflective plate disposed at a position symmetric to the light emitting unit with respect to the measurement point and configured to reflect the measurement light reflected at the measurement point to the measurement point, and the light receiving unit configured to receive, in the vicinity of the light emitting unit, reflected light formed by further reflecting, at the measurement point, the reflected light reflected by the retroreflective plate, the determining section can determine that the tape is affixed to the measurement point when the received light amount received by the light receiving unit is smaller than the reference value, and the determining section can determine that the tape is not affixed to the measurement point when the received light amount received by the light receiving unit is equal to or more than the reference value, irrespective of whether the dicing tape is a transparent tape or an opaque tape. The determining section can thus determine

whether or not the dicing tape is affixed such that the center of the dicing tape coincides with the center of the ring frame.

In the case where the sensor includes the light emitting unit configured to emit the measurement light to the measurement point from an obliquely upward direction with respect to the upper surface of the ring frame, and the light receiving unit disposed at a position symmetric to the light emitting unit with respect to the measurement point and configured to receive the reflected light reflected at the measurement point, the determining section can determine that the tape is affixed to the measurement point when the received light amount received by the light receiving unit is smaller than the reference value, and the determining section can determine that the tape is not affixed to the measurement point when the received light amount received by the light receiving unit is equal to or more than the reference value, even when the dicing tape is an opaque tape. The determining section can thus determine whether or not the dicing tape is affixed such that the center of the dicing tape coincides with the center of the ring frame.

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 preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view depicting an example of a tape mounter;

FIG. 2 is a perspective view depicting an example of a ring frame holding table and a wafer holding table;

FIG. 3 is a side view of assistance in explaining a state in which a tape is starting to be affixed to a ring frame and a wafer in the tape mounter;

FIG. 4 is a side view of assistance in explaining a state in which the tape has started to be affixed to the ring frame and the wafer in the tape mounter;

FIG. 5 is a side view of assistance in explaining a state in which a wafer set is fabricated with the tape affixed to the ring frame and the wafer in the tape mounter;

FIG. 6 is a plan view of assistance in explaining a case where the tape is affixed to the ring frame such that the center of the tape coincides with the center of

the ring frame on the ring frame holding table located below a sensor according to a first embodiment;

FIG. 7 is a plan view of assistance in explaining a case where the tape is affixed to the ring frame such that the center of the tape is displaced from the center of the ring frame on the ring frame holding table located below the sensor according to the first embodiment;

FIG. 8 is a diagram of assistance in explaining a state in which a light emitting unit in the sensor according to the first embodiment irradiates a first measurement point with measurement light and a light receiving unit receives reflected light in the case where the center of the tape coincides with the center of the ring frame;

FIG. 9 is a graph depicting received light amounts of the light receiving unit of the sensor according to the first embodiment;

FIG. 10 is a diagram of assistance in explaining a state in which the light emitting unit in the sensor according to the first embodiment irradiates the first measurement point with the measurement light and the light receiving unit receives reflected light in the case where the center of the tape is displaced from the center of the ring frame;

FIG. 11 is a diagram of assistance in explaining a state in which the light emitting unit in the sensor according to the first embodiment irradiates a second measurement point with the measurement light and the light receiving unit receives reflected light in the case where the center of the tape is displaced from the center of the ring frame;

FIG. 12 is a plan view of assistance in explaining a case where the tape is affixed to the ring frame such that the center of the tape coincides with the center of the ring frame on the ring frame holding table located below a sensor according to a second embodiment;

FIG. 13 is a diagram of assistance in explaining a state in which a light emitting unit in the sensor according to the second embodiment irradiates the first measurement point with the measurement light and a light receiving unit hardly receives reflected light in the case where the center of the tape coincides with the center of the ring frame;

FIG. 14 is a graph depicting received light amounts of the light receiving unit of the sensor according to the second embodiment;

FIG. 15 is a plan view of assistance in explaining a case where the tape is affixed to the ring frame such

that the center of the tape is displaced from the center of the ring frame on the ring frame holding table located below the sensor according to the second embodiment;

FIG. 16 is a diagram of assistance in explaining a state in which the light emitting unit in the sensor according to the second embodiment irradiates the first measurement point with the measurement light and the light receiving unit receives reflected light in the case where the center of the tape is displaced from the center of the ring frame; and

FIG. 17 is a diagram of assistance in explaining a state in which the light emitting unit in the sensor according to the second embodiment irradiates the second measurement point with the measurement light and the light receiving unit hardly receives reflected light in the case where the center of the tape is displaced from the center of the ring frame.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A tape mounter 1 according to one aspect of the present invention which tape mounter is depicted in FIG. 1 includes a base 10 on which inventive constituent elements to be described later are arranged and whose longitudinal direction is an X-axis direction. The upper

surface of the base 10 is a horizontal surface. A tape roll TR is disposed above the rear side (+X direction side) of the base 10.

The tape roll TR has a structure formed by bonding an adhesive tape in a band shape and a sheet T1 in a band shape to each other. The adhesive tape includes, for example, a substrate formed by a polyolefin resin or the like and an adhesive layer on the substrate. The sheet T1 is affixed to the adhesive layer side. The adhesive tape is cut in advance into a plurality of circular shapes corresponding to the diameter of a ring frame F as an affixing target. A plurality of tapes T2 (dicing tapes T2) formed by precutting the adhesive tape are affixed to the sheet T1 at equal intervals in the longitudinal direction of the sheet T1. Incidentally, the materials and the like of the tapes T2 and the sheet T1 are not particularly limited. For example, while the tapes T2 in the present embodiment are tapes transparent to visible light, the tapes T2 may be tapes colored and opaque to visible light.

As depicted in FIG. 1, the tape roll TR is wound in a roll shape around a roll tube 19 with the tapes T2 on the inside. The diameter of the tapes T2 is larger than the inside diameter of a circular opening Fc of the ring

frame F (see FIG. 2), and is smaller than the outside diameter of the ring frame F.

As depicted in FIG. 2, the ring frame F is formed of a predetermined metal (for example, stainless steel (SUS) or the like) and formed in the shape of an annular flat plate, and the ring frame F has the circular opening Fc whose inside diameter is larger than the outside diameter of a wafer W. In addition, the ring frame F has two first flat surfaces Fd parallel with each other and two second flat surfaces Fe parallel with each other in a direction orthogonal to the first flat surfaces Fd, the two first flat surfaces Fd and the two second flat surfaces Fe being formed by cutting away a part of the outer circumference of the ring frame F in a flat manner, for example. The first flat surfaces Fd and the second flat surfaces Fe are used for positioning of the ring frame F.

The wafer W is, for example, a circular semiconductor wafer formed of a silicon base material or the like. A front surface Wa (lower surface Wa) of the wafer W which front surface Wa is oriented downward in FIG. 1 has a plurality of devices formed in regions demarcated in a lattice manner, and is protected by affixing a protective tape not depicted to the front

surface Wa. A back surface Wb (upper surface Wb) of the wafer W is a surface to which to affix a tape T2. Incidentally, the wafer W may be formed by gallium arsenide, sapphire, gallium nitride, ceramics, resin, silicon carbide, or the like other than silicon, or may be a rectangular package substrate or the like.

Disposed at a position obliquely below the tape roll TR depicted in FIG. 1 is a peeling plate 15 that bends the sheet T1 being drawn out and thereby peels off the tapes T2 from the sheet T1. The peeling plate 15 is, for example, an inclined plate having a triangular shape as viewed from a side in a Y-axis direction. The peeling plate 15 extends in the Y-axis direction with a length equal to or more than the width (length in the Y-axis direction) of the sheet T1. As depicted in FIG. 3 and FIG. 4, the peeling plate 15 can peel the tapes T2 off the sheet T1 by pressing the sheet T1 by a front end side of the peeling plate 15 and thus bending the sheet T1 at an acute angle.

As depicted in FIG. 1 and FIG. 3, the sheet T1 from which the tapes T2 are peeled by the peeling plate 15 is fed to the rear of the peeling plate 15 (+X direction). The sheet T1 is then wound into a roll shape by a sheet winding roller 16 rotated about a rotational axis in the

Y-axis direction by a rotation driving source such as a motor or the like. The rotation driving source of the sheet winding roller 16, for example, controls the speed of extraction of the sheet T1 from the tape roll TR by torque control.

A sheet supporting roller 160 is disposed between the sheet winding roller 16 and the peeling plate 15. The sheet supporting roller 160 prevents the sheet T1 from which the tapes T2 are peeled from being loose.

The tape mounter 1 includes a ring frame holding table 20 that holds the ring frame F, a wafer holding table 21 that holds the wafer W within the opening Fc of the ring frame F, and an affixing unit (affixing means) 22 that affixes a circular tape T2 to an upper surface Fa of the ring frame F held on the ring frame holding table 20 and the upper surface Wb of the wafer W held on the wafer holding table 21.

The ring frame holding table 20 depicted in FIG. 2 is, for example, formed in a square shape as viewed in plan. The ring frame holding table 20 houses the wafer holding table 21 within a recessed portion 200 formed in the center of the ring frame holding table 20. An upper surface 20a of the ring frame holding table 20 is a ring frame holding surface as a flat surface. The upper

surface 20a of the ring frame holding table 20 is provided with, for example, four recess suction cup housing portions 201 having an opening. Suction cups 25 that can suck the ring frame F are respectively arranged in these four suction cup housing portions 201. The suction cups 25 are, for example, obtained by forming an elastic material such as a deformable rubber or the like in a circular shape as viewed in plan. Each of the suction cups 25 communicates with a suction source not depicted, such as a vacuum generating apparatus or the like.

Incidentally, the external shape, structure, and the like of the ring frame holding table 20 are not limited to those of the present embodiment.

A first fixed positioning unit 23 and a first movable positioning unit 24 opposite to the first fixed positioning unit 23 for positioning (centering) the ring frame F on the upper surface 20a are arranged in the upper surface 20a of the ring frame holding table 20. Further, a second fixed positioning unit 26 and a second movable positioning unit 27 opposite to the second fixed positioning unit 26 are arranged in the upper surface 20a.

A direction in which the first fixed positioning unit 23 and the first movable positioning unit 24 are

opposite to each other and a direction in which the second fixed positioning unit 26 and the second movable positioning unit 27 are opposite to each other are, for example, substantially orthogonal to each other.

The first fixed positioning unit 23, for example, includes two cylindrical first fixed pins 23a and 23b. As viewed in plan, the first fixed pin 23a and the first fixed pin 23b are arranged so as to be symmetric to each other with a center line of the ring frame holding table 20 as a symmetry axis, the center line being parallel with the X-axis direction.

The first movable positioning unit 24, for example, includes a cylindrical first movable pin 24a, a first movable block 24b supporting the first movable pin 24a, and a cylinder not depicted, which moves the first movable block 24b in the X-axis direction.

The second fixed positioning unit 26, for example, includes two cylindrical second fixed pins 26a and 26b. As viewed in plan, the second fixed pin 26a and the second fixed pin 26b are arranged so as to be symmetric to each other with a center line of the ring frame holding table 20 as a symmetry axis, the center line being parallel with the Y-axis direction.

The second movable positioning unit 27, for example,

includes a cylindrical second movable pin 27a, a second movable block 27b supporting the second movable pin 27a, and a cylinder not depicted, which moves the second movable block 27b in the Y-axis direction.

In the present embodiment, at least either the first fixed positioning unit 23 and the first movable positioning unit 24 or the second fixed positioning unit 26 and the second movable positioning unit 27 position (center) the ring frame F at a target position on the upper surface 20a of the ring frame holding table 20 by pinching at least either the two first flat surfaces Fd or the two second flat surfaces Fe of the ring frame F. The center of the opening Fc of the ring frame F centered on the ring frame holding table 20 and the center of a holding surface 210a of the wafer holding table 21 substantially coincide with each other. The ring frame F is thereafter sucked and held by each suction cup 25.

The wafer holding table 21, for example, has a circular external shape. The wafer holding table 21 includes a sucking portion 210 formed by a porous member or the like and configured to suck the wafer W, and a frame body 211 having a recessed shape in vertical section and configured to support the sucking portion 210. The sucking portion 210 is in a state of being fitted in the

recessed portion of the frame body 211 communicates with a suction source not depicted. When a suction force produced by the suction source is transmitted to the holding surface 210a, which is the upper surface of the sucking portion 210 and is a flat surface, the wafer holding table 21 sucks and holds the wafer W on the holding surface 210a.

The height of the upper surface 20a of the ring frame holding table 20 is, for example, set such that the upper surface Fa of the ring frame F and the upper surface Wb of the wafer W are at substantially a same height when the wafer W is held by the holding surface 210a of the wafer holding table 21 and the ring frame F is held by the upper surface 20a of the ring frame holding table 20.

As depicted in FIG. 1, a table moving mechanism (table moving means) 13 that reciprocates the wafer holding table 21 and the ring frame holding table 20 in the X-axis direction is disposed on the base 10. The table moving mechanism 13 includes a ball screw 130 having an axis in the X-axis direction, guide rails 131 arranged in parallel with the ball screw 130, and a motor 132 coupled to the ball screw 130 to rotate the ball screw 130. A nut not depicted that is provided to the

lower surface side of the ring frame holding table 20 is screwed on the ball screw 130. When the motor 132 rotates the ball screw 130, the wafer holding table 21 and the ring frame holding table 20 are correspondingly reciprocated in the X-axis direction while guided by the guide rails 131.

The affixing unit 22 is disposed at a position above the movement path of the ring frame holding table 20 and in the vicinity of the front end of the peeling plate 15. The affixing unit 22 is, for example, a rotatable affixing roller having a length equal to or more than the width in the Y-axis direction of the ring frame holding table 20. The affixing unit 22 is, for example, disposed so as to traverse the ring frame holding table 20 in the Y-axis direction, and is movable in an upward-downward direction by moving means not depicted. Incidentally, the affixing unit 22 may not be movable in the upward-downward direction.

The ring frame F is sucked and held on the ring frame holding table 20 in a state in which the ring frame F is centered, and the wafer W is sucked and held on the wafer holding table 21 in a state in which the center of the wafer W substantially coincides with the center of the holding surface 210a. Then, as depicted in FIG. 4 and

FIG. 5, the table moving mechanism 13 moves the ring frame holding table 20 in a -X direction and thereby passes the ring frame holding table 20 below the affixing unit 22. As a result, the tape T2 peeled off the sheet T1 by the peeling plate 15 is pressed by the affixing unit 22 against the upper surface Fa of the ring frame F held on the ring frame holding table 20 and the upper surface Wb of the wafer W held on the wafer holding table 21 from the upper side of the tape T2 which upper side is a substrate surface side. The tape T2 is thereby affixed to the ring frame F and the wafer W positioned within the opening Fc of the ring frame F. Then, a wafer set depicted in FIG. 5 which wafer set includes the wafer W, the tapes T2, and the ring frame F is fabricated, which enables the wafer W to be handled via the ring frame F.

In order to check whether or not the tape T2 is affixed such that the center of the tape T2 coincides with the center of the ring frame F (the center of the opening Fc) after the wafer set is formed as described above, as depicted in FIG. 1, FIG. 5, and FIG. 6, the tape mounter 1 includes a sensor 6 including a light emitting unit 60 (depicted only in FIG. 6) that emits measurement light to a measurement point in a region in which the tape T2 is to be affixed on the upper surface

Fa of the ring frame F and a light receiving unit 61 (depicted only in FIG. 6) that receives reflected light reflected at the measurement point, a setting section 90 that sets a reference value for a received light amount received by the light receiving unit 61, and a determining section 92 that determines whether or not the tape T2 is affixed such that the center of the tape T2 coincides with the center of the ring frame F (the center of the opening Fc).

The sensor 6 will hereinafter be referred to as a sensor 6 according to a first embodiment.

FIG. 6 illustrates a case where the tape T2 is affixed such that the center of the tape T2 coincides with the center of the ring frame F (the center of the opening Fc). FIG. 7 illustrates a case where the tape T2 is affixed such that the center of the tape T2 does not coincide with the center of the ring frame F, that is, a case where the center of the tape T2 is displaced to the +X direction side with respect to the center of the ring frame F in an example depicted in the figure.

As depicted in FIG. 6, measurement points that are set on the upper surface Fa of the ring frame F and to which the sensor 6 emits the measurement light are, for example, a first measurement point P1 and a second

measurement point P2 set in a region in which the tape T2 is to be affixed on the periphery of the opening Fc. The region in which the tape T2 is to be affixed is determined experimentally, empirically, or theoretically, and corresponds to an annular region of the tape T2 which annular region is affixed to the ring frame F in the case where the tape T2 is affixed such that the center of the tape T2 coincides with the center of the ring frame F (the center of the opening Fc). The first measurement point P1 and the second measurement point P2 are, for example, preferably set at positions as midpoints of the width of the annular region of the tape T2 which annular region is affixed to the ring frame F.

The measurement points are at least two measurement points, that is, the first measurement point P1 and the second measurement point P2 set symmetrically with respect to the center of the opening Fc of the ring frame F in the X-axis direction as a feed direction of the sheet T1 depicted in FIG. 1.

Incidentally, as measurement points, in addition to the first measurement point P1 and the second measurement point P2 described above, a third measurement point P3 and a fourth measurement point P4 depicted in FIG. 6 may be further set so as to be symmetric with respect to the

center of the opening Fc in the Y-axis direction orthogonal in a horizontal plane to the X-axis direction as the feed direction of the sheet T1, which feed direction is indicated in FIG. 6. Incidentally, the third measurement point P3 and the fourth measurement point P4 may not be set because affixation displacement of the tape T2 with respect to the ring frame F does not occur very often in the Y-axis direction orthogonal to the feed direction of the sheet T1.

The sensor 6 depicted in FIG. 1, FIG. 5, and FIG. 6 is, for example, disposed above the ring frame holding table 20 in a state of having been moved in the -X direction to a position beyond the affixing unit 22, and disposed so as to be opposed to the upper surface 20a of the ring frame holding table 20 in a Z-axis direction.

The sensor 6 according to the first embodiment is, for example, a retroreflective photoelectric sensor. The sensor 6 according to the first embodiment includes the light emitting unit 60 that emits the measurement light to the measurement point from an obliquely upward direction with respect to the upper surface Fa of the ring frame F, a retroreflective plate 62 that is disposed at, for example, a position symmetric to the light emitting unit 60 with respect to the measurement point

and reflects the measurement light reflected at the measurement point to the measurement point (retroreflection), and the light receiving unit 61 that receives, in the vicinity of the light emitting unit 60, reflected light formed by further reflecting, at the measurement point, the reflected light reflected by the retroreflective plate 62.

Incidentally, when a spot type laser beam is used as the measurement light, the measurement light in the form of a fine line is applied to the measurement point, and facilitates determination of whether or not the tape T2 is affixed to the measurement point.

As depicted in FIG. 6 and FIG. 8, the sensor 6, for example, has a casing 63 that can block extraneous light and is provided with an opening 630 on a lower side of the casing 63, the opening 630 allowing the measurement light L1 to pass through. The casing 63, for example, extends in the Y-axis direction orthogonal to the X-axis direction as the direction of movement of the ring frame holding table 20 by the table moving mechanism 13.

The light emitting unit 60 and the light receiving unit 61 are, for example, arranged side by side in a part on the +Y direction side of the casing 63 in FIG. 6 and FIG. 8. The light emitting unit 60, for example, includes

a laser oscillator, a lens, and the like. The light emitting unit 60 can linearly apply a low-power laser beam in the form of a fine line in an obliquely downward direction. The laser beam applied by the light emitting unit 60 enters the ring frame F located below the sensor 6 at a predetermined angle of incidence. Incidentally, the angle of incidence of the laser beam and the height position of a condensing point of the laser beam, for example, may be adjustable by adjusting means not depicted. The light receiving unit 61 is, for example, formed by a light receiving element such as a charge-coupled device (CCD) or the like.

The first measurement point P1 and the second measurement point P2 set on the ring frame F in a state of being centered on the upper surface 20a of the ring frame holding table 20 are, for example, positioned on a center line of the ring frame holding table 20 which center line is parallel with the X-axis direction. The retroreflective plate 62 such as a mirror or the like is, for example, disposed in a part on the -Y direction side of the casing 63 with the center line of the ring frame holding table 20 as a symmetry axis, the center line being parallel with the X-axis direction. When the ring frame holding table 20 is moved in the -X direction by

the table moving mechanism 13 depicted in FIG. 1, and the first measurement point P1 is positioned on the optical axis of the light emitting unit 60, the retroreflective plate 62 is disposed at a position symmetric to the light emitting unit 60 in the Y-axis direction with respect to the first measurement point P1.

As depicted in FIG. 1, for example, the tape mounter 1 includes a control unit (control means) 9 including a central processing unit (CPU) or the like, which control unit controls the whole of the apparatus, that is, controls operation of each constituent element such as the table moving mechanism 13, the first movable positioning unit 24, the second movable positioning unit 27, the sheet winding roller 16, the sensor 6, and the like described above. In the present embodiment, the control unit 9 includes the setting section 90 that sets a reference value for the received light amount received by the light receiving unit 61 and the determining section 92 that determines whether or not the tape is affixed to the measurement point.

The tape mounter 1 in the present embodiment includes a storage section 95 that stores a received light amount when the light receiving unit 61 receives reflected light L2 formed by reflecting the measurement

light L1 by the upper surface Fa of the ring frame F, that is, the reflected light L2 reflected by the upper surface Fa of the ring frame F in a state in which the tape T2 is not affixed to the ring frame F, for example. The storage section 95 is, for example, included in the control unit 9, and includes a read-only memory (ROM) storing a control program, processing information set in advance, and the like, a random-access memory (RAM) storing a measurement result of the sensor 6, and the like.

In the following, description will be made of a case where the tape mounter 1 determines whether or not the tape T2 is affixed such that the center of the tape T2 of the wafer set formed by the wafer W, the ring frame F, and the tape T2 coincides with the center of the ring frame F (the center of the opening Fc).

The control unit 9 depicted in FIG. 1 always grasps the X-axis coordinate position of the ring frame holding table 20 on the tape mounter 1 by controlling the table moving mechanism 13. The ring frame holding table 20 fed in the -X direction by the table moving mechanism 13 depicted in FIG. 1 passes the affixing unit 22. As depicted in FIG. 5, after the tape T2 is affixed to the ring frame F, the ring frame holding table 20 further

moves in the -X direction to a predetermined coordinate position in the X-axis direction.

The ring frame F is centered on the ring frame holding table 20. Thus, when the ring frame holding table 20 moves to the predetermined coordinate position in the X-axis direction, the control unit 9 determines that the first measurement point P1 is positioned at a coordinate position grasped in advance in the X-axis direction, that is, on the optical axis of the light emitting unit 60 of the sensor 6, as depicted in FIG. 6 and FIG. 8. Then, an operating signal is sent from the control unit 9 to the sensor 6 electrically connected to the control unit 9. The light emitting unit 60 of the sensor 6 emits the measurement light L1 in the form of a fine line to the first measurement point P1 from an obliquely upward direction with respect to the upper surface Fa of the ring frame F.

When the tape T2 is affixed such that the center of the tape T2 coincides with the center of the ring frame F, as depicted in FIG. 6, the measurement light L1 passes through the tape T2, and is reflected at the first measurement point P1 on the upper surface Fa of the ring frame F, as depicted in FIG. 8. The measurement light L1 reflected at the first measurement point P1 on the upper

surface Fa of the ring frame F is reflected by the retroreflective plate 62 disposed at a position symmetric to the light emitting unit 60 in the Y-axis direction with respect to the first measurement point P1, is reflected at the first measurement point P1 again, and is received by the light receiving unit 61 in the vicinity of the light emitting unit 60. A received light amount V2 depicted in FIG. 9 which light amount is received by the light receiving unit 61 as a result of the light emission to the first measurement point P1 is stored in, for example, the RAM of the storage section 95 of the control unit 9 depicted in FIG. 8.

When the ring frame holding table 20 depicted in FIG. 6 and FIG. 8 further moves in the -X direction, the control unit 9 determines that the second measurement point P2 is positioned at the coordinate position grasped in advance in the X-axis direction, that is, on the optical axis of the light emitting unit 60 of the sensor 6. Then, the light emitting unit 60 of the sensor 6 emits the measurement light L1 in the form of a fine line to the second measurement point P2 from an obliquely upward direction with respect to the upper surface Fa of the ring frame F.

When the tape T2 is affixed such that the center of

the tape T2 coincides with the center of the ring frame F as depicted in FIG. 6, the measurement light L1 passes through the tape T2, and is reflected at the second measurement point P2 on the upper surface Fa of the ring frame F. The measurement light L1 reflected by the upper surface Fa of the ring frame F is reflected by the retroreflective plate 62 disposed at a position symmetric to the light emitting unit 60 in the Y-axis direction with respect to the second measurement point P2, is reflected at the second measurement point P2 again, and is received by the light receiving unit 61 in the vicinity of the light emitting unit 60. A received light amount received by the light receiving unit 61 as a result of the light emission to the second measurement point P2 is the received light amount V2 depicted in FIG. 9.

A received light amount V1 depicted in FIG. 9, for example, is a received light amount when the light receiving unit 61 receives the reflected light L2 reflected by the upper surface Fa of the ring frame F, the received light amount obtained by a past experiment or the like and stored in the ROM of the storage section 95, that is, in the present embodiment, a received light amount when the retroreflective plate 62 reflects the

measurement light L1 emitted from the light emitting unit 60 to the upper surface Fa of the ring frame F and reflected by the upper surface Fa of the ring frame F and the light receiving unit 61 receives the reflected light L2 reflected by the retroreflective plate 62.

The setting section 90 depicted in FIG. 8 in the present embodiment sets, in the determining section 92, the received light amount V1 stored in the storage section 95 as a reference value V1 for a received light amount received by the light receiving unit 61, the reference value V1 being used for the determining section 92 to determine whether or not the tape T2 is affixed such that the center of the tape T2 coincides with the center of the ring frame F.

The determining section 92 compares each of the received light amount V2 received by the light receiving unit 61 as a result of the light emission to the first measurement point P1, the received light amount V2 being obtained previously and stored in the RAM of the storage section 95, and the received light amount V2 received by the light receiving unit 61 as a result of the light emission to the second measurement point P2 with the received light amount V1 (reference value V1) stored in the storage section 95. Here, the received light amount

V2 is the amount of the reflected light L2 received by the light receiving unit 61 after undergoing attenuation as a result of the passage of the measurement light L1 applied by the light emitting unit 60 through the tape T2. The received light amount V2 is thus a smaller value than the received light amount V1.

Hence, the determining section 92 determines that the received light amount V2 received by the light receiving unit 61 as a result of the light emission to the first measurement point P1 depicted in FIG. 6 and the received light amount V2 received by the light receiving unit 61 as a result of the light emission to the second measurement point P2 are each smaller than the received light amount V1 as a reference value. Thus, the determining section 92 determines that the tape T2 is affixed to the first measurement point P1 and the second measurement point P2 on the upper surface Fa of the ring frame F, and determines that the tape T2 is affixed such that the center of the tape T2 coincides with the center of the ring frame F.

Incidentally, while the above-described determination is made on the basis of the application of the measurement light L1 to the first measurement point P1 and the second measurement point P2 in the present

embodiment, the determining section 92 may make the above-described determination in consideration also of data further obtained by the application of the measurement light L1 to the third measurement point P3 and the fourth measurement point P4 by the sensor 6.

In the present embodiment, the tape T2 is a transparent tape. However, in a case where the tape T2 is an opaque tape (colored tape), the received light amount received by the light receiving unit 61 as a result of the light emission to the first measurement point P1 depicted in FIG. 6 is a received light amount V3 depicted in FIG. 9. In addition, the received light amount received by the light receiving unit 61 as a result of the light emission to the second measurement point P2 depicted in FIG. 6 is the received light amount V3 depicted in FIG. 9. The received light amount V3 is the amount of the reflected light L2 received by the light receiving unit 61 after the measurement light L1 applied by the light emitting unit 60 undergoes absorption and scattering by the opaque tape. The received light amount V3 is therefore a value smaller than the received light amount V1 and the received light amount V2. Hence, the determining section 92 determines that the received light amount V3 received by the light receiving unit 61 as a

result of the light emission to the first measurement point P1 and the received light amount V3 received by the light receiving unit 61 as a result of the light emission to the second measurement point P2 are each smaller than the received light amount V1 as a reference value. Thus, the determining section 92 can determine that the tape T2 is affixed to the first measurement point P1 and the second measurement point P2, and determine that the tape T2 is affixed such that the center of the tape T2 coincides with the center of the ring frame F.

After the above-described determination by the determining section 92 depicted in FIG. 8 is made, the wafer set is, for example, housed in a wafer cassette by transfer means not depicted. The wafer cassette has a plurality of shelves. Wafer sets are housed on the shelves one by one.

Description will be made of determination of the determining section 92 in a case where the tape T2 is affixed such that the center of the tape T2 of the wafer set does not coincide with the center of the ring frame F (the center of the opening Fc), as depicted in FIG. 7, for example.

As depicted in FIG. 7, when the ring frame holding table 20 moves to the predetermined coordinate position

in the X-axis direction, the control unit 9 determines that the first measurement point P1 is positioned at the coordinate position grasped in advance in the X-axis direction, that is, positioned on the optical axis of the light emitting unit 60 of the sensor 6, as depicted in FIG. 7 and FIG. 10. Then, an operating signal is sent from the control unit 9 to the sensor 6. The light emitting unit 60 emits the measurement light L1 in the form of a fine line to the first measurement point P1 from an obliquely upward direction with respect to the upper surface Fa of the ring frame F.

As depicted in FIG. 10, when the light emitting unit 60 emits the measurement light L1 in the form of a fine line to the first measurement point P1 from an obliquely upward direction with respect to the upper surface Fa of the ring frame F, the measurement light L1 is directly reflected at the first measurement point P1 on the upper surface Fa of the ring frame F because the tape T2 is not present on the first measurement point P1. The measurement light L1 reflected by the upper surface Fa of the ring frame F is reflected by the retroreflective plate 62, is reflected at the first measurement point P1 again, and is received by the light receiving unit 61 in the vicinity of the light emitting

unit 60. A received light amount received by the light receiving unit 61 is, for example, the received light amount V1 depicted in FIG. 9. This is because attenuation attendant on the passage of the measurement light L1 through the tape T2 does not occur. The received light amount V1 is stored in the RAM of the storage section 95 of the control unit 9.

When the ring frame holding table 20 depicted in FIG. 7 is further moved in the -X direction, and is moved to a predetermined coordinate position in the X-axis direction, the control unit 9 determines that the second measurement point P2 is positioned on the optical axis of the light emitting unit 60 of the sensor 6, as depicted in FIG. 11. The light emitting unit 60 of the sensor 6 then emits the measurement light L1 in the form of a fine line to the second measurement point P2 from an obliquely upward direction with respect to the upper surface Fa of the ring frame F.

As depicted in FIG. 7, the center of the tape T2 is displaced to the +X direction side with respect to the center of the ring frame F. Thus, as depicted in FIG. 11, the measurement light L1 passes through the tape T2, and is reflected at the second measurement point P2 on the upper surface Fa of the ring frame F. The measurement

light L1 reflected by the upper surface Fa of the ring frame F is reflected by the retroreflective plate 62, is reflected at the second measurement point P2 again, and is received by the light receiving unit 61 in the vicinity of the light emitting unit 60. The received light amount received by the light receiving unit 61 as a result of the light emission to the second measurement point P2 is the amount of the reflected light L2 received by the light receiving unit 61 after undergoing attenuation as a result of the passage of the measurement light L1 applied by the light emitting unit 60 through the tape T2, and is therefore the received light amount V2 depicted in FIG. 9.

The determining section 92 compares each of the received light amount V1 received by the light receiving unit 61 as a result of the light emission to the first measurement point P1, the received light amount V1 being stored in the RAM of the storage section 95, and the received light amount V2 received by the light receiving unit 61 as a result of the light emission to the second measurement point P2 with the received light amount V1 as a reference value stored in the ROM of the storage section 95. Then, the determining section 92 determines that the received light amount V1 received by the light

receiving unit 61 as a result of the light emission to the first measurement point P1 is equal to or more than the received light amount V1 as a reference value (that is, the same as the received light amount V1). Thus, the determining section 92 determines that the tape T2 is not affixed to the first measurement point P1, and determines that the tape T2 is affixed such that the center of the tape T2 does not coincide with the center of the ring frame F.

Incidentally, while the above-described determination is made on the basis of the application of the measurement light L1 to the first measurement point P1 and the second measurement point P2 in the present embodiment, the determining section 92 may make the above-described determination in consideration also of data further obtained by the application of the measurement light L1 to the third measurement point P3 and the fourth measurement point P4.

When the determining section 92 determines that the tape T2 is affixed such that the center of the tape T2 does not coincide with the center of the ring frame F, the determining section 92 notifies an operator of the determination by sounding an alarm sound or displaying an error, for example. After the above-described

determination by the determining section 92 is made, the defective wafer set for which the determination is made is housed in the wafer cassette by the transfer means not depicted. The operator can grasp the position of a shelf in the wafer cassette on which shelf the defective wafer set is housed, and can therefore remove the defective wafer set from the wafer cassette afterward.

The control unit 9 may, for example, store the stage number (position) of the shelf of the wafer cassette on which shelf the defective wafer set is housed.

In addition, an extraction table on which to mount the defective wafer set may be provided, and the defective wafer set may be transferred to the extraction table by the transfer means not depicted.

As described above, the tape mounter 1 according to the present embodiment includes the sensor 6 including the light emitting unit 60 that emits the measurement light L1 to a measurement point in a region in which the tape T2 is to be affixed on the upper surface Fa of the ring frame F and the light receiving unit 61 that receives the reflected light L2 reflected at the measurement point, the setting section 90 that sets a reference value for a received light amount received by the light receiving unit 61, and the determining section

92. The determining section 92 determines that the tape T2 is affixed to the measurement point when the received light amount received by the light receiving unit 61 is smaller than the reference value. The determining section 92 determines that the tape T2 is not affixed to the measurement point when the received light amount received by the light receiving unit 61 is equal to or more than the reference value. The tape mounter 1 can therefore check whether or not the tape T2 is affixed such that the center of the tape T2 coincides with the center of the ring frame F. Conventionally, a part of the ring frame F to which part the tape T2 is not affixed can be checked by a transmission type sensor, but it is not possible to check whether or not the tape T2 is affixed such that the center of the tape T2 coincides with the center of the ring frame F, or in other words, whether or not there is a part in which the affixation area of the tape T2 is partly decreased on the periphery of the opening Fc of the ring frame F. However, the tape mounter 1 according to the present embodiment, for example, sets the measurement point to be measured by the sensor 6 within a region slightly outward of the opening Fc of the ring frame F (region in which the tape T2 is to be affixed). Thus, when there is a part in which the affixation area

of the tape T2 affixed to the ring frame F is decreased (a part in which the tape T2 is not affixed onto the measurement point), the received light amount of the reflected light L2 received from the ring frame F by the light receiving unit 61 is equal to or more than the reference value. The determining section 92 can therefore determine that there is a part in which the affixation area of the tape T2 is partly decreased, and that there is a part in which the tape T2 may be easily peeled off the ring frame F.

The tape mounter 1 according to the present embodiment further includes the storage section 95 that stores the received light amount when the light receiving unit 61 receives the reflected light L2 formed by reflecting the measurement light L1 by the upper surface Fa of the ring frame F. The setting section 90 sets a value stored in the storage section 95 as the reference value. Thus, the reference value for the determining section 92 to determine whether or not the tape T2 is affixed such that the center of the tape T2 coincides with the center of the ring frame F can be set appropriately.

In the tape mounter 1 according to the present embodiment, the sensor 6 includes the light emitting unit

60 that emits the measurement light L1 to the measurement point from an obliquely upward direction with respect to the upper surface Fa of the ring frame F, the retroreflective plate 62 that is disposed at a position symmetric to the light emitting unit 60 with respect to the measurement point and reflects the measurement light L1 reflected at the measurement point to the measurement point (retroreflection), and the light receiving unit 61 that receives, in the vicinity of the light emitting unit 60, the reflected light L2 formed by further reflecting, at the measurement point, the reflected light L2 reflected by the retroreflective plate 62. Thus, irrespective of whether the tape T2 is a transparent tape or an opaque tape, the determining section 92 can determine that the tape T2 is affixed to the measurement point when the received light amount received by the light receiving unit 61 is smaller than the reference value, and the determining section 92 can determine that the tape T2 is not affixed to the measurement point when the received light amount received by the light receiving unit 61 is equal to or more than the reference value. The determining section 92 can therefore determine whether or not the tape T2 is affixed such that the center of the tape T2 coincides with the center of the ring frame F.

In a case where the tape affixed to the ring frame F is not the transparent tape T2 but a colored tape T3 (see FIG. 12) not transparent to visible light, for example, the tape mounter 1 depicted in FIG. 1 may include a sensor 6A according to a second embodiment which sensor is depicted in FIG. 12 and FIG. 13 to be described in the following in place of the sensor 6 according to the first embodiment.

The sensor 6A according to the second embodiment is, for example, a limited reflection type photoelectric sensor. The sensor 6A includes a light emitting unit 66 that emits measurement light L3 to the measurement point from an obliquely upward direction with respect to the upper surface Fa of the ring frame F, and a light receiving unit 67 that is disposed at a position symmetric to the light emitting unit 66 with respect to the measurement point and receives reflected light L4 reflected at the measurement point.

The sensor 6A is, for example, disposed above the ring frame holding table 20 in a state of having been moved in the -X direction to a position beyond the affixing unit 22 depicted in FIG. 1, and disposed so as to be opposed to the upper surface 20a of the ring frame holding table 20 in the Z-axis direction. The light

emitting unit 66 is, for example, disposed in a part on the +Y direction side of the casing 63, as depicted in FIG. 12. The light emitting unit 66 can, for example, pass light emitted from a built-in light source through a rectangular slit, convert the light passed through the slit into collimated light (measurement light L3) through a collimator lens, and apply the measurement light L3 obliquely downward while maintaining a predetermined width of the measurement light L3. Incidentally, the angle of incidence of the measurement light L3 having the predetermined width or the like, for example, may be adjustable by adjusting means not depicted. In addition, the measurement light L3 may form a cylindrical shape having a predetermined width as a diameter thereof.

The first measurement point P1 and the second measurement point P2 set on the ring frame F in a state of being centered on the upper surface 20a of the ring frame holding table 20 are, for example, positioned on a center line of the ring frame holding table 20 which center line is parallel with the X-axis direction. The light receiving unit 67 is, for example, disposed in a part on the -Y direction side of the casing 63 with the center line of the ring frame holding table 20 as a symmetry axis, the center line being parallel with the X-

axis direction. When the ring frame holding table 20 is moved in the -X direction by the table moving mechanism 13 depicted in FIG. 1, and the first measurement point P1 is positioned on the optical axis of the light emitting unit 66, the light receiving unit 67 is disposed at a position symmetric to the light emitting unit 66 in the Y-axis direction with respect to the first measurement point P1.

In the following, description will be made of a case where the determining section 92 in the tape mounter 1 including the sensor 6A according to the second embodiment determines whether or not the tape T3 depicted in FIG. 12 is affixed such that the center of the tape T3 coincides with the center of the ring frame F (the center of the opening Fc).

Under control of the control unit 9 depicted in FIG. 1, the ring frame holding table 20 fed in the -X direction by the table moving mechanism 13 passes the affixing unit 22. After the tape T3 depicted in FIG. 12 is affixed to the ring frame F, the ring frame holding table 20 further moves in the -X direction to the predetermined coordinate position in the X-axis direction.

The ring frame F is centered on the ring frame holding table 20. Thus, when the ring frame holding table

20 moves to the predetermined coordinate position in the X-axis direction, the control unit 9 determines that the first measurement point P1 is positioned at a coordinate position grasped in advance in the X-axis direction, that is, on the optical axis of the light emitting unit 66 of the sensor 6A, as depicted in FIG. 12 and FIG. 13. Then, an operating signal is sent from the control unit 9 to the sensor 6A electrically connected to the control unit 9. The light emitting unit 66 emits the measurement light L3 having a predetermined width to the first measurement point P1 from an obliquely upward direction with respect to the upper surface Fa of the ring frame F.

The light emitting unit 66 and the light receiving unit 67 of the sensor 6A of the limited reflection type have respective optical axes intersecting each other with a same inclination angle. The light receiving unit 67 receives only regular reflected light from a limited region in which the respective optical axes of the light emitting unit 66 and the light receiving unit 67 intersect each other, that is, from certain limited distances. The height positions or the like of the light emitting unit 66 and the light receiving unit 67 are, for example, set in advance such that the light receiving unit 67 receives the reflected light L4 directly

reflected by the upper surface Fa of the ring frame F.

Therefore, when the tape T3 is affixed such that the center of the tape T3 coincides with the center of the ring frame F (the center of the opening Fc) as depicted in FIG. 12, the measurement light L3 is reflected by the upper surface of the tape T3 affixed to the upper surface Fa of the ring frame F, the upper surface of the tape T3 being above the first measurement point P1, and therefore the light receiving unit 67 hardly receives the reflected light L4 of the measurement light L3, as depicted in FIG. 13. Hence, the received light amount received by the light receiving unit 67 as a result of the light emission to the first measurement point P1 is, for example, a small received light amount V4 depicted in FIG. 14. The measured received light amount V4 is stored in the RAM of the storage section 95 of the control unit 9.

When the ring frame holding table 20 depicted in FIG. 12 is further moved in the -X direction, and is moved to a predetermined coordinate position in the X-axis direction, the control unit 9 determines that the second measurement point P2 is positioned on the optical axis of the light emitting unit 66 of the sensor 6A. The light emitting unit 66 of the sensor 6A then emits the

measurement light L3 having a predetermined width to the second measurement point P2 from an obliquely upward direction with respect to the upper surface Fa of the ring frame F.

When the tape T3 is affixed such that the center of the tape T3 coincides with the center of the ring frame F as depicted in FIG. 12, the measurement light L3 is reflected by the upper surface of the tape T3 affixed to the upper surface Fa of the ring frame F, the upper surface of the tape T3 being above the second measurement point P2, and therefore the light receiving unit 67 hardly receives the reflected light L4 of the measurement light L3. Hence, the received light amount received by the light receiving unit 67 as a result of the light emission to the second measurement point P2 is, for example, the received light amount V4 depicted in FIG. 14.

A received light amount V5 depicted in FIG. 14, for example, is a received light amount when the light receiving unit 67 receives the reflected light L4 emitted by the light emitting unit 66 and reflected by the upper surface Fa of the ring frame F, the received light amount being obtained by a past experiment or the like and stored in the ROM of the storage section 95.

The setting section 90 depicted in FIG. 13 in the

present embodiment sets, in the determining section 92, the received light amount V5 stored in the storage section 95 as a reference value V5 for a received light amount received by the light receiving unit 67, the reference value V5 being used for the determining section 92 to determine whether or not the tape T3 is affixed such that the center of the tape T3 coincides with the center of the ring frame F.

The determining section 92 compares each of the received light amount V4 received by the light receiving unit 67 as a result of the light emission to the first measurement point P1, the received light amount V4 being obtained previously and stored in the RAM of the storage section 95, and the received light amount V4 received by the light receiving unit 67 as a result of the light emission to the second measurement point P2 with the received light amount V5 (reference value V5) stored in the storage section 95. Then, the determining section 92 determines that the received light amount V4 received by the light receiving unit 67 as a result of the light emission to the first measurement point P1 depicted in FIGS. 12 and 13 and the received light amount V4 received by the light receiving unit 67 as a result of the light emission to the second measurement point P2 are each

smaller than the received light amount V5 as a reference value. Thus, the determining section 92 determines that the tape T3 is affixed to the first measurement point P1 and the second measurement point P2 on the upper surface Fa of the ring frame F, and determines that the tape T3 is affixed such that the center of the tape T3 coincides with the center of the ring frame F.

Incidentally, while the above-described determination is made on the basis of the application of the measurement light L3 to the first measurement point P1 and the second measurement point P2 in the present embodiment, the determining section 92 may make the above-described determination in consideration also of data further obtained by the application of the measurement light L3 to the third measurement point P3 and the fourth measurement point P4 by the sensor 6A.

After the above-described determination by the determining section 92 depicted in FIG. 13 is made, the wafer set is, for example, housed in a wafer cassette by transfer means not depicted. The wafer cassette has a plurality of shelves. Wafer sets are housed on the shelves one by one.

Description will be made of a case where the tape T3 is affixed such that the center of the tape T3 of the

wafer set does not coincide with the center of the ring frame F, as depicted in FIG. 15, for example.

As depicted in FIGS. 15 and 16, when the ring frame holding table 20 moves to the predetermined coordinate position in the X-axis direction, the control unit 9 determines that the first measurement point P1 is positioned on the optical axis of the light emitting unit 66 of the sensor 6A. Then, as depicted in FIG. 16, an operating signal is sent from the control unit 9 to the sensor 6A, and the light emitting unit 66 of the sensor 6A emits the measurement light L3 having a predetermined width to the first measurement point P1 from an obliquely upward direction with respect to the upper surface Fa of the ring frame F.

As depicted in FIG. 16, when the light emitting unit 66 emits the measurement light L3 having a predetermined width to the first measurement point P1 from an obliquely upward direction with respect to the upper surface Fa of the ring frame F, the measurement light L3 is reflected at the first measurement point P1 on the upper surface Fa of the ring frame F because the tape T3 is not present on the first measurement point P1. The measurement light L3 reflected by the upper surface Fa of the ring frame F is received by the light receiving

unit 67. A received light amount received by the light receiving unit 61 is, for example, the received light amount V5 depicted in FIG. 14. The received light amount V5 is stored in the RAM of the storage section 95 of the control unit 9.

When the ring frame holding table 20 depicted in FIG. 15 is further moved in the -X direction, and is moved to a predetermined coordinate position in the X-axis direction, the control unit 9 determines that the second measurement point P2 is positioned on the optical axis of the light emitting unit 66 of the sensor 6A, as depicted in FIG. 17. The light emitting unit 66 of the sensor 6A then emits the measurement light L3 having a predetermined width to the second measurement point P2 from an obliquely upward direction with respect to the upper surface Fa of the ring frame F.

As depicted in FIG. 17, the measurement light L3 is reflected by the upper surface of the tape T3 affixed to the upper surface Fa of the ring frame F, the upper surface of the tape T3 being above the second measurement point P2, and therefore the light receiving unit 67 hardly receives the reflected light L4 of the measurement light L3. Hence, the received light amount received by the light receiving unit 67 as a result of the light

emission to the second measurement point P2 is, for example, a small received light amount V4 depicted in FIG. 14.

The determining section 92 depicted in FIG. 15 compares each of the received light amount V5 received by the light receiving unit 67 as a result of the light emission to the first measurement point P1, the received light amount V5 being stored in the RAM of the storage section 95, and the received light amount V4 received by the light receiving unit 67 as a result of the light emission to the second measurement point P2 with the received light amount V5 as a reference value stored in the ROM of the storage section 95. Then, the determining section 92 determines that the received light amount V5 received by the light receiving unit 67 as a result of the light emission to the first measurement point P1 is equal to or more than the received light amount V5 as a reference value (that is, the same as the received light amount V5). Thus, the determining section 92 determines that the tape T3 is not affixed to the first measurement point P1, and determines that the tape T3 is affixed such that the center of the tape T3 does not coincide with the center of the ring frame F.

Incidentally, while the above-described

determination is made on the basis of the application of the measurement light L3 to the first measurement point P1 and the second measurement point P2 in the present embodiment, the determining section 92 may make the above-described determination in consideration also of data further obtained by the application of the measurement light L3 to the third measurement point P3 and the fourth measurement point P4.

When the determining section 92 determines that the tape T3 is affixed such that the center of the tape T3 does not coincide with the center of the ring frame F, the determining section 92 notifies an operator of the determination by sounding an alarm sound or displaying an error, for example. After the above-described determination by the determining section 92 is made, the defective wafer set for which the determination is made is housed in the wafer cassette by the transfer means not depicted. The operator can grasp the position of a shelf in the wafer cassette on which shelf the defective wafer set is housed, and can therefore remove the defective wafer set from the wafer cassette afterward.

The control unit 9 may, for example, store the stage number (position) of the shelf of the wafer cassette on which shelf the defective wafer set is housed.

In addition, an extraction table on which to mount the defective wafer set may be provided, and the defective wafer set may be transferred to the extraction table by the transfer means not depicted.

It is to be noted that the tape mounter 1 according to the present invention is not limited to the foregoing embodiments, and that each configuration and the like depicted in the accompanying drawings are not limited to the foregoing embodiments either but can be modified as appropriate within a range in which effects of the present invention can be exerted.

The present invention is not limited to the details of the above described preferred embodiments. 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 tape mounter comprising:

a ring frame holding table configured to hold a ring frame;

a wafer holding table configured to hold a wafer within an opening of the ring frame;

an affixing unit configured to affix a circular tape to an upper surface of the ring frame held on the ring frame holding table and an upper surface of the wafer held on the wafer holding table;

a sensor including a light emitting unit configured to emit measurement light to a measurement point in a region in which the tape is to be affixed on the upper surface of the ring frame and a light receiving unit configured to receive reflected light reflected at the measurement point;

a setting section configured to set a reference value for a received light amount received by the light receiving unit; and

a determining section configured to determine that the tape is affixed to the measurement point when the received light amount received by the light receiving unit is smaller than the reference value, and determine that the tape is not affixed to the measurement point

when the received light amount received by the light receiving unit is equal to or more than the reference value.

2. The tape mounter according to claim 1, further comprising:

a storage section configured to store a value of the received light amount when the light receiving unit receives reflected light formed by reflecting the measurement light by the upper surface of the ring frame, wherein

the setting section sets the value stored in the storage section as the reference value.

3. The tape mounter according to claim 1, wherein the sensor includes

the light emitting unit configured to emit the measurement light to the measurement point from an obliquely upward direction with respect to the upper surface of the ring frame,

a retroreflective plate disposed at a position symmetric to the light emitting unit with respect to the measurement point and configured to reflect the measurement light reflected at the measurement point to the measurement point, and

the light receiving unit configured to

receive, in a vicinity of the light emitting unit, reflected light formed by further reflecting, at the measurement point, the reflected light reflected by the retroreflective plate.

4. The tape mounter according to claim 2, wherein the sensor includes

the light emitting unit configured to emit the measurement light to the measurement point from an obliquely upward direction with respect to the upper surface of the ring frame,

the retroreflective plate disposed at a position symmetric to the light emitting unit with respect to the measurement point and configured to reflect the measurement light reflected at the measurement point to the measurement point, and

the light receiving unit configured to receive, in a vicinity of the light emitting unit, reflected light formed by further reflecting, at the measurement point, the reflected light reflected by the retroreflective plate.

5. The tape mounter according to claim 1, wherein the sensor includes

the light emitting unit configured to emit the measurement light to the measurement point from an

obliquely upward direction with respect to the upper surface of the ring frame, and

the light receiving unit disposed at a position symmetric to the light emitting unit with respect to the measurement point and configured to receive the reflected light reflected at the measurement point.

6. The tape mounter according to claim 2, wherein the sensor includes

the light emitting unit configured to emit the measurement light to the measurement point from an obliquely upward direction with respect to the upper surface of the ring frame, and

the light receiving unit disposed at a position symmetric to the light emitting unit with respect to the measurement point and configured to receive the reflected light reflected at the measurement point.