PROCESSING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a processing apparatus that processes a wafer on which a device is formed in each of regions marked out by plural planned dividing lines.

Description of the Related Art

Device chips are mounted in pieces of electrical equipment such as mobile phones and personal computers. The device chips are manufactured by cutting a wafer on which a device such as an integrated circuit (IC) or large scale integration (LSI) is formed in each of regions marked out by plural planned dividing lines along each planned dividing line and dividing the wafer into plural device chips. For the dividing of the wafer, a processing apparatus is used that includes a processing unit such as a cutting unit having a cutting blade (for example, refer to Japanese Patent Laid-open No. 2000-108119) or a laser irradiation unit that executes irradiation with a laser beam having such a wavelength as to be absorbed by the wafer (for example, refer to Japanese Patent Laid-open No. 2005-150523).

The processing apparatus includes a chuck table disposed under the processing unit. A processing feed unit that moves the chuck table along a processing feed direction (X-axis direction) is disposed under the chuck table. Furthermore, an imaging unit for imaging a wafer held by the chuck table is disposed over the chuck table. In addition, the processing apparatus is equipped with a control unit that controls operation of the respective constituent elements such as the processing unit, the chuck table, the processing feed unit, and the imaging unit. An operator inputs a predefined processing condition to the control unit and thereafter each wafer is processed along the planned dividing lines by the processing unit.

In order to check whether the processing condition is appropriate, the operator takes out a wafer for which the processing has been actually executed along several planned dividing lines from the processing apparatus and observes plural places on the planned dividing lines by a microscope disposed outside the processing apparatus (i.e. executes kerf check) in some cases. By this observation, the operator checks whether or not the width of a cut groove, the size and number of defects (chipping), deviation between the center line of the cut

groove and the center line of the planned dividing line, and so forth fall within allowable ranges, for example. If the deviation and so forth exceed the allowable range, the operator corrects the processing condition as appropriate. Then, the wafer returned to the processing apparatus is processed under the processing condition after the correction.

SUMMARY OF THE INVENTION

However, if the wafer is taken out from the processing apparatus every time the processing condition is checked by the microscope, there are a risk that the wafer breaks in conveyance and a risk that a foreign matter or the like adheres to the wafer and the wafer is contaminated. The present invention is made in view of this problem and intends to provide a processing apparatus that allows an operator to determine whether or not a processing condition is appropriate without taking out the wafer from the processing apparatus.

In accordance with an aspect of the present invention, there is provided a processing apparatus that processes a wafer on which a device is formed in each of a plurality of regions marked out by a plurality of planned dividing lines set on a front surface side. The

processing apparatus includes a cassette table on which a cassette that houses a plurality of wafers is placed, a chuck table that holds the wafer carried out from the cassette placed on the cassette table, and a processing unit that executes processing for a region corresponding to the planned dividing line of the wafer held by the chuck table. The processing apparatus includes also a processing feed unit that executes processing feed of the chuck table and the processing unit relatively, an imaging unit that images the wafer held by the chuck table, and a control unit that controls the processing unit, the processing feed unit, and the imaging unit. The control unit includes a control section that positions the chuck table directly under the imaging unit by actuating the processing feed unit to relatively move the chuck table and causes the imaging unit to image the wafer after the processing unit has processed regions corresponding to all of the planned dividing lines of the wafer held by the chuck table. The control unit includes also a report creating section that derives information relating to a processing state in each area on the basis of images obtained by individually imaging two or more different areas in the regions corresponding to all of the planned dividing lines along which the processing has

been executed and creates a report in which the information and the images are recorded.

Preferably, the report creating section creates the report for a wafer for which the processing has been executed first in the plurality of wafers housed in the cassette.

Furthermore, preferably, the information relating to the processing state includes the width of a groove formed in the region corresponding to the planned dividing line, the state of a defect formed at the groove, and the amount of deviation of the groove from a center line of the planned dividing line.

Moreover, preferably, the processing apparatus further includes a display unit that displays content of the report.

Furthermore, preferably, the control unit further includes an arrangement deciding section that decides an arrangement of the two or more different areas if the number of the two or more different areas imaged by the imaging unit is specified.

Moreover, preferably, the processing unit is either a cutting unit including a cutting blade rotatably or a laser beam irradiation unit including a light collector that collects a laser beam.

The control unit of the processing apparatus according to the aspect of the present invention has the control section and the report creating section. After the processing unit has processed the regions corresponding to all of the planned dividing lines of the wafer held by the chuck table, the control section positions the chuck table directly under the imaging unit by actuating the processing feed unit to relatively move the chuck table and causes the imaging unit to image the wafer. Furthermore, the report creating section derives the information relating to the processing state in each area on the basis of the images obtained by individually imaging the two or more different areas in the regions corresponding to all of the planned dividing lines along which the processing has been executed and creates the report in which the information and the images are recorded. By referring to this report, the operator can check whether or not the processing condition is appropriate without taking out the wafer from the processing apparatus. Therefore, the risk of breakage, contamination, and so forth of the wafer due to taking out the wafer from the processing apparatus can be eliminated.

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 some preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a cutting apparatus;

FIG. 2 is a perspective view of a frame unit;

FIG. 3 is a diagram illustrating how a front surface side of a wafer is imaged;

FIG. 4 is a diagram illustrating each inspection region;

FIG. 5 is a diagram illustrating an image that depicts one example of a report;

FIG. 6 is a perspective view of a laser processing apparatus according to a second embodiment;

FIG. 7A is a diagram illustrating an example in which inspection regions located at an end part are located outside relative to a circumference of the wafer; and

FIG. 7B is a diagram illustrating an arrangement of

the inspection regions after correction.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments according to an aspect of the present invention will be described with reference to the accompanying drawings. FIG. 1 is a perspective view of a cutting apparatus (processing apparatus) 2. Incidentally, in FIG. 1, part of constituent elements of the cutting apparatus 2 is illustrated as functional blocks. Furthermore, hereinafter, an X-axis direction (processing feed direction), a Y-axis direction (indexing feed direction), and a Z-axis direction (height direction) are directions orthogonal to each other.

An operation panel 4 is disposed on the front surface side of the cutting apparatus 2. An operator can set a processing condition and so forth for the cutting apparatus 2 by executing predetermined input through the operation panel 4, for example. A monitor (display unit) 6 is disposed on the side surface of the cutting apparatus 2 on the front surface side. On the monitor 6, a guide screen that guides the operator in operation, an image obtained by imaging by an imaging unit 24 to be described later, the content of a report to be described later, and so forth are displayed. Incidentally, the

monitor 6 may be a touch panel that functions also as the operation panel 4. In this case, the operation panel 4 may be omitted.

In the cutting apparatus 2, a wafer 11 (see FIG. 2) formed of a semiconductor material such as silicon is cut (processed). As illustrated in FIG. 2, plural planned dividing lines (streets) 13 are set in a lattice manner on the side of a front surface 11a of the wafer 11. A device 15 such as an IC or LSI is formed in each of regions marked out by the plural planned dividing lines 13.

A circular adhesive tape (dicing tape 17) formed of a resin is stuck to the side of a back surface 11b of the wafer 11. The diameter of the dicing tape 17 is larger than that of the wafer 11. The wafer 11 is stuck to the central part of the dicing tape 17 and one surface of an annular frame 19 formed of a metal is stuck to the peripheral part of the dicing tape 17. The wafer 11, the dicing tape 17, and the frame 19 configure a frame unit 21. FIG. 2 is a perspective view of the frame unit 21. Plural (for example, 25) frame units 21 are conveyed to the cutting apparatus 2 in the state of being housed in one cassette 8 (see FIG. 1).

Referring back to FIG. 1, other constituent

elements of the cutting apparatus 2 will be described. The cutting apparatus 2 has a cassette table 10 with a rectangular plate shape. The above-described cassette 8 is placed on the cassette table 10. A cassette elevator 12 that can move the cassette table 10 up and down is joined to the lower side of the cassette table 10. A push-pull arm 14 is disposed on the rear side of the cassette table 10. The push-pull arm 14 carries out (pull out) the wafer 11 before cutting from the cassette 8 in the state in which the push-pull arm 14 grips the frame 19 of the frame unit 21. Furthermore, it is also possible for the push-pull arm 14 to carry in the wafer 11 after cutting to the cassette 8 by pushing the frame 19.

A pair of positioning members (guide rails) 16 are disposed at both sides of the movement path of the push-pull arm 14. The pair of positioning members 16 adjust the position of the frame unit 21 in the X-axis direction. Near the pair of positioning members 16, a first conveying unit 18 that conveys the frame unit 21 from the pair of positioning members 16 is disposed. The first conveying unit 18 has an arm, a suction adhesion mechanism disposed on one end side of the arm, and a pivot mechanism disposed on the other end side of the arm. The first conveying unit 18 conveys the frame unit

21 by rotating the arm by a predetermined angle by the pivot mechanism in the state in which suction adhesion of the frame 19 by the suction adhesion mechanism is executed.

The first conveying unit 18 conveys the frame unit 21 to a chuck table 20 moved to the region closest to the cassette table 10 in the X-axis direction. A porous plate with a circular disc shape is fixed to the upper surface side of the chuck table 20. One end of a flow path (not illustrated) formed inside the chuck table 20 is connected to the lower surface side of the porous plate and a suction source (not illustrated) such as an ejector is connected to the other end of this flow path.

When the suction source is operated, a negative pressure is generated for the upper surface of the porous plate and the upper surface of the chuck table 20 functions as a holding surface 20a that sucks and holds the frame unit 21. The side of the dicing tape 17 of the frame unit 21 is held by the holding surface 20a in such a manner that the side of the front surface 11a of the wafer 11 is exposed. Plural clamp units 20b for fixing the frame 19 are disposed at the peripheral part of the chuck table 20. Furthermore, a θ table (not illustrated) that rotates the chuck table 20 around a predetermined

rotation axis is joined to the lower side of the chuck table 20.

A processing feed unit 22 that moves the chuck table 20 along the X-axis direction is joined to the lower side of the θ table. Incidentally, in FIG. 1, the outline of the position of the processing feed unit 22 is depicted and a specific shape is not illustrated. The processing feed unit 22 has an X-axis moving table (not illustrated) that supports the θ table. The X-axis moving table is disposed in a slidable manner on a pair of X-axis guide rails (not illustrated) parallel to the X-axis direction.

A ball screw (not illustrated) is disposed along the X-axis direction between the pair of X-axis guide rails. A pulse motor (not illustrated) for rotating the ball screw is joined to one end of the ball screw. Furthermore, a nut part (not illustrated) is disposed on the lower surface of the X-axis moving table and this nut part is joined to the ball screw in a rotatable manner. When the pulse motor is driven, the chuck table 20 moves along the X-axis direction together with the X-axis moving table and so forth.

Above the movement path of the chuck table 20, the imaging unit 24 is disposed in such a manner as to be

capable of facing the holding surface 20a. The imaging unit 24 includes a camera including a predetermined optical system and an imaging element such as a charge coupled device (CCD) image sensor or a complementary metal-oxide semiconductor (CMOS) image sensor and, for example, images the side of the front surface 11a of the wafer 11 held by the holding surface 20a to acquire an image. The acquired image is displayed on the monitor 6, for example. A cutting unit (processing unit) 26 is disposed on one side relative to the imaging unit 24 in the X-axis direction. The cutting unit 26 has a spindle (not illustrated) that is disposed along the Y-axis direction and has a circular column shape. A cutting blade 26a having a circular annular cutting edge is mounted to one end part of the spindle. Furthermore, a rotational drive source such as a motor is joined to the other end side of the spindle. When the rotational drive source is operated, the cutting blade 26a rotates at high speed.

Here, a cutting method of the wafer 11 with use of the cutting unit 26 will be described. In the case of cutting the wafer 11, first, the side of the back surface 11b of the wafer 11 (i.e. dicing tape 17) is held by the holding surface 20a in such a manner that the front

surface 11a is exposed, and the frame 19 is fixed by the plural clamp units 20b. Subsequently, the side of the front surface 11a of the wafer 11 is imaged by the imaging unit 24 and image processing such as pattern matching is executed for an image obtained by the imaging to detect the coordinates of a predetermined alignment mark. Thereby, the position of the planned dividing line 13 separated from the coordinates of the alignment mark by a predetermined distance is identified.

Next, the cutting blade 26a is positioned above an extended line of one planned dividing line 13. Thereafter, the lower end of the cutting blade 26a rotated is positioned between the back surface 11b of the wafer 11 and the holding surface 20a. Then, the wafer 11 and the chuck table 20 are relatively moved along the X-axis direction by executing processing feed of the chuck table 20 by the processing feed unit 22. Thereby, a region corresponding to the one planned dividing line 13 is cut (processed) and a cut groove 13a is formed (see FIG. 3).

After the wafer 11 is cut along the one planned dividing line 13, the cutting unit 26 is moved along the Y-axis direction and the cutting blade 26a is positioned above an extended line of another planned dividing line

13 adjacent to the one planned dividing line 13 in the Y-axis direction. Then, the wafer 11 is cut along the other planned dividing line 13. Similarly, the wafer 11 is cut along the remaining planned dividing lines 13. After the wafer 11 is cut along all planned dividing lines 13 along the X-axis direction, the wafer 11 is rotated by 90 degrees by the θ table.

Thereafter, the wafer 11 is cut along all planned dividing lines 13 along the X-axis direction. When the cut grooves 13a have been formed in regions corresponding to all planned dividing lines 13 set in a lattice manner in this manner, the cutting is ended. The frame unit 21 after the end of the cutting is conveyed from the chuck table 20 to a spinner cleaning unit 30 located on the rear side of the chuck table 20 by a second conveying unit 28. In the spinner cleaning unit 30, the frame unit 21 is subjected to spin cleaning and spin drying. The frame unit 21 for which the spin cleaning and the spin drying have been executed by the spinner cleaning unit 30 is carried into the cassette 8 by the first conveying unit 18, the positioning members 16, the push-pull arm 14, and so forth. Next, a control unit 32 that controls operation of the cutting apparatus 2 will be described.

The control unit 32 controls operation of the

cassette elevator 12, the push-pull arm 14, the positioning members 16, the chuck table 20, the processing feed unit 22, the imaging unit 24, the cutting unit 26, the second conveying unit 28, the spinner cleaning unit 30, and so forth. For example, the control unit 32 is configured by a computer including a processing unit such as a central processing unit (CPU), a main storing unit such as a dynamic random access memory (DRAM), and an auxiliary storing unit such as flash memory and hard disk drive. Functions of the control unit 32 are implemented by causing the processing unit and so forth to operate according to software that is stored in the auxiliary storing unit and includes a predetermined program.

The control unit 32 includes a control section 34 configured by a program, for example. The control section 34 controls operation of a solenoid valve (not illustrated) disposed between one end and the other end of the flow path formed inside the chuck table 20, for example. When the solenoid valve is set to the open state, a negative pressure is generated for the holding surface 20a. When the solenoid valve is set to the closed state, the negative pressure of the holding surface 20a disappears. Furthermore, the control section 34 controls

operation of the rotational drive source of the cutting unit 26, for example.

After all planned dividing lines 13 are cut by the cutting unit 26 in accordance with the above-described cutting method of the wafer 11, the control section 34 controls the pulse motor of the processing feed unit 22 to position the chuck table 20 directly under the imaging unit 24. Thereafter, the control section 34 causes the imaging unit 24 to operate and causes the imaging unit 24 to image the side of the front surface 11a of the wafer 11. FIG. 3 is a diagram illustrating how the side of the front surface 11a of the wafer 11 is imaged.

The imaging unit 24 images the whole of the side of the front surface 11a of the wafer 11. In addition, the imaging unit 24 individually images predefined two or more inspection regions (areas) in such a manner that the inspection regions are enlarged relative to the whole image of the wafer 11. The imaging unit 24 of the present embodiment images seven inspection regions that exist at positions different from each other. FIG. 4 is a diagram illustrating each inspection region. Incidentally, in the present embodiment, the horizontal direction illustrated in FIG. 4 is referred to as a channel 1 (CH1) direction and the vertical direction illustrated in FIG. 4 is

referred to as a channel 2 (CH2) direction.

Each inspection region includes a predetermined range centered at the intersection of the planned dividing lines 13 of the CH1 direction and the CH2 direction. As illustrated in the image of inspection region A, defects (chipping) 13b are generated at each of a cut groove $13a_1$ along the CH1 direction and a cut groove $13a_2$ along the CH2 direction. In inspection region A, the center line of the cut groove $13a_1$ of the CH1 direction deviates rearward from the center line of the planned dividing line 13 of the CH1 direction. The center line of the cut groove $13a_1$ is the straight line that passes through the central position of the width in the CH2 direction regarding the cut groove $13a_1$ and is parallel to the CH1 direction. Furthermore, the center line of the planned dividing line 13 of the CH1 direction is the straight line that passes through the central position of the width in the CH2 direction regarding the planned dividing line 13 of the CH1 direction and is parallel to the CH1 direction.

Inspection region B is located on the right side relative to inspection region A in the CH1 direction and exists at the same position as inspection region A in the CH2 direction. In inspection region B, the center line of

the cut groove $13a_2$ of the CH2 direction deviates leftward from the center line of the planned dividing line 13 of the CH2 direction. The center line of the cut groove $13a_2$ is the straight line that passes through the central position of the width in the CH1 direction regarding the cut groove $13a_2$ and is parallel to the CH2 direction. Furthermore, the center line of the planned dividing line 13 of the CH2 direction is the straight line that passes through the central position of the width in the CH1 direction regarding the planned dividing line 13 of the CH2 direction and is parallel to the CH2 direction. In inspection region B, similarly to inspection region A, the center line of the cut groove $13a_1$ of the CH1 direction deviates rearward from the center line of the planned dividing line 13 of the CH1 direction. Incidentally, the defect 13b is not generated at the cut groove $13a_1$ of the CH1 direction.

Inspection region C is located on the left side relative to inspection region A in the CH1 direction and is located on the front side relative to inspection region A in the CH2 direction. In inspection region C, the center line of the cut groove $13a_1$ of the CH1 direction deviates rearward from the center line of the planned dividing line 13 of the CH1 direction, and the

center line of the cut groove $13a_2$ of the CH2 direction deviates rightward from the center line of the planned dividing line 13 of the CH2 direction. Inspection region D is located at substantially the center of the front surface 11a. Inspection region D is located between inspection regions A and B in the CH1 direction and exists at the same position as inspection region C in the CH2 direction. Also, in inspection region D, the center line of the cut groove $13a_1$ of the CH1 direction deviates rearward from the center line of the planned dividing line 13 of the CH1 direction.

Inspection region E is located on the right side relative to inspection region B in the CH1 direction and exists at the same position as inspection regions C and D in the CH2 direction. Also, in inspection region E, the center line of the cut groove $13a_1$ of the CH1 direction deviates rearward from the center line of the planned dividing line 13 of the CH1 direction. Inspection region F exists at the same position as inspection region A in the CH1 direction and exists on the front side relative to inspection region C in the CH2 direction. In inspection region F, the center line of the cut groove $13a_1$ of the CH1 direction deviates rearward from the center line of the planned dividing line 13 of the CH1

direction.

Inspection region G exists at the same position as inspection region B in the CH1 direction and exists at the same position as inspection region F in the CH2 direction. In inspection region G, the center line of the cut groove $13a_1$ of the CH1 direction deviates rearward from the center line of the planned dividing line 13 of the CH1 direction, and the center line of the cut groove $13a_2$ of the CH2 direction deviates leftward from the center line of the planned dividing line 13 of the CH2 direction. The arrangement of inspection regions A to G is decided by an arrangement deciding section 36 that is part of the control unit 32 if an operator specifies the number of two or more different inspection regions (areas) imaged by the imaging unit 24. The arrangement deciding section 36 is configured by a program, for example.

The arrangement deciding section 36 sets the coordinates of the intersection of the center line of the planned dividing line 13 of the CH1 direction and the center line of the planned dividing line 13 of the CH2 direction as the center coordinates of the inspection region. The arrangement deciding section 36 decides plural sets of the center coordinates of the inspection

regions according to the specified number of inspection regions.

For example, the arrangement deciding section 36 employs each of one set of coordinates located at substantially the center of the front surface 11a and plural other sets of coordinates located around the one set of coordinates in the coordinates of plural intersections as the center coordinates of the inspection region. For example, the arrangement deciding section 36 decides the arrangement of the center coordinates of the inspection regions in such a manner that the center coordinates of at least two inspection regions are the same in the CH1 direction or the CH2 direction. After the arrangement of the center coordinates of the inspection regions is decided, ranges of a predetermined diameter (for example, 200 μm to 300 μm) from the center coordinates of the respective inspection regions are imaged by the imaging unit 24. Incidentally, the range imaged by the imaging unit 24 is not limited to the circular shape and may have an optional shape.

The control unit 32 further includes a report creating section 38 that creates a report in which an image of each inspection region and information relating to the processing state of the wafer 11 in each

inspection region are recorded. The report creating section 38 is configured by a program, for example, and creates the report for the wafer 11 for which processing has been executed first in plural wafers 11 housed in the cassette 8. By referring to this report, the operator can check whether or not the processing condition is appropriate without taking out the wafer 11 from the processing apparatus. If the processing condition is inappropriate, the processing condition can be corrected. Therefore, when the second and subsequent wafers 11 are processed, the wafers 11 can be processed under the corrected processing condition.

The information relating to the processing state includes the width of the cut groove 13a, the state of the defect 13b formed at the cut groove 13a, and the amount of deviation of the center line of the cut groove 13a from the center line of the planned dividing line 13. Incidentally, the width of the cut groove $13a_1$ along the CH1 direction is the length of the cut groove $13a_1$ in the CH2 direction and the width of the cut groove $13a_2$ along the CH2 direction is the length of the cut groove $13a_2$ in the CH1 direction. Furthermore, the state of the defect 13b formed at the cut groove 13a is the number of defects 13b and the size of the defect 13b, for example. For

example, the size of the defect 13b means the maximum length of the defect 13b in the CH2 direction from the edge of the cut groove $13a_1$ and the maximum length of the defect 13b in the CH1 direction from the edge of the cut groove $13a_2$.

The report of the present embodiment is displayed on the monitor 6 as an image. FIG. 5 is an image illustrating one example of the report. On the upper right side of the report, the whole image of the side of the front surface 11a of the wafer 11 is displayed. In this whole image, positions corresponding to inspection regions A to G are depicted by circles. A circle in which the whole image is simplified is displayed under the whole image of the wafer 11 and inspection regions A to G are illustrated in this circle. An image of the inspection region is displayed on the left side of the whole image of the wafer 11. In the example illustrated in FIG. 5, an image of inspection region D is displayed. Incidentally, the operator can select the displayed image of the inspection region by specifying the desired inspection region. For example, the operator can switch the image of inspection region D to an image of inspection region A by specifying inspection region A represented in the circuit in which the whole image is

simplified.

The information relating to the processing state of the selected inspection region is displayed under the image of the inspection region. In the example illustrated in FIG. 5, the information relating to the processing state of inspection region D is displayed. Each kind of information is generated by the report creating section 38 on the basis of the obtained image, for example. As depicted in “width of groove” in FIG. 5, the width of the cut groove $13a_1$ of inspection region D is 30 μm and the width of the cut groove $13a_2$ of inspection region D is 31 μm. Furthermore, “chipping” in FIG. 5 depicts the number of defects with a size smaller than 5 μm. As illustrated in FIG. 5, in inspection region D, the number of defects with a size smaller than 5 μm in the cut groove $13a_1$ is one and the number of defects with a size smaller than 5 μm in the cut groove $13a_2$ is four.

“(5 μm or larger)” in FIG. 5 depicts the number of defects with a size equal to or larger than 5 μm. As illustrated in FIG. 5, in inspection region D, a defect with a size equal to or larger than 5 μm at the cut grooves $13a_1$ and $13a_2$ does not exist. Furthermore, “street deviation” in FIG. 5 is the amount of deviation of the center line of the cut groove 13a from the center

line of the planned dividing line 13. As illustrated in FIG. 5, the center line of the cut groove $13a_1$ of the CH1 direction in inspection region D deviates from the center line of the planned dividing line 13 of the CH1 direction by 3 μm. Moreover, the center line of the cut groove $13a_2$ of the CH2 direction in inspection region D deviates from the center line of the planned dividing line 13 of the CH2 direction by 2 μm.

The report creating section 38 derives the width of the cut groove 13a, the number of defects with a size smaller than 5 μm, the number of defects with a size equal to or larger than 5 μm, the street deviation, and so forth on the basis of the acquired image. The length per one pixel regarding the acquired image is defined in advance. Therefore, the report creating section 38 calculates the width of the cut groove 13a and the position of the center line of the cut groove 13a from the number of pixels corresponding to the width of the cut groove 13a in the image, for example. Similarly, the report creating section 38 can calculate the size of a defect in a predetermined direction from the number of pixels corresponding to the defect in the predetermined direction in the image. Furthermore, the report creating section 38 can count the number of defects according to

the size of the defect. In this manner, the report creating section 38 creates the report in which the image of each inspection region and the information relating to the processing state in each inspection region are recorded.

By referring to this report, the operator can check whether or not the processing condition is appropriate without taking out the wafer 11 from the cutting apparatus 2 and observing the planned dividing lines 13 by a microscope or the like. Therefore, the risk of breakage, contamination, and so forth of the wafer 11 due to taking out the wafer 11 from the cutting apparatus 2 can be eliminated. Incidentally, the report is not limited to image displaying and may be printed on paper. In the case in which the report is printed on paper, the cutting apparatus 2 may include a report printing part (not illustrated) including a printer. Furthermore, instead of using the report printing part, the report creating section 38 may output data necessary for creation of the report to an external printer (not illustrated) and cause this printer to print the report. In the case in which the report is printed on paper, it is preferable that images of inspection regions and the information relating to the processing state be recorded

in the report in such a manner that the correspondence relation between the image of each inspection region and the information relating to the processing state of the wafer 11 in each inspection region can be identified.

Next, a method for check and correction of the processing condition will be described. First, an operator inputs a predetermined processing condition to the control unit 32 through the operation panel 4 (preparation step S10). The processing condition is the kind of cutting blade 26a, the flow rate of cutting water supplied to a processing point, the rotation speed of the spindle, and so forth. In the preparation step S10, the number of imaged inspection regions (areas) is also input and the above-described arrangement deciding section 36 automatically decides the arrangement of the inspection regions. After the input of the processing condition, the operator presses an automatic processing start button and causes the cutting apparatus 2 to start processing of the wafer 11.

When the automatic processing start button is pressed, the first frame unit 21 is conveyed from the cassette 8 onto the chuck table 20 and this frame unit 21 is held by the holding surface 20a and the clamp units 20b (holding step S20). After the holding step S20,

regions corresponding to all planned dividing lines 13 of the wafer 11 are cut by the cutting unit 26 in accordance with the above-described cutting method (cutting step S30). After the cutting step S30, each inspection region specified by the arrangement deciding section 36 and the whole of the side of the front surface 11a of the wafer 11 are imaged by the imaging unit 24 (imaging step S40).

After the imaging step S40, the report creating section 38 creates the above-described report (report creation step S50). The operator checks whether or not the processing condition input in the preparation step S10 is appropriate by referring to the created report (check step S60). This can eliminate the risk of breakage, contamination, and so forth of the wafer 11 due to taking out the wafer 11 from the cutting apparatus 2. After the check step S60, the first frame unit 21 is cleaned and dried by the spinner cleaning unit 30 and is carried into the cassette 8. If the processing condition is appropriate, the cutting step S30 is executed under the same processing condition also regarding the second and subsequent frame units 21.

However, if the processing condition is inappropriate, the processing condition is corrected after the check step S60 (correction step S70). In the

correction step S70, for example, replacement of the cutting blade 26a or redoing of mounting thereof, setting change of the flow rate of the cutting water, setting change of the rotation speed of the spindle, and so forth are executed. After the correction step S70, the step from the holding step S20 to the check step S60 is executed for the second frame unit 21. If the processing condition is appropriate, the second frame unit 21 is cleaned and dried and is carried into the cassette 8. However, if the processing condition is inappropriate, the correction step S70 and so forth are executed again.

Next, a second embodiment will be described. FIG. 6 is a perspective view of a laser processing apparatus (processing apparatus) 40 according to the second embodiment. The laser processing apparatus 40 has a laser beam irradiation unit (processing unit) 42 instead of the cutting unit 26. The laser processing apparatus 40 is different from the cutting apparatus 2 in this point. The laser beam irradiation unit 42 has a laser beam generating part (not illustrated) that generates a pulsed laser beam having such a wavelength as to be absorbed by the wafer 11. Incidentally, the laser beam generating part includes a laser oscillator (not illustrated). The laser beam irradiation unit 42 has a circular cylindrical

housing part 42a and a head part 42b is disposed at the tip part of the housing part 42a.

A collecting lens (not illustrated) that collects the laser beam is disposed in the head part 42b and the head part 42b functions as a light collector. The laser beam generated by the laser beam generating part goes through a predetermined optical system disposed in the housing part 42a and is emitted downward from the head part 42b. When the wafer 11 is processed, for example, the side of the back surface 11b of the wafer 11 is held by the holding surface 20a in such a manner that the front surface 11a is exposed. Then, a region directly under the head part 42b is positioned above an extended line of one planned dividing line 13.

When processing feed of the chuck table 20 and the head part 42b is relatively executed in the state in which irradiation with the laser beam with predetermined output power from the head part 42b is executed, a region corresponding to the planned dividing line 13 is subjected to ablation processing and a laser processed groove is formed. The laser processing apparatus 40 also has the control unit 32 similarly to the cutting apparatus 2. Therefore, similarly to the first embodiment, after the laser processed grooves are formed

along all planned dividing lines 13 of the first wafer 11, a report is created by the report creating section 38. By referring to this report, the operator can check whether or not the processing condition is appropriate without taking out the wafer 11 from the laser processing apparatus 40. Therefore, the risk of breakage, contamination, and so forth of the wafer 11 due to taking out the wafer 11 from the laser processing apparatus 40 can be eliminated.

Next, another example of decision of the arrangement of inspection regions by the arrangement deciding section 36 will be described. The inspection region makes no sense when being not set on the wafer 11. However, because the wafer 11 has a circular disc shape, the inspection region located at an end part is located outside relative to the circumference of the front surface 11a in some cases if plural inspection regions are disposed at equal intervals in the CH1 and CH2 directions. FIG. 7A is a diagram illustrating an example in which inspection regions 13c located at an end part are located outside relative to a circumference of the wafer 11. Incidentally, in FIG. 7A, the positions of the inspection regions 13c are simply depicted by crosses. In this case, the arrangement deciding section 36 corrects

the arrangement of the inspection regions 13c in such a manner that the interval of the inspection regions 13c becomes shorter in the CH1 or CH2 direction.

FIG. 7B is a diagram illustrating the arrangement of the inspection regions 13c after the correction. The arrangement deciding section 36 corrects the coordinates of the inspection regions 13c in such a manner that the inspection regions 13c located at an end part are located inside relative to the circumference of the front surface 11a. For example, the arrangement deciding section 36 sets the interval in the CH1 direction in five inspection regions 13c located between one end part and the central part in the CH2 direction and five inspection regions 13c located between the other end part and the central part in the CH2 direction to a short first interval compared with the case of FIG. 7A.

Moreover, the arrangement deciding section 36 sets the interval in the CH1 direction in five inspection regions 13c located at the one end part in the CH2 direction and five inspection regions 13c located at the other end part in the CH2 direction to a second interval shorter than the first interval. Incidentally, in the correction example of FIG. 7B, the interval in the CH1 direction is set shorter. However, instead of this, the

interval in the CH2 direction may be set shorter. As above, the arrangement deciding section 36 corrects the arrangement of the inspection regions 13c according to the number of inspection regions 13c specified by the operator. This can avoid the occurrence of the situation in which the imaging unit 24 acquires an image outside relative to the circumference of the wafer 11.

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. For example, the cut grooves 13a and the laser processed grooves are not limited to grooves formed by splitting (that is, fully cutting) the wafer 11 and may be half-cut grooves obtained through partial removal of the wafer 11.

WHAT IS CLAIMED IS:

1. A processing apparatus that processes a wafer on which a device is formed in each of a plurality of regions marked out by a plurality of planned dividing lines set on a front surface side, the processing apparatus comprising:

a cassette table on which a cassette that houses a plurality of wafers is placed;

a chuck table that holds the wafer carried out from the cassette placed on the cassette table;

a processing unit that executes processing for a region corresponding to the planned dividing line of the wafer held by the chuck table;

a processing feed unit that executes processing feed of the chuck table and the processing unit relatively;

an imaging unit that images the wafer held by the chuck table; and

a control unit that controls the processing unit, the processing feed unit, and the imaging unit, wherein

the control unit includes

a control section that positions the chuck table directly under the imaging unit by actuating the processing feed unit to relatively move the chuck table

and causes the imaging unit to image the wafer after the processing unit has processed regions corresponding to all of the planned dividing lines of the wafer held by the chuck table, and

a report creating section that derives information relating to a processing state in each area on a basis of images obtained by individually imaging two or more different areas in the regions corresponding to all of the planned dividing lines along which the processing has been executed and creates a report in which the information and the images are recorded.

2. The processing apparatus according to claim 1, wherein

the report creating section creates the report for a wafer for which the processing has been executed first in the plurality of wafers housed in the cassette.

3. The processing apparatus according to claim 1, wherein

the information relating to the processing state includes width of a groove formed in the region corresponding to the planned dividing line, a state of a defect formed at the groove, and an amount of deviation of the groove from a center line of the planned dividing line.

4. The processing apparatus according to claim 1, further comprising:

a display unit that displays content of the report.

5. The processing apparatus according to claim 1, wherein

the control unit further includes an arrangement deciding section that decides an arrangement of the two or more different areas if the number of the two or more different areas imaged by the imaging unit is specified.

6. The processing apparatus according to claim 1, wherein

the processing unit is either a cutting unit including a cutting blade rotatably or a laser beam irradiation unit including a light collector that collects a laser beam.