

PROCESSING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a processing apparatus for processing a workpiece included in a frame unit in which the workpiece is supported on an annular frame by a resin sheet.

Description of the Related Art

For processing a plate-shaped workpiece such as a semiconductor wafer, a resin-packaged substrate, a glass substrate, or a ceramic substrate, it is known in the art to assemble a frame unit by affixing a resin sheet to a surface of an annular metal frame having an opening that is larger in diameter than the workpiece and also to a surface of the workpiece. The workpiece in the frame unit thus assembled is then processed on a processing apparatus. For example, a plurality of such frame units is housed in a cassette and the cassette is then delivered onto a cassette rest of the processing apparatus. A first delivery unit such as a push-pull arm of the processing apparatus then grips the metal frame of one of the frame units in the cassette and pulls the frame unit out of the cassette onto a temporary rest unit

such as a pair of guide rails.

Next, the guide rails move toward each other to sandwich the metal frame of the frame unit in predetermined directions to adjust the position of the frame unit in the predetermined directions. Thereafter, the frame unit is delivered from the guide rails to a processing unit by a second delivery unit such as a suction arm that attracts the metal frame under suction. Since the delivery units and the temporary rest unit deliver the frame unit by contacting the metal frame, they deliver the frame unit without contacting the workpiece. Furthermore, after the workpiece in the frame unit has been divided into a plurality of device chips, the device chips remain stuck to the resin sheet and hence can easily be delivered all together. The workpiece can be divided by a cutting apparatus having a cutting blade or a sheet expanding apparatus for expanding the resin sheet thereby to apply external forces to the workpiece (see, for example, Japanese Patent Laid-open No. 2018-181921).

In a processing apparatus such as a cutting apparatus, a sheet expanding apparatus, a frame unit is delivered to various spots in the processing apparatus by a delivery unit. Usually, transmissive or reflective

photoelectric sensors are disposed in various places in the processing apparatus for recognizing spots where the frame unit is positioned in the processing apparatus. The photoelectric sensor has a light emitter for emitting light and a light detector for detecting the light emitted from the light emitter, for example. In a case where transmissive photoelectric sensors are used, when the frame unit is positioned between the light emitter and the light detector, the light emitted from the light emitter is blocked by the frame unit and the amount of light detected by the light detector is reduced. The light detector converts the reduced amount of light into an electric signal and outputs the electric signal to a controller of the processing apparatus. The controller now recognizes the frame unit from the received electric signal.

SUMMARY OF THE INVENTION

With the photoelectric sensor, however, the positional relation between the light emitter and the light detector needs to be adjusted in advance in order that the amount of light detected by the light detector will be reduced as the frame unit blocks the light from the light emitter. Furthermore, of the components of the

processing apparatus, those which are small compared to the push-pull arm, the guide rails, etc. may fail to provide enough support for installing transmissive or reflective photoelectric sensors thereon. The present invention has been made in view of the above problems of the related art. It is an object of the present invention to provide a processing apparatus that is capable of detecting the position of a frame unit without the need for adjusting in advance the positional relation between a light emitter and a light detector and at components on which a photoelectric sensor cannot be installed.

In accordance with an aspect of the present invention, there is provided a processing apparatus including a temporary rest unit for temporarily placing thereon a frame unit in which a workpiece is supported on an electrically conductive annular frame by a resin sheet, a delivery unit for delivering the frame unit to the temporary rest unit, and a processing unit for processing the workpiece of the frame unit, in which the temporary rest unit includes a plurality of electrically conductive support portions for supporting the frame unit thereon, the electrically conductive support portions including a first support portion and a second support portion, and a detection unit including a power supply having a terminal

electrically connected to the first support portion, and a conduction detector electrically connected to the second support portion and another terminal of the power supply, and when the electrically conductive annular frame is supported on the first support portion and the second support portion, a conduction circuit is made that includes the electrically conductive annular frame, the first support portion, the second support portion, the power supply, and the conduction detector.

Preferably, the plurality of support portions of the temporary rest unit includes at least three support pins, and the at least three support pins support an outer circumferential portion of the electrically conductive annular frame at at least three locations thereon and position the frame unit in a predetermined position.

Preferably, the plurality of support portions of the temporary rest unit includes a pair of guide rails for supporting the electrically conductive annular frame thereon.

The processing apparatus according to the aspect of the present invention includes the temporary rest unit for temporarily placing the frame unit thereon. The temporary rest unit includes the plurality of

electrically conductive support portions for supporting the frame unit thereon, the electrically conductive support portions including the first support portion and the second support portion, and the detection unit. The detection unit includes the power supply having the terminal electrically connected to the first support portion, and the conduction detector electrically connected to the second support portion and the other terminal of the power supply. When the electrically conductive annular frame is supported on the first support portion and the second support portion, the conduction circuit is made which includes the electrically conductive annular frame contacting the support portions, the power supply, and the conduction detector. The conductor detector detects whether or not there is a frame unit on the temporary rest unit by detecting whether or not there is conduction, i.e., whether or not the conduction circuit is made. Since the conductor detector detects whether or not there is a frame unit on the basis of the making of the conduction circuit, the detection unit does not require a transmissive or reflective photoelectric sensor. It is therefore not necessary to adjust in advance the positional relation between a light emitter and a light

detector which would otherwise be included in a photoelectric sensor. Since the conduction circuit can be constructed by connecting wires to the support portions, i.e., components, of the processing apparatus, the detection unit can be constructed without being affected by the size of the components and also without suffering from spatial limitations in the processing apparatus.

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

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a frame unit;

FIG. 2 is a plan view of an expanding unit, etc. disposed in a second processing region of a processing apparatus;

FIG. 3 is a cross-sectional view, partly in side elevation, of a centering unit of the processing apparatus;

FIG. 4 is a plan view of the centering unit, etc.

at the time the centering unit adjusts the frame unit in position;

FIG. 5 is a cross-sectional view, partly in side elevation, of the centering unit, etc. at the time a conduction circuit is made;

FIG. 6A is a cross-sectional view, partly in side elevation, of the expanding unit, etc.;

FIG. 6B is a cross-sectional view, partly in side elevation, of the frame unit placed on an annular table, etc.;

FIG. 7A is a cross-sectional view, partly in side elevation, of the expanding unit, etc. at the time a wafer is divided;

FIG. 7B is a cross-sectional view, partly in side elevation, of the expanding unit, etc. at the time an expandable sheet is heated;

FIG. 8 is a plan view of a pair of guide rails, etc.; and

FIG. 9 is a cross-sectional view, partly in side elevation, of the guide rails, etc.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the present invention will be described below with reference to the

accompanying drawings. First, as illustrated in FIG. 1, a frame unit 5 where a wafer, i.e., a workpiece, 11 is supported on an annular frame 7 by an expandable sheet, i.e., a resin sheet, 9 will be described below. FIG. 1 illustrates the frame unit 5 in perspective. The frame 7 is made of a metal material such as aluminum or stainless steel and is electrically conductive. The frame 7 has an opening defined therein that is larger in diameter than the wafer 11. The expandable sheet 9 is a resin sheet that is expandable and shrinkable, and is also referred to as "dicing tape."

The expandable sheet 9 is a circular sheet that is larger in diameter than the opening of the frame 7. The expandable sheet 9 is of a layered structure including a base layer and an adhesive layer, i.e., a glue layer, for example. The base layer is made of a polyolefin (PO) resin, for example. The adhesive layer that is made of an adhesive resin such as ultraviolet (UV)-curable resin and is disposed wholly or partly on one surface of the base layer. The wafer 11 is a disk-shaped silicon wafer, for example. The wafer 11 has a face side 11a demarcated into a plurality of areas by a grid of projected dicing lines 13. Devices 15 such as integrated circuits (ICs), large-scale-integration (LSI) circuits, or light-emitting

diodes (LEDs) are formed respectively in the areas demarcated by the projected dicing lines 13. The wafer 11 includes fragile layers, also referred to as "modified layers," formed therein along the projected dicing lines 13 and acts as division initiating points when the wafer 11 is to be divided. The wafer 11 is disposed substantially centrally in the opening of the frame 7 and spaced radially inwardly from the frame 7. The adhesive layer of the expandable sheet 9 is affixed to a reverse side 11b of the wafer 11 and one surface of the frame 7.

One or more frame units 5 are housed in a cassette, not illustrated, and the cassette is delivered to a sheet expanding apparatus, i.e., a processing apparatus, 2 (see FIG. 2). The sheet expanding apparatus 2 includes a cassette rest, not illustrated, that is movable in vertical directions, i.e., Z-axis directions or heightwise directions, by an elevator. The cassette delivered to the sheet expanding apparatus is placed on the cassette rest. A first processing region, not illustrated, including a pair of guide rails, not illustrated, is disposed rearwardly of the cassette rest in one of Y-axis directions. A first push-pull arm, not illustrated, for gaining access to the cassette on the cassette rest is disposed above the first processing

region.

A first temporary rest region, not illustrated, including another pair of guide rails, not illustrated, is disposed leftwardly of the first processing region in one of X-axis directions. The first temporary rest region and the first processing region are disposed one on each side of a suction arm, not illustrated, that can access both the first temporary rest region and the first processing region. A second push-pull arm 4 (see FIG. 2) for delivering a frame unit 5 is disposed above the first temporary rest region. A second processing region A is disposed forwardly of a second temporary rest region in the other of the Y-axis directions. The second processing region A includes an expanding unit, i.e., a processing unit, 20 (see FIG. 2) having a pair of guide rails 6-1 and 6-2.

FIG. 2 illustrates in plan the expanding unit 20, etc. of the second processing region A. FIG. 2 illustrates only the guide rails 6-1 and 6-2 of the components of the expanding unit 20. The guide rails 6-1 and 6-2 include respective substantially flat plate-shaped horizontal portions 6a extending substantially parallel to first directions, i.e., the Y-axis directions. The guide rails 6-1 and 6-2 also include respective

substantially flat plate-shaped vertical portion 6b perpendicular to the horizontal portions 6a, on outer sides thereof opposite to their inner sides where the guide rails 6-1 and 6-2 face each other.

According to the present embodiment, each of the guide rails 6-1 and 6-2 is made in its entirety of an electrically conductive material such as metal. However, each of the guide rails 6-1 and 6-2 may not be made in its entirety of an electrically conductive material. As long as at least the horizontal portion 6a of each of the guide rails 6-1 and 6-2 is made of an electrically conductive material, the vertical portion 6b of each of the guide rails 6-1 and 6-2 may be made of an electrically nonconductive material. The portions of the guide rails 6-1 and 6-2 that are made of an electrically conductive material are electrically connected to a controller, to be described later, of the sheet expanding apparatus 2 through wires, terminals, etc. For example, when the guide rails 6-1 and 6-2 are electrically connected to each other by the annular frame 7 of a frame unit 5 placed thereon, as illustrated in FIG. 2, the controller can recognize that the frame unit 5 is supported on the guide rails 6-1 and 6-2.

In a case where the frame unit 5 is supported on

the guide rails 6-1 and 6-2 with the face side 11a of the wafer 11 facing downwardly, the horizontal portions 6a support thereon the other surface of the frame 7 to which the adhesive layer of the expandable sheet 9 is not affixed, and the vertical portions 6b sandwich an outer circumferential edge of the frame 7. When the guide rails 6-1 and 6-2 are moved toward each other in second directions, i.e., the X-axis directions, the frame unit 5 is adjusted to a predetermined position in the second directions.

The guide rails 6-1 and 6-2 of the second processing region A function as a delivery unit. After having adjusted the frame unit 5 in position, the guide rails 6-1 and 6-2 transfer, i.e., deliver, the frame unit 5 to a centering unit, i.e., a temporary unit, 8 (see FIGS. 3 and 4). The centering unit 8 will be described below with reference to FIGS. 3 and 4. FIG. 3 illustrates the centering unit 8 in cross section, partly in side elevation. In FIG. 3, some components are illustrated as symbols and a block.

The centering unit 8 has a frame 10 made of stainless steel. The frame 10 is of a rectangular plate-like shape having a circular opening 10a defined centrally therein. Air cylinders, not illustrated, are

disposed on an upper surface 10b of the frame 10 at respective four corners thereof. The air cylinders have respective cylinder tubes in which end portions of respective piston rods 12 are inserted. Pistons, not illustrated, are connected to respective ends of the piston rods 12 and axially movably positioned in the cylinder tubes.

Frame support pins, e.g., support portions, 14-1, 14-2, 14-3, and 14-4, which are also referred to as frame support pins 14, are disposed on the respective other ends of the piston rods 12 perpendicularly to the upper surface 10b of the frame 10. The frame support pins 14 include respective slender cylindrical portions 14a having upper ends fixed to the respective other ends of the piston rods 12. The cylindrical portions 14a are inserted in through slots, not illustrated, formed in the frame 10 along the directions in which the piston rods 12 are movable. The through slots extend through the frame 10 from the upper surface 10b to a lower surface 10c thereof. The cylindrical portions 14a have respective lower ends projecting downwardly from the lower surface 10c. Disk-shaped members 14b that are larger in diameter than the cylindrical portions 14a are fixed respectively to the lower ends of the cylindrical portions 14a.

The frame support pins 14 are positioned inwardly of ranges in which the guide rails 6-1 and 6-2 are movable so that the frame support pins 14 are kept out of physical interference with the guide rails 6-1 and 6-2 (see FIG. 4). According to the present embodiment, the centering unit 8 includes the four frame support pins 14-1, 14-2, 14-3, and 14-4, as described above. FIG. 4 illustrates in plan the centering unit 8, etc. at the time the centering unit 8 adjusts the frame unit 5 in position. In FIG. 4, the frame 10 is omitted from illustration. The four cylindrical portions 14a of the frame support pins 14 contact and move the outer circumferential edge of the frame 7 to adjust the position of the frame unit 5 in a horizontal plane. The frame unit 5 has its outer circumferential portions vertically supported on the disk-shaped members 14b.

Air cylinders and frame support pins 14 may be disposed on the frame 10 at any three of the four corners thereof, or may alternatively be disposed on the frame 10 at five or more locations thereon. Specifically, frame support pins 14 may be disposed at three or more locations on the frame 10, and the frame unit 5 may be supported on the three or more frame support pins 14. In this case, the frame unit 5 is supported at three or more

locations on the outer circumferential portion thereof by the three or more frame support pins 14.

Each of the frame support pins 14 is made of metal and is hence electrically conductive. Any two of the frame support pins 14 are electrically connected to each other by wires or the like. According to the present embodiment, as illustrated in FIG. 3, the two frame support pins 14-1 and 14-2 that are positioned on a rear portion of the frame 10 are electrically connected to each other by wires or the like. According to the present invention, however, any two of the frame support pins 14, not necessarily the two frame support pins 14-1 and 14-2, may be electrically connected to each other by wires or the like.

As illustrated in FIG. 5, the frame support pin 14-1, i.e., a first support portion, is electrically connected to a first terminal B1 of a wiring board, not illustrated, outside of the frame 10. The wiring board has a power supply 16a having a terminal electrically connected to the first terminal B1. The frame support pin 14-2, i.e., a second support portion, is electrically connected to a second terminal B2 of the wiring board. The wiring board has a resistor 16b and a conduction detector 16c such as a photocouple that includes an LED

and a photodiode, the resistor 16b and the conduction detector 16c being connected in series to each other. The second terminal B2 is electrically connected to the resistor 16b.

The resistor 16b is electrically connected to an end of the conduction detector 16c, e.g., the anode of the LED of the photocoupler. The other end of the conduction detector 16c, e.g., the cathode of the LED of the photocoupler, is connected to the other terminal of the power supply 16a. The resistor 16b is used for adjusting the voltage applied to the conduction detector 16c, e.g., the LED of the photocoupler. The power supply 16a, the resistor 16b, and the conduction detector 16c jointly make up a detection unit 18 for detecting when the frame unit 5 is placed in the centering unit 8. When the frame unit 5 is supported on the four frame support pins 14, the frame 7 contacts the frame support pins 14.

When the frame 7 contacts the frame support pins 14, a conduction circuit is made which includes the frame 7, the frame support pins 14-1 and 14-2, the power supply 16a, the resistor 16b, and the conduction detector 16c. When the conduction circuit is made, the conduction detector 16c detects electrical conduction. When the conduction detector 16c detects electrical conduction, it

outputs an electric signal to the controller, not illustrated, of the sheet expanding apparatus 2. The controller now recognizes that the frame unit 5 is placed in the centering unit 8 of the expanding unit 20. The controller is constructed as a computer including a processing apparatus such as a central processing unit (CPU) and a storage apparatus such as a flash memory or the like. When the processing apparatus operates according to software such as programs stored in the storage apparatus, the controller functions as specific means realized by cooperation between the software and the processing apparatus, i.e., a hardware resource.

According to the present embodiment, the wiring board that includes the power supply 16a, the resistor 16b, and the conduction detector 16c is disposed outside of the frame 10. The frame support pins 14 are free of light emitters and light detectors that make up photoelectric sensors but are connected to only wires. Though it is relatively difficult to provide transmissive or reflective photoelectric sensors on the frame support pins 14, it is easy to connect wires to the frame support pins 14. By connecting wires to the frame support pins 14, the detection unit 18 can be constructed without being affected by the size of the frame support pins 14 and

furthermore without suffering from spatial limitations around the centering unit 8.

For adjusting the position of the frame unit 5 using the centering unit 8, the frame unit 5 prior to being processed by the expanding unit 20 is temporarily placed in the centering unit 8. Then, the air cylinders are actuated to position the frame unit 5 in a predetermined position while supporting the frame unit 5 on the four frame support pins 14. Specifically, the frame unit 5 is adjusted in position such that the wafer 11 is positioned directly below the opening 10a and the frame 7 is positioned directly below the frame 10. At this time, the conduction circuit referred to above is made. FIG. 5 illustrates in cross section, partly in side elevation, the centering unit 8, etc. at the time the conduction circuit is made.

Details of the expanding unit 20 will be described below. FIG. 6A illustrates the expanding unit, etc. in cross section, partly in side elevation. As illustrated in FIG. 6A, the expanding unit 20 includes a pressing member 22 in addition to the guide rails 6-1 and 6-2 and the centering unit 8. The pressing member 22 is of a cylindrical shape. The diameter of the pressing member 22 is larger than the diameter of the wafer 11 and smaller

than the diameter of the opening 10a. The pressing member 22 has an upper portion fixed to a bracket, not illustrated. The pressing member 22 has a lower portion including a porous plate, not illustrated, disposed therein.

The porous plate has an upper surface to which there is connected a suction source, not illustrated, such as an ejector through a fluid channel. When the suction source is actuated, a negative pressure is developed in a lower surface of the porous plate, i.e., a lower surface 22a of the pressing member 22. The porous plate may be replaced with a plurality of suction ports defined in the lower surface 22a. The lower surface 22a is positioned lower than the lower surface of the frame 10. A plurality of rollers 22b are mounted on an outer circumferential portion of the lower surface 22a of the pressing member 22. A lifting and lowering member 24 is disposed below the lower surface 22a of the pressing member 22. The lifting and lowering member 24 has a ball screw 24a extending along the heightwise directions of the sheet expanding apparatus 2. The ball screw 24a has a lower end coupled to an electric motor 24b.

The ball screw 24a has an upper end on which a disk-shaped stopper 24c is disposed. The ball screw 24a

is rotatably threaded through a nut 24d disposed between the stopper 24c and the electric motor 24b. The nut 24d is fixed to a plurality of radial arms 26 disposed laterally of the nut 24d. In FIG. 6A, two radial arms 26 are illustrated. The arms 26 have radially outer end portions on which a hollow cylindrical member 28 is disposed in surrounding relation to the ball screw 24a. An annular table 30 having a substantially horizontal upper surface for supporting the frame 7 thereon is disposed on an upper portion of the hollow cylindrical member 28.

A plurality of columnar members 32 is disposed in a region between the hollow cylindrical member 28 and the ball screw 24a in surrounding relation to the ball screw 24a. There are as many columnar members 32 as the number of the arms 26, and the columnar members 32 have their lower ends fixed to the respective arms 26. Heaters 34 for giving off heat are disposed on respective upper ends of the columnar members 32. When the frame unit 5 is placed on the annular table 30, the heaters 34 are positioned below a region between the wafer 11 and the frame 7.

A procedure of processing the wafer 11 using the expanding unit 20 will be described below. First, as

described above with reference to FIG. 2, the frame unit 5 is delivered from the second push-pull arm 4 onto the guide rails 6-1 and 6-2 in first delivering step (S10). After first delivering step (S10), the frame support pins 14 support the frame unit 5, and then the guide rails 6-1 and 6-2 are retracted away from the frame unit 5. The frame unit 5 is thus delivered from the guide rails 6-1 and 6-2 onto the frame support pins 14 in second delivering step (S20), as illustrated in FIG. 4.

After second delivering step (S20), as described above with reference to FIG. 4, the frame support pins 14 adjust the position of the frame unit 5, positioning the frame unit 5 substantially centrally in the opening 10a in centering step (S30). In centering step (S30), the detection unit 18 and the frame 7 make up a conduction circuit, as described above with reference to FIG. 5. The controller now recognizes that the frame unit 5 is placed in the expanding unit 20.

After centering step (S30), the electric motor 24b is energized to rotate the ball screw 24a about its own axis, lifting the nut 24d and the hollow cylindrical member 28, etc. until the upper surface of the annular table 30 is brought into contact with the other surface of the frame 7. Thereafter, the frame support pins 14 are

retracted radially outwardly, whereupon the frame unit 5 is delivered from the frame support pins 14 onto the annular table 30 in third delivering step (S40). FIG. 6B illustrates the frame unit 5 placed on the annular table 30, etc. in cross section partly in side elevation.

After third delivering step (S40), the electric motor 24b is energized again to lift the nut 24d and the hollow cylindrical member 28, etc. further. Specifically, the nut 24d is lifted until the expandable sheet 9 on the one surface of the frame 7 contacts the lower surface 10c of the frame 10, causing the pressing member 22 to press the reverse side 11b of the wafer 11. The expandable sheet 9 is now expanded radially outwardly, applying radially outward external forces to the wafer 11. Under the applied radially outward external forces, the wafer 11 is divided, i.e., processed, at the fragile layers formed therein as division initiating points along the projected dicing lines 13, into a plurality of device chips 17 in dividing step (S50). FIG. 7A illustrates the expanding unit 20, etc. at the time the wafer 11 is divided in cross section partly in side elevation.

After dividing step (S50), the suction source is actuated to apply a negative pressure to the lower surface 22a of the pressing member 22, which holds the

expandable sheet 9 under suction. Then, the electric motor 24 is reversed to lower the hollow cylindrical member 28, etc. until the one surface of the frame 7 lies substantially flush with the lower surface 22a of the pressing member 22. Thereafter, the heaters 34 are energized to heat the region between the wafer 11 and the frame 7 in thermally shrinking step (S60). FIG. 7B illustrates the expanding unit 20, etc. at the time the expandable sheet 9 is heated.

In thermally shrinking step (S60), an annular area of the expandable sheet 9 that is positioned radially outwardly of the device chips 17, i.e., in the region between the wafer 11 and the frame 7, is thermally shrunk by the heat from the heaters 34, removing the slack caused in the annular area of the expandable sheet 9 in dividing step (S50). Consequently, the distances between the device chips 17 are maintained in thermally shrinking step (S60). After thermally shrinking step (S60), the frame unit 5 is turned upside down by an inverting apparatus, not illustrated, and then delivered by the suction arm, not illustrated, as another delivery unit. Specifically, the frame unit 5 is delivered by the suction arm to a pair of guide rails 40-1 and 40-2 (see FIG. 8) of a temporary rest unit positioned in the first

processing region, denoted by C in FIG. 8, disposed rearwardly of the cassette rest.

FIG. 8 illustrates the guide rails 40-1 and 40-2, etc. in plan. The guide rails 40-1 and 40-2 are a temporary unit functioning as a plurality of support portions. The one surface of the frame 7 of the frame unit 5 delivered to the guide rails 40-1 and 40-2 is held in contact with the guide rails 40-1 and 40-2. The guide rails 40-1 and 40-2 are structurally and functionally identical to the guide rails 6-1 and 6-2. The guide rails 40-1 and 40-2 include respective horizontal portions 40a and respective vertical portion 40b. The horizontal portions 40a correspond to the horizontal portions 6a of the guide rails 6-1 and 6-2 and the vertical portions 40b correspond to the vertical portions 6b of the guide rails 6-1 and 6-2.

The guide rail 40-1, i.e., a first support portion, is electrically connected to a third terminal B3 (see FIG. 9) of a wiring board, not illustrated, outside of a first processing region C by a wire or the like. FIG. 9 illustrates the guide rails 40-1 and 40-2, etc. in cross section partly in side elevation. In FIG. 9, some components are illustrated as symbols and a block. The wiring board has a power supply 46a having a terminal

electrically connected to the third terminal B3. The guide rail 40-2, i.e., a second support portion, is electrically connected to a fourth terminal B4 of the wiring board, not illustrated, by a wire or the like. The wiring board has a resistor 46b and a conduction detector 46c such as a photocoupler that includes an LED and a photodiode, the resistor 46b and the conduction detector 46c being connected in series to each other. The fourth terminal B4 is electrically connected to the resistor 46b.

The resistor 46b is electrically connected to an end of the conduction detector 46c, e.g., the anode of the LED of the photocoupler. The other end of the conduction detector 46c, e.g., the cathode of the LED of the photocoupler, is connected to the other terminal of the power supply 46a. The power supply 46a, the resistor 46b, and the conduction detector 46c jointly make up a detection unit 48 for detecting when the frame unit 5 is placed on the guide rails 40-1 and 40-2. When the frame unit 5 is placed on the guide rail 40-1, i.e., the first support portion, and the guide rail 40-2, i.e., the second support portion, the frame 7, the guide rails 40-1 and 40-2, the power supply 46a, the resistor 46b, and the conduction detector 46c make a conduction circuit. When the conduction detector 46c detects electrical conduction

in the conduction circuit, it outputs an electric signal to the controller. The controller now recognizes that the frame unit 5 is placed on the guide rails 40-1 and 40-2 in the first processing region C.

An ultraviolet radiation applying unit, i.e., a processing unit, 50 for applying an ultraviolet radiation 52 upwardly to the frame unit 5 is disposed below the guide rails 40-1 and 40-2. A first push-pull arm 42 for delivering the frame unit 5 that has been irradiated with the ultraviolet radiation 52 to the cassette is disposed above the guide rails 40-1 and 40-2. For processing the wafer 11 with the ultraviolet radiation applying unit 50, the frame unit 5 is delivered onto the guide rails 40-1 and 40-2 by the suction arm in fourth delivering step (S100).

After fourth delivering step (S100), the guide rails 40-1 and 40-2 are moved closely to each other along the second directions, i.e., the X-axis directions, thereby adjusting the position of the frame unit 5 so that the frame unit 5 is positioned substantially centrally in the ultraviolet radiation applying unit 50 in centering step (S110). After centering step (S110), the ultraviolet radiation applying unit 50 applies the ultraviolet radiation 52 to the expandable sheet 9

thereby to cure the adhesive layer of the expandable sheet 9 in ultraviolet radiation applying step (S120).

By thus processing the adhesive layer with the ultraviolet radiation 52, the bonding strength of the adhesive layer is reduced. After ultraviolet radiation applying step (S120), the frame unit 5 is delivered to the cassette by the first push-pull arm 42 in fifth delivering step (S130). According to the present embodiment, the wiring board that includes the power supply 46a, the resistor 46b, and the conduction detector 46c is disposed outside of the frame 10. The guide rails 40-1 and 40-2 are free of light emitters and light detectors that make up photoelectric sensors but are connected to only wires. By connecting wires to the guide rails 40-1 and 40-2, the detection unit 18 can be constructed without suffering from spatial limitations around the guide rails 40-1 and 40-2.

The structural and functional details according to the present embodiment may be changed or modified without departing from the scope of the present invention. For example, the frame unit 5 that has been adjusted in position by the guide rails 40-1 and 40-2 may be delivered to a spinner cleaning unit, not illustrated, for cleaning the wafer 11 by a push-pull arm, not

illustrated. Furthermore, the delivery unit such as the push-pull arm, and the temporary rest unit such as the pair of guide rails may be applied to a processing unit such as a cutting unit having a cutting blade, a laser beam applying unit capable of applying a laser beam, or the like.

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

WHAT IS CLAIMED IS:

1. A processing apparatus comprising:

a temporary rest unit for temporarily placing thereon a frame unit in which a workpiece is supported on an electrically conductive annular frame by a resin sheet;

a delivery unit for delivering the frame unit to the temporary rest unit; and

a processing unit for processing the workpiece of the frame unit, wherein

the temporary rest unit includes

a plurality of electrically conductive support portions for supporting the frame unit thereon, the electrically conductive support portions including a first support portion and a second support portion, and

a detection unit having a power supply having a terminal electrically connected to the first support portion and a conduction detector electrically connected to the second support portion and another terminal of the power supply, and

when the electrically conductive annular frame is supported on the first support portion and the second support portion, a conduction circuit is made that includes the electrically conductive annular frame, the

first support portion, the second support portion, the power supply, and the conduction detector.

2. The processing apparatus according to claim 1, wherein

the plurality of support portions of the temporary rest unit includes at least three support pins, and

the at least three support pins support an outer circumferential portion of the electrically conductive annular frame at at least three locations thereon and position the frame unit in a predetermined position.

3. The processing apparatus according to claim 1, wherein

the plurality of support portions of the temporary rest unit includes a pair of guide rails for supporting the electrically conductive annular frame thereon.