ALIGNMENT MARK SETTING METHOD

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an alignment mark setting method for setting a region inclusive of one or more marks designated by an operator, as an alignment mark, and a processing apparatus capable of setting the region as an alignment mark, in a processing apparatus for processing a wafer formed with a plurality of marks on a front surface side thereof.

Description of the Related Art

A wafer formed with a device such as an integrated circuit (IC) in each of regions partitioned by a plurality of streets set in a grid pattern on a front surface side thereof is subjected to grinding on the back surface side to become a predetermined thickness, and is thereafter processed along the streets by a processing apparatus to be divided into a plurality of device chips. As the processing apparatus for processing the wafer along the streets, for example, a cutting apparatus is used. The cutting apparatus includes a chuck table for suction holding the wafer. The chuck table is rotatable around a predetermined rotational axis. A camera and a

cutting unit including a cutting blade are provided on an upper side of the chuck table.

Before cutting the wafer by the cutting apparatus, an alignment step is conducted for positioning the cutting blade on an extension line of the street (see, for example, Japanese Patent Laid-open No. Hei7-106405). In the alignment step, in a state in which the back surface side of the wafer is suction held by the chuck table, a mark of a predetermined shape formed on the front surface side of the wafer is imaged, and the mark is set as an alignment mark on the cutting apparatus (teaching step). Thereafter, using pattern matching in the image, alignment marks of the same shape present at spaced two positions are specified. By using the coordinates of the alignment marks at the two positions, the chuck table is rotated by a predetermined angle, whereby the orientation of the wafer is adjusted such that the street becomes parallel to an X-axis of the cutting apparatus.

In this way, in the alignment step, first, the teaching step is conducted. In the teaching step, in a state in which the image of the front surface side of the wafer obtained by imaging with the camera is displayed on a display device, the operator searches for the alignment

mark and determines which mark is to be used as the alignment mark. In the teaching step, a frame line including a cross and a square frame surrounding the periphery of the cross is displayed at a central part of the image, and the operator adjusts the position of the frame line in an X-axis direction and a Y-axis direction and enlarges or reduces the size of the frame line, by use of operation keys.

Then, in a state in which the mark to be used as the alignment mark is accommodated inside the frame line, the mark and the region in the periphery of the mark surrounded by the frame line are registered as the alignment mark. However, since the adjustment of the position and the size of the frame line is normally conducted on a sense basis by a manual operation of the operator, the size of the frame line may be different each time the alignment mark is set, or each time a different operator sets the alignment mark.

SUMMARY OF THE INVENTION

If the size of the frame line differs each time of setting, there may be cases where the range of the mark to be set as an alignment mark is different or cases where the area of a region in the periphery of the mark

is different, notwithstanding the mark of the same shape is set as an alignment mark. In other words, though the mark of the same shape is adopted as an object, alignment marks different in shape or size may be set. The present invention has been made in consideration of such a problem. It is an object of the present invention to set an alignment mark by automatically adjusting the range for a designated mark.

In accordance with an aspect of the present invention, there is provided an alignment mark setting method for setting a region inclusive of one or more marks designated by an operator as an alignment mark, in a processing apparatus for processing a wafer formed with a plurality of marks on a front surface side thereof, the alignment mark setting method including an imaging step of imaging one or more marks formed on the wafer by an imaging unit, an information acquiring step of acquiring information constituting respective circumscribing rectangles of the one or more marks, with respect to the one or more marks imaged in the imaging step, a frame line adjusting step of automatically adjusting the position and the size of a tetragonal frame line used when setting an alignment mark on the processing apparatus, relative to the circumscribing rectangle, in

such a manner that, according to designation of one mark or a plurality of marks of the one or more marks, the center of the circumscribing rectangle of one mark or all of the plurality of marks is moved to the center of the frame line, the circumscribing rectangle is accommodated in the frame line, and the spacing between the circumscribing rectangle and the frame line is adjusted to a predetermined distance, after the information acquiring step, and a registration step of registering a region including the one mark or the plurality of marks inside the frame line adjusted in size, as an alignment mark, on the processing apparatus.

In accordance with another aspect of the present invention, there is provided a processing apparatus capable of setting a region inclusive of one or more marks designated by an operator, as an alignment mark, when processing a wafer formed with a plurality of marks on a front surface size thereof, the processing apparatus including a chuck table that suction holds the wafer, an imaging unit that has an imaging element, is disposed on an upper side of the chuck table, and images the wafer suction held by the chuck table, a display device that displays an image acquired by the imaging unit, a control unit that has a processor and controls operations of the

chuck table, the imaging unit, and the display device, and an input device that inputs an operator’s instruction to the control unit, in which the control unit includes an information acquiring section that acquires information constituting respective circumscribing rectangles of the one or more marks, with respect to the one or more marks imaged by the imaging unit, a frame line adjusting section that automatically adjusts the position and the size of a tetragonal frame line used when setting an alignment mark on the processing apparatus, relative to the circumscribing rectangle, in such a manner that, according to designation of one mark or a plurality of marks of the one or more marks through the input device, the center of the circumscribing rectangle of the one mark or all of the plurality of marks is moved to the center of the frame line, the circumscribing rectangle is accommodated in the frame line, and the spacing between the circumscribing rectangle and the frame line is adjusted to a predetermined distance, and an alignment mark registration section that registers a region inclusive of the one mark or the plurality of marks inside the frame line adjusted in size, as an alignment mark.

In the alignment mark setting method according to

one mode of the present invention, first, with respect to one or more marks imaged, information constituting circumscribing rectangles of the one or more marks is acquired (information acquiring step). Then, after the information acquiring step, one or a plurality of marks of the one or more marks are designated by the operator. According to the designation by the operator, the position and the size of a frame line relative to the circumscribing rectangle is automatically adjusted in such a manner that the center of the circumscribing rectangle for the one mark or all of the plurality of marks is moved to the center of the tetragonal frame line, the circumscribing rectangle is accommodated in the frame line, and the spacing between the circumscribing rectangle and the frame line is adjusted to a predetermined distance (frame line adjusting step). Thereafter, a region including the one mark or the plurality of marks inside the frame line adjusted in size is registered as an alignment mark on the processing apparatus (registration step). Thus, the alignment mark can be automatically set in a predetermined range according to the shape and the size of the mark, instead of depending on the operator’s sense.

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 top plan view of a wafer or the like;

FIG. 3 is a partially enlarged view of a front surface side of the wafer;

FIG. 4 is a diagram for explaining the configuration of a control unit;

FIG. 5 is a diagram depicting an example of processing of labeling;

FIG. 6 is a diagram depicting an example of a screen in which a circumscribing rectangle of each mark is displayed;

FIG. 7 is a diagram depicting the manner in which an operator designates a mark;

FIG. 8A is a diagram depicting a frame line of which the position and the size are adjusted;

FIG. 8B is a diagram depicting an alignment mark;

FIG. 9 is a flow chart of an alignment mark setting method;

FIG. 10A is a diagram depicting the manner in which any position surrounded by a plurality of marks is designated by the operator;

FIG. 10B is a diagram depicting the frame line after a frame line adjusting step;

FIG. 11A is a diagram depicting the manner in which a display region corresponding to the vicinity of a corner part at the right lower side of a mark is touched by an operator’s finger; and

FIG. 11B is a diagram depicting the frame line after the frame line adjusting step.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment according to one mode of the present invention will be described below referring to the attached drawings. FIG. 1 is a perspective view of a cutting apparatus (processing apparatus) 2. An X-axis direction (processing feeding direction), a Y-axis direction (indexing feeding direction), and a Z-axis direction (vertical direction, height direction) each depicted in FIG. 1 are orthogonal to one another. Note

that, in FIG. 1, some components are depicted in the form of a functional block. The cutting apparatus 2 includes a base 4 that supports each of structures. On an upper side of the base 4, a cover 6 covering the base 4 is provided. In the inside of the cover 6, a predetermined space is formed.

In the predetermined space, a cutting unit (processing unit) 8 for cutting (processing) a wafer 11 is disposed. The cutting unit 8 is movable in the Y-axis direction and the Z-axis direction by an unillustrated Y-axis Z-axis direction moving mechanism. The Y-axis Z-axis direction moving mechanism includes, for example, a ball screw type Y-axis direction moving mechanism (not illustrated) for moving a Y-axis moving plate (not illustrated) in the Y-axis direction and a ball screw type Z-axis direction moving mechanism (not illustrated) that is provided on the Y-axis moving plate and moves the cutting unit 8 in the Z-axis direction.

The cutting unit 8 has a prismatic spindle housing of which the longitudinal direction is disposed substantially in parallel to the Y-axis direction. In the spindle housing, part of a cylindrical spindle (not illustrated) is accommodated in a rotatable manner. A rotational drive source (not illustrated) such as a motor

is provided at one end portion of the spindle, and a cutting blade having an annular cutting edge is mounted to the other end portion of the spindle. Part of a camera unit (imaging unit) 10 is fixed to a side surface on one side in the X-axis direction of the spindle housing. The camera unit 10 includes a light source (not illustrated) such as a light emitting diode (LED), an optical system including a condenser lens (not illustrated), and an imaging element such as a charge coupled device (CCD) image sensor or a complementary metal oxide semiconductor (CMOS) image sensor.

On a lower side of the cutting unit 8, a chuck table 12 for suction holding the wafer 11 is provided. The chuck table 12 has a substantially disk-shaped frame body formed of a metal. The frame body is formed with a recess including a disk-shaped space. One end portion of a suction passage (not illustrated) is exposed at a bottom surface of the recess, and a suction source (not illustrated) such as a vacuum pump and an ejector is connected to the other end portion of the suction passage. A disk-shaped porous plate is fixed to the recess.

When the suction source is operated, a negative pressure is generated at an upper surface (holding

surface 12a) of a porous plate through the suction passage. A rotational drive source (not illustrated) such as a motor is connected to the lower side of the chuck table 12. The rotational drive source rotates the chuck table 12 around a predetermined rotational axis substantially parallel to the Z-axis direction. On a lower side of the rotational drive source, a ball screw type X-axis direction moving mechanism (not illustrated) for moving the chuck table 12 and the rotational drive source along the X-axis direction is provided.

On the holding surface 12a of the chuck table 12, a disk-shaped wafer 11 or the like is mounted. FIG. 2 is a top plan view of the wafer 11 or the like. The wafer 11 is, for example, formed of a semiconductor such as silicon. It is to be noted, however, that the material, shape, structure, size, and the like of the wafer 11 are not limited to any particular kind. A front surface 11a of the wafer 11 is partitioned into a plurality of regions by streets 13 arranged in a grid pattern. In each of the regions, a device 15 such as an IC and large-scale integration (LSI) is formed. Note that the kind, number, shape, structure, size, layout, and the like of the devices 15 are also not limited to any particular kind.

In the vicinity of the streets 13, a plurality of

marks 17 (see FIG. 3) having predetermined shapes are formed. The marks 17 are used as an alignment mark 29 (see FIG. 8B) as a reference at the time of performing alignment of the wafer 11. The marks 17 are formed, for example, by removing with etching or the like part of an outermost surface of a circuit layer formed on an active region constituting the semiconductor element. When the front surface 11a side is imaged by the camera unit 10, an image of the marks 17 is acquired. FIG. 3 is a partially enlarged view of the front surface 11a side of the wafer 11.

In FIG. 3, two devices 15 with one street 13 interposed therebetween are depicted. A substantially L-shaped mark 17a, a substantially circular mark 17b, a substantially square mark 17c, and a substantially cross-shaped mark 17d are formed in the vicinity of the street 13 of one device 15 depicted in FIG. 3. As illustrated in FIG. 2, on a back surface 11b side of the wafer 11 before cutting, an adhesive tape (dicing tape) 19 including a circular base layer formed of resin and a resin-made adhesive layer (glue layer) provided on one surface of the base layer is adhered. The wafer 11 is adhered to a central portion of the adhesive tape 19, and a metallic annular frame 21 is adhered to a peripheral portion of

the adhesive tape 19. As a result, the wafer 11 is supported by the frame 21 through the adhesive tape 19, whereby a wafer unit 23 is formed.

As depicted in FIG. 1, a touch panel 14 is provided on a front surface 6a of the cover 6 of the cutting apparatus 2. The touch panel 14 is, for example, a touch panel-type liquid crystal display, and functions as both an input device for an operator to input instructions to a control unit 16 (described later) and a display device for displaying an image acquired by the camera unit 10, various processing conditions, and the like. Note that a monitor, a display, or the like having the function of only a display device may be provided in place of the touch panel 14. It is to be noted, however, that, in this case, a user interface such as a keyboard, a mouse, a track ball, and a joystick is separately provided as an input device.

The cutting apparatus 2 is provided with the control unit 16 for controlling operations of the components. The control unit 16 controls, for example, operations of the cutting unit 8, the camera unit 10, the chuck table 12, the touch panel 14, the X-axis direction moving mechanism, and the Y-axis Z-axis direction moving mechanism. The control unit 16 includes a computer which

includes, for example, a processing device such as a processor represented by a central processing unit (CPU), a main storage device such as a dynamic random access memory (DRAM), and an auxiliary storage device such as a flash memory, a hard disk drive, or a solid state drive.

Software including a predetermined program is stored in the auxiliary storage device. With the processing device and the like operated according to the software, the functions of the control unit 16 are realized. FIG. 4 is a diagram for explaining the configuration of the control unit 16. As illustrated in FIG. 4, the control unit 16 includes functional blocks for applying various kinds of processing to the image picked up by the camera unit 10. One of the functional blocks is an information acquiring section 16a, and the information acquiring section 16a applies known labeling processing to a two-valued image including one or a plurality of marks 17.

For example, the information acquiring section 16a gives a label number 1 to each of pixels located on boundary lines of the marks 17a and on the inside of the boundary lines and gives a label number 0 to each of pixels located on the outside of the boundary lines of the marks 17a. In this way, the information acquiring

section 16a acquires information concerning coordinates and the label number corresponding to each pixel. FIG. 5 is a diagram depicting an example of the labeling processing for one mark 17a. In FIG. 5, one pixel is represented by a circle, for convenience of description. While FIG. 5 depicts an example in which the mark 17a includes 29 × 29 pixels in a column direction and a row direction, the number of the pixels constituting the mark 17a is not limited to that in this example.

The information acquiring section 16a specifies the positions of end portions in the column direction and the row direction, of the pixels each having the label number 1. Specifically, the information acquiring section 16a specifies an upper end position Y_U and a lower end position Y_D and a left end position X_L and a right end position X_R. In FIG. 5, (X, Y, label number) obtained by adding the label number to the coordinates is depicted, for convenience of explanation. In addition, FIG. 5 refers to, as representatives, two of the plurality of coordinates (X_U, Y_U) located at an upper end. Similarly, FIG. 5 refers to, as representatives, two coordinates (X_D, Y_D) located at a lower end, two coordinates (X_L, Y_L) located at a left end, and two coordinates (X_R, Y_R) located at a right end.

The information acquiring section 16a specifies center coordinates (X_C, Y_C) located in the center of the column direction and the row direction of one or a plurality of marks 17. For example, the information acquiring section 16a calculates the center position Y_C in the column direction from the average of the upper end position Y_U and the lower end position Y_D and calculates the center position X_C in the row direction from the average of the left end position X_L and the right end position X_R. The upper end position Y_U, the lower end position Y_D, the left end position X_L, the right end position X_R, and the center coordinates (X_C, Y_C) are information constituting a circumscribing rectangle 25 (see FIG. 6) of the mark 17. Incidentally, an example in which the circumscribing rectangle 25 is displayed on the screen of the touch panel 14 is explained in the present embodiment for easy understanding, the circumscribing rectangle 25 is not necessarily required to be displayed on the screen.

As depicted in FIG. 6, a tetragonal frame line 27 including a cross and a square outer frame surrounding the periphery of the cross is displayed in a central portion of the imaging region of the camera unit 10. A frame line adjusting section 16b (see FIG. 4)

automatically adjusts the position and the size of the frame line 27 relative to the circumscribing rectangle 25 in such a manner that the circumscribing rectangle 25 is accommodated in the frame line 27. Specifically, the frame line adjusting section 16b first moves the X-axis direction moving mechanism and the Y-axis Z-axis direction moving mechanism to move the imaging region of the camera unit 10 in such a manner that the center coordinates (X_C, Y_C) of the circumscribing rectangle 25 of one mark 17 are moved to the center of the frame line 27 (namely, the intersection of the cross).

Next, the frame line adjusting section 16b adjusts the size of the frame line 27 relative to the circumscribing rectangle 25 in such a manner that the spacing between the frame line 27 and the circumscribing rectangle 25 located inside the frame line 27 becomes a predetermined distance. The spacing between the frame line 27 and the circumscribing rectangle 25 is, for example, adjusted to be a distance corresponding to 10 pixels, but the spacing is not limited to the distance corresponding to 10 pixels and may be any distance. The frame line 27 adjusted in size is displayed on the touch panel 14 for confirmation.

The control unit 16 has an alignment mark

registration section 16c (see FIG. 4). The alignment mark registration section 16c registers the frame line 27 adjusted in size and a region including one or a plurality of marks 17 inside the frame line 27, as an alignment mark 29 (see FIG. 8B), in a predetermined memory region of the control unit 16. In this way, the alignment mark 29 is set on the cutting apparatus 2. The control unit 16 in the present embodiment automatically adjusts the position and the size of the frame line 27 according to the mark 17. As a result, the alignment mark 29 can be automatically set in a predetermined range according to the shape, size, and the like of the mark 17, instead of depending on the operator’s sense.

Next, a setting method for the alignment mark 29 according to the first embodiment (namely, a method of performing a teaching step) will be described referring to FIGS. 4 to 9. In the first embodiment, one mark 17 is registered as the alignment mark 29. FIG. 9 is a flow chart of the setting method for the alignment mark 29. First, the back surface 11b side of the wafer 11 is held by the holding surface 12a through the adhesive tape 19. Then, the operator observes the front surface 11a side through the camera unit 10 and images one or more marks 17 which may possibly be used as the alignment mark 29

(imaging step S10) (see FIG. 4).

Subsequently, the information acquiring section 16a acquires information constituting the respective circumscribing rectangles 25 of the one or more marks 17 imaged in the imaging step S10 (namely, the upper end position Y_U, the lower end position Y_D, the left end position X_L, the right end position X_R, and the center coordinates (X_C, Y_C) depicted in FIG. 5) (information acquiring step S20). FIG. 6 is a diagram depicting an example of the screen on which the circumscribing rectangle 25 of each mark 17 is displayed. FIG. 6 depicts a circumscribing rectangle 25a of the mark 17a, a circumscribing rectangle 25b of the mark 17b, a circumscribing rectangle 25c of the mark 17c, and a circumscribing rectangle 25d of the mark 17d.

In the first embodiment, after the information acquiring step S20, the operator touches the display region of one mark 17 by a finger, to thereby designate one mark 17 through the touch panel 14. FIG. 7 is a diagram depicting the manner in which the operator designates one mark 17a. Note that, in FIG. 7, the finger and hand of the operator are depicted in pictogram for convenience of description. According to the designation of the one mark 17a, the frame line adjusting section 16b

moves the imaging region (broken line arrow in FIG. 7) in such a manner that the center of the circumscribing rectangle 25a is moved to the center of the frame line 27. Then, the frame line adjusting section 16b adjusts the size of the frame line 27 in such a manner that the spacing between the circumscribing rectangle 25a and the frame line 27 becomes a predetermined distance (frame line adjusting step S30). FIG. 8A is a diagram depicting the frame line 27 adjusted in position and size. While a pattern is applied to the mark 17a in FIG. 8A for convenience of explanation, specifically, for making clear the range of the mark 17a, the pattern is not displayed on a practical screen.

After the frame line adjusting step S30, the alignment mark registration section 16c registers the frame line 27 adjusted in size and a region including the mark 17a inside the frame line 27, as an alignment mark 29, in a predetermined memory region of the control unit 16 (registration step S40). FIG. 8B is a diagram depicting the alignment mark 29 set on the cutting apparatus 2 through S10 to S40. Note that, while a part corresponding to the square of the frame line 27 is depicted in broken lines in FIG. 8B for the purpose of clearly defining a peripheral end part of the alignment

mark 29, the broken line is not displayed for the alignment mark 29 in practice. In the present embodiment, the position and the size of the frame line 27 are automatically adjusted according to the mark 17a. As a result, the alignment mark 29 can be automatically set in a predetermined range according to the shape, size, and the like of the mark 17a, instead of depending on the operator’s sense.

Next, a second embodiment will be described. In the second embodiment, a region including a plurality of marks 17 is set as an alignment mark 29 by use of the cutting apparatus 2. First, the marks 17a, 17b, 17c, and 17d which may possibly be used as an alignment mark 29 are imaged (imaging step S10). Next, the information acquiring section 16a acquires the upper end positions Y_U, the lower end positions Y_D, the left end positions X_L, the right end positions X_R and the center coordinates (X_C, Y_C) of the marks 17a, 17b, 17c, and 17d (information acquiring step S20). In other words, information constituting the respective circumscribing rectangles 25 of the four marks 17 is acquired.

In the second embodiment, after the information acquiring step S20, the operator touches the display region corresponding to a freely-selected region

surrounded by the marks 17a, 17b, 17c, and 17d by a finger. FIG. 10A is a diagram depicting the manner in which the operator designates a freely-selected region 31 surrounded by the plurality of marks 17. The information acquiring section 16a of the second embodiment specifies all the marks 17 of which at least part is located within the range of a rectangle 33 of a predetermined size centered in the region 31, according to the designation by the operator, and determines that the operator has designated all the marks 17.

In the example depicted in FIG. 10A, since the respective parts of the four marks 17a, 17b, 17c, and 17d are located within the rectangle 33, the information acquiring section 16a determines that the operator designated the four marks 17a, 17b, 17c, and 17d. In the case where a plurality of marks 17 are designated, the information acquiring section 16a acquires information constituting a circumscribing rectangle 35 that circumscribes the all of the plurality of marks 17. For example, the information acquiring section 16a acquires information constituting the circumscribing rectangle 35 circumscribing the all of the four marks 17, from information constituting the respective circumscribing rectangles 25 of the four marks 17.

In the example of FIG. 10A, the information acquiring section 16a acquires information of the upper end position Y_U, the lower end position Y_D, the left end position X_L, and the right end position X_R of the circumscribing rectangle 35, from the upper end position Y_U of the mark 17a or 17b, the lower end position Y_D of the mark 17d, the left end position X_L of the mark 17b, and the right end position X_R of the mark 17a or 17d. In addition, the information acquiring section 16a calculates the center position Y_C of the circumscribing rectangle 35 in the column direction from the average of the upper end position Y_U and the lower end position Y_D of the circumscribing rectangle 35 and calculates the center position X_C of the circumscribing rectangle 35 in the row direction from the average of the left end position X_L and the right end position X_R of the circumscribing rectangle 35. By this, the center coordinates (X_C, Y_C) of the circumscribing rectangle 35 are acquired.

Thereafter, according to the designation of the four marks 17, the frame line adjusting section 16b moves the imaging region in such a manner that the center of the circumscribing rectangle 35 is moved to the center of the frame line 27. Then, the frame line adjusting section 16b adjusts the size of the frame line 27 in such a

manner that the circumscribing rectangle 35 is accommodated in the frame line 27 and that the spacing between the circumscribing rectangle 35 and the frame line 27 becomes a predetermined distance (frame line adjusting step S30). FIG. 10B is a diagram depicting the frame line 27 after the frame line adjusting step S30. After the frame line adjusting step S30, the alignment mark registration section 16c registers the frame line 27 adjusted in size and a region including the marks 17a, 17b, 17c, and 17d inside the frame line 27, as an alignment mark 29 (registration step S40). In the present embodiment, the size of the frame line 27 is automatically adjusted according to the shapes, sizes, and layout of the four marks 17. Thus, the alignment mark 29 can be automatically set in a predetermined range according to the shapes, sizes, and layout of the plurality of marks 17, instead of depending on the operator’s sense.

Next, a third embodiment will be described. In the third embodiment, as in the second embodiment, the imaging step S10 and the information acquiring step S20 are conducted. It is to be noted, however, that, in the third embodiment, the operator touches a display region corresponding to the vicinity of a corner part of one

mark 17 by a finger such that the mark 17 located in the rectangle 33 is only one. FIG. 11A is a diagram depicting the manner in which the operator touches the display region corresponding to the vicinity of a right lower corner part of the mark 17d by a finger. In this way, only the mark 17d of which a part is located in the rectangle 33 centered in a region 31 on the right lower side of the mark 17d is designated by the operator.

According to the designation by the operator, the imaging region is moved in such a manner that the center of the circumscribing rectangle 25d is moved to the center of the frame line 27, and the size of the frame line 27 is adjusted in such a manner that the spacing between the circumscribing rectangle 25d and the frame line 27 becomes a predetermined distance (frame line adjusting step S30). FIG. 11B is a diagram depicting the frame line 27 after the frame line adjusting step S30. In the present embodiment, the mark 17d can be selected by designating the vicinity of the display region of the mark 17d in such a manner that the rectangle 33 includes a part of the one mark 17d. In addition, the alignment mark 29 can be automatically set in a predetermined range according to the shape and size of the selected mark 17d.

In addition to the above, the structures, methods,

and the like according to the above embodiments may be appropriately modified insofar as the modifications do not depart from the scope of the object of the present invention. The marks 17 may be formed on the devices 15 as in the abovementioned embodiments, or may be formed on the streets 13. In addition, the marks 17 are not limited to geometric shapes, and may be characters, numerals, or the like. Incidentally, while an example in which the processing apparatus is the cutting apparatus 2 has been described in the above embodiments, the processing apparatus may be a laser processing apparatus (not illustrated) for processing the wafer 11 by a laser beam.

The laser processing apparatus may include a laser processing unit in place of the cutting unit 8. The laser processing unit includes a laser oscillator that is configured to generate a pulsed laser beam, a condenser lens for condensing the laser beam, and the like. The laser beam has such a wavelength as to be transmitted through the wafer 11. In this case, the focal point of the pulsed laser beam is positioned in the inside of the wafer 11, and the wafer 11 is processed by multiphoton absorption (what is generally called stealth dicing). The laser beam may have such a wavelength as to be absorbed in the wafer 11. In this case, the wafer 11 is subjected

to ablation by the pulsed laser beam.

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. An alignment mark setting method for setting a region inclusive of one or more marks designated by an operator, as an alignment mark, in a processing apparatus for processing a wafer formed with a plurality of marks on a front surface side thereof, the alignment mark setting method comprising:

an imaging step of imaging the one or more marks formed on the wafer by an imaging unit;

an information acquiring step of acquiring information constituting respective circumscribing rectangles of the one or more marks, with respect to the one or more marks imaged in the imaging step;

a frame line adjusting step of automatically adjusting a position and a size of a tetragonal frame line used when setting an alignment mark on the processing apparatus, relative to the circumscribing rectangle, in such a manner that, according to designation of one mark or a plurality of marks of the one or more marks, a center of the circumscribing rectangle of the one mark or all of the plurality of marks is moved to a center of the frame line, the circumscribing rectangle is accommodated in the frame line, and a spacing between the circumscribing rectangle

and the frame line is adjusted to a predetermined distance, after the information acquiring step; and

a registration step of registering a region including the one mark or the plurality of marks inside the frame line adjusted in size, as an alignment mark, on the processing apparatus.

2. A processing apparatus capable of setting a region inclusive of one or more marks designated by an operator, as an alignment mark, when processing a wafer formed with a plurality of marks on a front surface size thereof, the processing apparatus comprising:

a chuck table that suction holds the wafer;

an imaging unit that has an imaging element, is disposed on an upper side of the chuck table, and images the wafer suction held by the chuck table;

a display device that displays an image acquired by the imaging unit;

a control unit that has a processor and controls operations of the chuck table, the imaging unit, and the display device; and

an input device that inputs an operator’s instruction to the control unit,

wherein the control unit includes

an information acquiring section that

acquires information constituting respective circumscribing rectangles of the one or more marks, with respect to the one or more marks imaged by the imaging unit,

a frame line adjusting section that automatically adjusts a position and a size of a tetragonal frame line used when setting an alignment mark on the processing apparatus, relative to the circumscribing rectangle, in such a manner that, according to designation of one mark or a plurality of marks of the one or more marks through the input device, a center of the circumscribing rectangle of the one mark or all of the plurality of marks is moved to a center of the frame line, the circumscribing rectangle is accommodated in the frame line, and a spacing between the circumscribing rectangle and the frame line is adjusted to a predetermined distance, and

an alignment mark registration section that registers a region inclusive of the one mark or the plurality of marks inside the frame line adjusted in size, as an alignment mark.