CLEANING METHOD FOR A LIFT PIN AND SUBSTRATE PROCESSING APPARATUS

FIELD

[0001] A disclosed embodiment relates to a cleaning method for a lift pin and a substrate processing apparatus.

BACKGROUND

[0002] A technique has conventionally been provided that discharges, in a substrate processing apparatus that has a plurality of pins for executing delivery of a substrate from/to a transfer device, a cleaning liquid from a cleaning liquid nozzle to the plurality of pins during a period of time when substrate processing is not executed, so as to eliminate an attached substance that is attached to each pin (see Japanese Patent Application Publication No. 2017-069261).

[0003] The present disclosure provides a technique that is capable of reducing or preventing contamination in an apparatus and cleaning a lift pin.

SUMMARY

[0004] According to an aspect of an embodiment, a cleaning method for a lift pin in a substrate processing apparatus that includes: a rotatable rotating plate; a

plurality of supporting units that are provided on the rotating plate and support a substrate; a liquid discharge unit that discharges a cleaning liquid to a top surface of the substrate that is supported by the plurality of supporting units; and a plurality of lift pins that respectively pass through a plurality of passage units that are provided on the rotating plate and push the substrate upward, wherein the cleaning method for a lift pin comprises: a supporting step that supports the substrate by using the plurality of supporting units; and a cleaning step that discharges the cleaning liquid from the liquid discharge unit to the top surface of the substrate that is supported by the plurality of supporting units in a state where the plurality of lift pins are arranged at positions that are lower than the rotating plate, to clean the plurality of lift pins with the cleaning liquid that flows down from the plurality of passage units.

BRIEF DESCRIPTION OF DRAWINGS

[0005] FIG. 1 is a diagram that illustrates a general configuration of a substrate processing system according to an embodiment;

FIG. 2 is a diagram for explaining a configuration of a processing unit according to an embodiment;

FIG. 3 is an explanatory diagram of an operation of a gripping unit and a lift pin according to an embodiment;

FIG. 4 is a perspective view of a rotating plate according to an embodiment;

FIG. 5 is a plan view of a rotating plate according to an embodiment;

FIG. 6 is a flowchart that illustrates a series of processing procedures that is executed by a processing unit according to an embodiment;

FIG. 7 is a flowchart that illustrates processing procedures of a cleaning process according to an embodiment;

FIG. 8 is a diagram that illustrates an example of an operation of a first nozzle in a cleaning process according to an embodiment; and

FIG. 9 is a diagram that illustrates an example of an operation of a second nozzle in a cleaning process according to an embodiment.

DESCRIPTION OF EMBODIMENT

[0006] Hereinafter, a mode(s) (that will be described as "an embodiment(s)" below) for implementing a cleaning method for a lift pin and a substrate processing apparatus according to the present disclosure will be explained in detail with reference to the drawing(s). Additionally, a cleaning method for a lift pin and a substrate processing apparatus according to the present disclosure are not

limited by such an embodiment(s). Furthermore, it is possible to combine respective embodiments appropriately unless process contents thereof are inconsistent.

[0007] A substrate processing apparatus has been known that places a substrate on a rotating plate, rotates the substrate, and supplies a cleaning liquid from an upper side of such a rotating substrate to a top surface of the substrate so as to clean the substrate.

[0008] Furthermore, such a substrate processing apparatus may include a plurality of lift pins for executing delivery of a substrate from/to a transfer device. A plurality of lift pins and a substrate directly contact one another when delivery of the substrate from/to a transfer device is executed, so that, for example, a particle(s) that is/are attached to the plurality of lift pins may be attached to a bottom surface of the substrate. Hence, it is preferable to clean a plurality of lift pins regularly in a substrate processing apparatus.

[0009] However, like a technique as described in Patent Literature 1 as described above, as a cleaning liquid is directly discharged from a cleaning liquid nozzle to a plurality of lift pins, scattering of the cleaning liquid may occur on the plurality of lift pins. As scattering of a cleaning liquid on a plurality of lift pins occurs, for example, a particle(s) that is/are included in a scattered

cleaning liquid may be attached to (an)other component(s) other than a lift pin(s) in a substrate processing apparatus so as to cause contamination in the substrate processing apparatus.

[0010] Hence, provision of a technique that is capable of reducing or preventing contamination in an apparatus and cleaning a lift pin(s) is desired.

[0011] Configuration of Substrate Processing System

FIG. 1 is a diagram that illustrates a general configuration of a substrate processing system according to an embodiment. Hereinafter, in order to clarify a positional relationship, an X-axis, a Y-axis, and a Z-axis that are orthogonal to one another are defined where a positive direction of the Z-axis is a vertically upward direction.

[0012] As illustrated in FIG. 1, a substrate processing system 1 includes a carrying-in/out station 2 and a processing station 3. The carrying-in/out station 2 and the processing station 3 are provided adjacently.

[0013] The carrying-in/out station 2 includes a carrier placing section 11 and a transfer section 12. In the carrier placing section 11, a plurality of carriers C that house a plurality of substrates, in the present embodiment, semiconductor wafers (wafers W, below) in a horizontal state are placed.

[0014] The transfer section 12 is provided so as to be adjacent to the carrier placing section 11 and includes a substrate transfer device 13 and a delivery unit 14 in an inside thereof. The substrate transfer device 13 includes a wafer holding mechanism that holds a wafer W. Furthermore, the substrate transfer device 13 is capable of moving in a horizontal direction and a vertical direction and turning around a vertical axis as a center, and executes transfer of a wafer W between a carrier C and the delivery unit 14 by using a wafer holding mechanism.

[0015] The processing station 3 is provided so as to be adjacent to the transfer section 12. The processing station 3 includes a transfer section 15 and a plurality of processing units 16. The plurality of processing units 16 are provided side by side on both sides of the transfer section 15.

[0016] The transfer section 15 includes a substrate transfer device 17 in an inside thereof. The substrate transfer device 17 includes a wafer holding mechanism that holds a wafer W. Furthermore, the substrate transfer device 17 is capable of moving in a horizontal direction and a vertical direction and turning around a vertical axis as a center, and executes transfer of a wafer W between the delivery unit 14 and a processing unit 16 by using a wafer holding mechanism.

[0017] A processing unit 16 executes predetermined substrate processing for a wafer W that is transferred by the substrate transfer device 17. Furthermore, a processing unit 16 executes a cleaning process for a lift pin 23H as described later (see FIG. 2 and FIG. 3) that is provided in the processing unit 16 by using a wafer W that is transferred by the substrate transfer device 17.

[0018] Furthermore, the substrate processing system 1 includes a control device 4. The control device 4 is, for example, a computer and includes a controller 18 and a storage 19. The storage 19 stores a program that controls various types of processes that are executed in the substrate processing system 1. The controller 18 reads and executes a program that is stored in the storage 19 so as to control an operation of the substrate processing system 1.

[0019] Additionally, such a program may be recorded in a computer-readable storage medium and be installed in the storage 19 of the control device 4 from such a storage medium. For a computer-readable storage medium, for example, a hard disk (HD), a flexible disk (FD), a compact disk (CD), a magnetooptical disk (MO), a memory card, etc., are provided.

[0020] In the substrate processing system 1 that is configured as described above, first, the substrate

transfer device 13 of the carrying-in/out station 2 takes a wafer W from a carrier C that is placed in the carrier placing section 11 and places a taken wafer W on the delivery unit 14. A wafer W that is placed on the delivery unit 14 is taken from the delivery unit 14 by the substrate transfer device 17 of the processing station 3 and is carried in a processing unit 16.

[0021] A wafer W that is carried in a processing unit 16 is processed by the processing unit 16, subsequently is carried out of the processing unit 16 by the substrate transfer device 17, and is placed on the delivery unit 14. Then, a processed wafer W that is placed on the delivery unit 14 is returned to a carrier C of the carrier placing section 11 by the substrate transfer device 13.

[0022] Configuration of Processing Unit

Next, a configuration of a processing unit 16 will be explained with reference to FIG. 2. FIG. 2 is a diagram for explaining a configuration of a processing unit 16 according to an embodiment.

[0023] As illustrated in FIG. 2, a processing unit 16 includes a housing 21, a cup unit 22 with a substantially cylindrical shape and an opened top surface that is provided on an central part in the housing 21, and a wafer holding/rotating unit 23 that is arranged inside the cup unit 22 and is capable of holding and rotating a wafer W.

Furthermore, a processing unit 16 includes a first supply unit 24 and a second supply unit 25 that supply a cleaning liquid to a wafer W that is held by the wafer holding/rotating unit 23.

[0024] On the housing 21, a non-illustrated transfer port for carrying a wafer W in/out of the housing 21 is formed by a substrate transfer device 17 (see FIG. 1). A non-illustrated shutter is provided for a transfer port where the shutter is opened at a time of carrying in/out thereof and the shutter is closed at a time of processing thereof so as to close the transfer port.

[0025] The cup unit 22 receives a cleaning liquid that is supplied to a wafer W and discharges the cleaning liquid from a non-illustrated drain.

[0026] The wafer holding/rotating unit 23 has a rotating shaft 23S that is connected to a motor M that is arranged below the housing 21 so as to rotate, and a rotating plate 23P that is attached to the rotating shaft 23S on a central part of a bottom surface thereof. Additionally, the motor M and the rotating shaft 23S are an example of a rotating mechanism that rotates the rotating plate 23P.

[0027] The first supply unit 24 moves from an outside of a wafer W to an upper side of the wafer W and supplies a first cleaning liquid, a rinse liquid, and a gas for drying toward a top surface of the wafer W that is held by the

wafer holding/rotating unit 23. A first cleaning liquid is, for example, an alkaline aqueous solution or a mixed liquid of an alkaline aqueous solution and a DIW (a pure water). A temperature of a first cleaning liquid is lower than 70 °C. For an alkaline aqueous solution, it is possible to use, for example, an inorganic alkaline aqueous solution or an organic alkaline aqueous solution. An inorganic alkaline aqueous solution is, for example, SC1 liquid (a mixed liquid of ammonia and a hydrogen peroxide solution). An organic alkaline aqueous solution is, for example, a solution that includes at least one of THAM (tetramethylammonium hydroxide) and an aqueous solution of choline. Furthermore, a rinse liquid is, for example, a DIW. Furthermore, a gas for drying is, for example, an N_2 gas.

[0028] The first supply unit 24 includes a first arm 24a that supports a first nozzle 24A, a rinse nozzle 24B, and a nozzle for drying 24C, and a turning/lifting/lowering mechanism 24b that turns the first arm 24a in a horizontal direction and lifts/lowers it in an upward/downward direction. Additionally, the first supply unit 24 may include a moving mechanism that moves the first arm 24a in a horizontal direction, although illustration thereof is omitted.

[0029] The first nozzle 24A is connected to a chemical

liquid supply source 31 through a flow control mechanism 26a such as a valve. The chemical liquid supply source 31 is, for example, a tank, and stores a chemical liquid such as an alkaline aqueous solution or a mixed solution of an alkaline aqueous solution and a DIW (a pure water), as a first cleaning liquid. The first nozzle 24A discharges a first cleaning liquid to a top surface of a wafer W. The first nozzle 24A is an example of a first liquid discharge unit.

[0030] The rinse nozzle 24B is connected to a DIW supply source 32 through a flow control mechanism 26b such as a valve. The DIW supply source 32 is, for example, a tank and stores a DIW as a rinse liquid. The rinse nozzle 24B discharges a rinse liquid to a top surface of a wafer W.

[0031] The nozzle for drying 24C is connected to an N_2 gas supply source 33 through a flow control mechanism 26c such as a valve. The N_2 gas supply source 33 is, for example, a tank and stores an N_2 gas. The nozzle for drying 24C discharges an N_2 gas that is a gas for drying to a top surface of a wafer W.

[0032] The second supply unit 25 moves from an outside of a wafer W to an upper side of the wafer W and supplies a second cleaning liquid toward a top surface of the wafer W that is held by the wafer holding/rotating unit 23. A second cleaning liquid is a mixed fluid of a liquid and a

gas. For a liquid, it is possible to use a solution that is obtained by dissolving at least one of a CO_2 gas, an ammonia gas, and an ammonia water in a DIW where such a liquid is also called a functional water. In a case where a liquid as a functional water is a solution that is obtained by dissolving a CO_2 gas in a DIW, it is preferable that a resistivity of a liquid is less than 0.1 (MΩ·cm). Furthermore, in a case where a liquid as a functional water is a solution that is obtained by dissolving at least one of an ammonia gas and an ammonia water in a DIW, it is preferable that a concentration of ammonia in a liquid is 1 (ppm) or greater and 100 (ppm) or less. As a functional water is used as a liquid that is included in a mixed fluid that is a second cleaning liquid, electricity removal of a wafer W is executed, so that damage (an electrostatic breakdown) that is received by a wafer W when a second cleaning liquid contacts the wafer W is reduced or prevented. For a gas, it is possible to use an N_2 gas.

[0033] The second supply unit 25 includes a second arm 25a that supports the second nozzle 25A, and a turning/lifting/lowering mechanism 25b that turns the second arm 25a in a horizontal direction and lifts/lowers it in an upward/downward direction. Additionally, the second supply unit 25 may include a moving mechanism that moves the second arm 25a in a horizontal direction,

although illustration thereof is omitted.

[0034] The second nozzle 25A is connected to a functional water supply source 34 through a flow control mechanism 26d such as a valve. The functional water supply source 34 is, for example, a tank, and stores a function water. Furthermore, the second nozzle 25A is connected to an N_2 gas supply source 33 through a flow control mechanism 26e such as a valve. The second nozzle 25A is, for example, a two-fluid nozzle, mixes a functional water and an N_2 gas in an inside thereof so as to produce a mixed fluid that is a second cleaning liquid, and discharges the second cleaning liquid to a top surface of a wafer W. A pressure of an N_2 gas that is supplied to the second nozzle 25A is comparatively high, so that it is possible for the second nozzle 25A to cause a top surface of a wafer W to attract a mixed fluid at a high pressure. The second nozzle 25A is an example of a second liquid discharge unit.

[0035] On the rotating shaft 23S, a conduit 23C that penetrates through a central part thereof is formed. The conduit 23C is connected to the N_2 gas supply source 33 through a flow control mechanism 26f such as a valve. A space is formed between the rotating plate 23P of the wafer holding/rotating unit 23 and a wafer W that is held by the wafer holding/rotating unit 23, so that an N_2 gas that passes through the conduit 23C flows out to such a space

from an upper end of the conduit 23C and flows toward an outer periphery thereof. As the wafer holding/rotating unit 23 and a wafer W are rotated, a pressure in a space between the rotating plate 23P and the wafer W is more negative than that in a space above the wafer W. Then, a central part of a wafer W may be bent so as to degrade flatness of a top surface of the wafer W and also degrade uniformity of liquid processing. However, such a space is supplied with a N_2 gas, so that it is possible to reduce or prevent bending of a central part of a wafer W. Furthermore, an N_2 gas blows out of a space between the rotating plate 23P and a wafer W, so that it is possible to obtain an advantageous effect in such a manner that attaching of a processing liquid that is supplied to a top surface of the wafer W to a bottom surface thereof is reduced.

[0036] Additionally, a gas that is supplied from the conduit 23C is not limited to an N_2 gas and may be another inert gas such as an argon gas, dry air, etc.

[0037] The rotating plate 23P is a member that has a shape of a circular plate that is capable of being rotated by a motor M and the rotating shaft 23S. On a peripheral part of the rotating plate 23P, a plurality of gripping units 23G (where only one thereof is illustrated in FIG. 2) that hold a peripheral part of a wafer W so as to grip the

wafer W from a lateral side thereof are provided.

[0038] Each gripping unit 23G has a lever member 23L that is capable of turning around a turning axis 23T and a gripping piece 23A that is turned in association with turning of the lever member 23L so as to be capable of contacting a peripheral part of a wafer W. Below each lever member 23L, a push-up plate 41 that is capable of contacting one end of the lever member 23L is provided. The push-up plate 41 extends in a horizontal direction and is supported from below by a plurality of supporting members 42 that extend in a vertical direction. The plurality of supporting members 42 are supported from below by an arm member 43 that extends in a horizontal direction and the arm member 43 is moved upward/downward by a lifting/lowering mechanism 44.

[0039] Furthermore, below the rotating plate 23P, a plurality of lift pins 23H (where only one thereof is illustrated in FIG. 2) that support a peripheral part of a wafer W from below and move the wafer W upward/downward when delivery of the wafer W from/to the substrate transfer device 17 (see FIG. 1) is executed are provided. Each lift pin 23H extends in a vertical direction and is supported by an arm member 51 that extends in a horizontal direction. The arm member 51 is moved upward/downward by a lifting/lowering mechanism 52.

[0040] Herein, an operation of a gripping unit 23G and a lift pin 23H as described above will be explained with reference to FIG. 3. FIG. 3 is an explanatory diagram of an operation of a gripping unit 23G and a lift pin 23H according to an embodiment.

[0041] As illustrated in FIG. 3, at a time of carrying-in of a wafer W, a push-up plate 41 is moved upward by a lifting/lowering mechanism 44 so as to push one end of a lever member 23L of a gripping unit 23G upward. Hence, a gripping piece 23A that is provided on another end of the lever member 23L slopes outward.

[0042] Furthermore, at a time of carrying-in of a wafer W, a lift pin 23H is moved upward by a lifting/lowering mechanism 52 so as to be provided in a state where it is arranged at a position that is higher than a rotating plate 23P.

[0043] On a peripheral part of the rotating plate 23P, a passage unit 65 that causes the lift pin 23H to pass therethrough is formed. The passage unit 65 is a cut part where an outer periphery of the rotating plate 23P is cut toward an inside thereof in a radial direction thereof. Although a plurality of passage units 65 are provided on the rotating plate 23P, FIG. 2 and FIG. 3 illustrate only one passage unit 65.

[0044] At a time of carrying-in of a wafer W, the lift

pin 23H is lifted by the lifting/lowering mechanism 52 so as to pass through the passage unit 65 that is provided on the rotating plate 23P and be arranged at a position that is higher than the rotating plate 23P.

[0045] A wafer W that is carried in a housing 21 is delivered from a substrate transfer device 17 to a plurality of lift pins 23H. Subsequently, as the plurality of lift pins 23H are lowered to a position that is lower than the rotating plate 23P, the push-up plate 41 is lowered. Thereby, a state of contact between the push-up plate 41 and the lever member 23L is broken, so that the lever member 23L is turned around a turning axis 23T as a center and accordingly a gripping piece 23A is pressed against a peripheral part of a wafer W. Gripping pieces 23A of a plurality of gripping units 23G are pressed against a peripheral part of a wafer W, so that the wafer W is gripped. As a motor M is rotated in such a state, the rotating plate 23P and the gripping units 23G that are attached thereto are rotated, so that a wafer W that is gripped by the gripping units 23G on the rotating plate 23P is rotated.

[0046] At a time of carrying-out of a wafer W, as gripping of the wafer W by the plurality of gripping units 23G is terminated, the lift pin 23H is lifted by the lifting/lowering mechanism 52 so as to pass through the

passage unit 65 that is provided on the rotating plate 23P and contact the wafer W from below. Then, the lift pin 23H pushes a wafer W upward. A wafer W that is pushed upward by the lift pin 23H is delivered to the substrate transfer device 17 and is carried out of the housing 21 by the substrate transfer device 17.

[0047] Configuration of Rotating Plate

Next, a configuration of a rotating plate 23P will be explained by using FIG. 4 and FIG. 5. FIG. 4 is a perspective view of a rotating plate 23P according to an embodiment and FIG. 5 is a plan view of a rotating plate 23P according to an embodiment.

[0048] As illustrated in FIG. 4 and FIG. 5, a rotating plate 23P includes a first flat part 61, a sloping part 62, and a second flat part 63.

[0049] The first flat part 61 has a shape of a circular plate with a diameter that is less than that of a wafer W. On a central part of the first flat part 61, an opening part 61a for supplying an N_2 gas to a bottom surface of a wafer W is provided.

[0050] The sloping part 62 is arranged so as to be adjacent to an outer periphery of the first flat part 61. The sloping part 62 has a diameter that is greater than that of a wafer W and a sloping surface that slopes downward from an outside of the wafer W (the second flat

part 63) toward an inside of the wafer W (the first flat part 61). Such a sloping surface extends along a peripheral direction of a wafer W. Specifically, a sloping surface of the sloping part 62 is provided on a whole circumference of an outer periphery of the first flat part 61. The second flat part 63 has a flat surface that is adjacent to an outer periphery of the sloping part 62.

[0051] Furthermore, the rotating plate 23P is provided with a plurality of cut parts 64, a plurality of passage parts 65, a plurality of supporting parts 66, and a plurality of raising parts 67.

[0052] The plurality of cut parts 64 are cut parts where respective parts of the rotating plate 23P on an outer periphery thereof that correspond to a plurality of gripping pieces 23A are cut away toward an inside thereof in a radial direction thereof. A cut part 64 reaches an intermediate part of a sloping surface of the sloping part 62. A gripping piece 23A of a gripping unit 23G is arranged at such a cut part 64.

[0053] The plurality of passage units 65 are cut parts where respective parts of the rotating plate 23P on an outer periphery thereof that correspond to a plurality of lift pins 23H are cut away toward an inside thereof in a radial direction thereof. The plurality of passage units 65 may be through-holes that penetrate respective parts of

the rotating plate 23P on an outer periphery thereof that correspond to the plurality of lift pins 23H upward/downward. A passage unit 65 is larger than a cut part 64 and reaches a lower part of a sloping surface of the sloping part 62. A lift pin 23H moves upward/downward through such a passage unit 65.

[0054] Additionally, although the present embodiment illustrates an example in a case where three cut parts 64 and three passage units 65 are alternately arranged at a predetermined intervals on an outer peripheral part of the rotating plate 23P, a number and/or arrangement of a plurality of cut parts 64 and passage units 65 is/are not limited to that/those of an example as described above.

[0055] The plurality of supporting part 66 are provided so as to protrude relative to a sloping surface of the sloping part 62 and support a wafer W from below. Such a supporting part 66 has an elongated shape that extends from an outside to an inside of a wafer W, specifically, along a radial direction of the first flat part 61 (in other words, the wafer W).

[0056] Furthermore, on the rotating plate 23P on a side that is inner than a passage unit 65 in a radial direction thereof, a raising part 67 that raises a sloping surface of the sloping part 62 and a part of the first flat part 61 is provided.

[0057] The raising part 67 is adjacent to a passage unit 65 and two supporting parts 66 that are provided on both sides of the passage unit 65.

[0058] Specific Operation of Processing Unit

Next, a specific operation of a processing unit 16 according to an embodiment will be explained with reference to FIG. 6. FIG. 6 is a flowchart that illustrates a series of processing procedures that are executed by a processing unit 16 according to an embodiment. Each processing procedure as illustrated in FIG. 6 is executed according to control that is provided by a controller 18.

[0059] Additionally, hereinafter, a wafer W is a dummy wafer (an example of a dummy substrate) that is different from a wafer as a processing target (an example of a product substrate). In a case where a wafer W is a dummy wafer, a series of processing procedures as illustrated in FIG. 6 is executed during a period of time when substrate processing for a wafer as a processing target is not executed by a processing unit 16. Furthermore, hereinafter, a circuit formation surface of a wafer W is a "principal surface" and a surface on an opposite side of the principal surface is a "back surface".

[0060] As illustrated in FIG. 6, in a processing unit 16, first, a carrying-in process is executed (step S101). In a carrying-in process, a wafer W is carried in a housing

21 of a processing unit 16 by a substrate transfer device 17 (see FIG. 1). Additionally, herein, a wafer W is carried in in a state where a principal surface of the wafer W is oriented downward. A wafer W that is carried in the housing 21 is supported by a plurality of supporting parts 66 of a rotating plate 23P and is gripped by a plurality of gripping units 23G. Herein, a plurality of lift pins 23H are provided in a state where they are arranged at positions that are lower than the rotating plate 23P (a state as illustrated in FIG. 2).

[0061] Subsequently, in a processing unit 16, a cleaning process is executed (step S102). In a cleaning process, in a state where a plurality of lift pins 23H are arranged at positions that are lower than the rotating plate 23P, a cleaning liquid is discharged from a first nozzle 24A and a second nozzle 25A to a top surface of a wafer W, so that the plurality of lift pins 23H are cleaned with the cleaning liquid that flows down from a plurality of passage units 65.

[0062] Meanwhile, the plurality of lift pins 23H and a wafer W directly contact one another when delivery of the wafer W between a processing unit 16 and the substrate transfer device 17 is executed. Thereby, for example, a particle(s) that is/are attached to the plurality of lift pins 23H may be attached to a bottom surface (a principal

surface) of a wafer W. Hence, in order to reduce or prevent attachment of a particle(s), it is preferable to clean the plurality of lift pins 23H regularly.

[0063] For such a point, it is considered that a cleaning liquid is directly discharged from a cleaning liquid nozzle to the plurality of lift pins 23H, like a conventional technique.

[0064] However, as a cleaning liquid is directly discharged from a cleaning liquid nozzle to the plurality of lift pins 23H, scattering of the cleaning liquid may occur at the plurality of lift pins 23H. As scattering of a cleaning liquid at the plurality of lift pins 23H occurs, for example, a particle(s) that is/are included in a scattered cleaning liquid may attach to (an)other component(s) other than a lift pin 23H, etc., in a processing unit 16, so as to cause contamination in the processing unit 16.

[0065] Hence, a processing unit 16 according to an embodiment executes a cleaning process that discharges a cleaning liquid to a top surface of a wafer W in a state where a plurality of lift pins 23H are arranged at positions that are lower than a rotating plate 23P, so as to clean the plurality of lift pins 23H with the cleaning liquid that flows down from a plurality of passage units 65.

[0066] According to such a cleaning process, it is possible to decrease a range where a cleaning liquid is scattered from a plurality of lift pins 23H, as compared with a case where a cleaning liquid is directly discharged from a cleaning liquid nozzle to a plurality of lift pins 23H like a conventional technique. As a result, it is possible to reduce or prevent contamination in a processing unit 16 and clean a lift pin 23H.

[0067] A content of a cleaning process as described above will specifically be explained with reference to FIG. 7 to FIG. 9. FIG. 7 is a flowchart that illustrates processing procedures of a cleaning process according to an embodiment. FIG. 8 is a diagram that illustrates an example of an operation of a first nozzle 24A in a cleaning process according to an embodiment. FIG. 9 is a diagram that illustrates an example of an operation of a second nozzle 25A in a cleaning process according to an embodiment.

[0068] As illustrated in FIG. 7, as a wafer W is supported by a plurality of supporting parts 66 of a rotating plate 23P and is gripped by a plurality of gripping units 23G, a processing unit 16 starts rotation of the wafer W (step S201). A rotating shaft 23S and the rotating plate 23P are rotated by using a motor M, so that rotation of a wafer W is executed. Additionally, rotation

of a wafer W is continued before a series of processing procedures as illustrated in FIG. 6 is ended.

[0069] Subsequently, the processing unit 16 arranges a first nozzle 24A above a wafer W by using a turning/lifting/lowering mechanism 24b (step S202).

[0070] Subsequently, the processing unit 16 starts discharging of a first cleaning liquid L1 to a top surface of a rotating wafer W from the first nozzle 24A (step S203). As illustrated in FIG. 8, a first cleaning liquid L1 that is discharged to a top surface of a wafer W is applied and spread on a top surface of the wafer W by centrifugal force in association with rotation of the wafer W so as to be scattered outward from a peripheral part of the wafer W. Furthermore, a part of a first cleaning liquid L1 that is discharged to a top surface of a wafer W transfers from the top surface to a bottom surface of the wafer W at a peripheral part of the wafer W and scatters from the bottom surface of the wafer W toward a passage unit 65 of the rotating plate 23P. A first cleaning liquid L1 that is scattered toward the passage unit 65 flows down from the passage unit 65 of the rotating plate 23P and lands on a lift pin 23H. Thereby, a foreign substance(s) such as a particle(s) that is/are attached to a lift pin 23H is/are rinsed away with a first cleaning liquid L1.

[0071] A first cleaning liquid L1 is a chemical liquid

such as an alkaline aqueous solution or a mixed liquid of an alkaline aqueous solution and a pure water, so as to have a chemical reactivity that is capable of eliminating a foreign substance(s) such as a particle(s) that is/are attached to a lift pin 23H. A lift pin 23H is cleaned with such a first cleaning liquid L1, so that it is possible to improve efficiency of eliminating of a foreign substance(s) such as a particle(s) that is/are attached to a lift pin 23H.

[0072] The processing unit 16 continues discharging of a first cleaning liquid L1 for a predetermined period of time. Subsequently, the processing unit 16 ends discharging of a first cleaning liquid L1 (step S204).

[0073] Additionally, a process at steps S201 to S204 is an example of a first cleaning step that discharges a first cleaning liquid from the first nozzle 24A to a top surface of a substrate while rotating the substrate that is supported by the plurality of supporting parts 66 by using the rotating plate 23P.

[0074] Subsequently, the processing unit 16 arranges a second nozzle 25A above a central part of a wafer W by using a turning/lifting/lowering mechanism 25b (step S205).

[0075] Subsequently, the processing unit 16 starts discharging of a second cleaning liquid L2 from the second nozzle 25A to a top surface of a rotating wafer W (step

S206).

[0076] Subsequently, the processing unit 16 moves the second nozzle 25A from a central part toward a peripheral part of a wafer W by using the turning/lifting/lowering mechanism 25b in a state where a second cleaning liquid L2 is discharged from the second nozzle 25A (step S207). As illustrated in FIG. 9, a second cleaning liquid L2 that is discharged to a top surface of a wafer W is scattered from a peripheral part of the wafer W to an outside thereof. Furthermore, a part of a second cleaning liquid L2 that is discharged to a top surface of a wafer W transfers from the top surface to a bottom surface of the wafer W at a peripheral part of the wafer W and is scattered from the bottom surface of the wafer W toward the passage unit 65 of the rotating plate 23P. A second cleaning liquid L2 that is scattered toward the passage unit 65 flows down from the passage unit 65 of the rotating plate 23P so as to land on a lift pin 23H. Thereby, a foreign substance(s) such as a particle(s) that is/are not rinsed away with a first cleaning liquid L1 from a lift pin 23H is/are rinsed away with a second cleaning liquid L2.

[0077] A second cleaning liquid L2 is a mixed fluid of a functional water and an N_2 gas at a comparatively high pressure, so as to land thereon at a pressure that is higher than that/those of a foreign substance(s) such as a

particle(s) that is/are attached to a lift pin 23H. A lift pin 23H is cleaned with such a second cleaning liquid L2, so that it is possible to improve efficiency of eliminating of a foreign substance(s) such as a particle(s) that is/are attached to the lift pin 23H.

[0078] Herein, in a case where the second nozzle 25A is moved at a constant speed in a process at step S207, a processing time for a cleaning process may be needlessly increased. Furthermore, as an amount of a second cleaning liquid L2 that stays on a top surface of a wafer W is insufficient, an amount of a second cleaning liquid L2 that is scattered toward the passage unit 65 may also be insufficient.

[0079] Hence, the processing unit 16 may control the turning/lifting/lowering mechanism 25b in such a manner that, as the second nozzle 25A approaches a predetermined position that does not reach a peripheral part of a wafer W from a central part of the wafer W, a movement speed of the second nozzle 25A is increased. Moreover, the processing unit 16 may decrease a movement speed of the second nozzle 25A as the second nozzle 25A approaches a peripheral part of a wafer W from a predetermined position. Thereby, it is possible to attain both of a decrease in a processing time for a cleaning process and maintenance of an amount of a second cleaning liquid L2 that is scattered toward the

passage unit 65.

[0080] Additionally, a process at steps S205 to S207 is an example of a second cleaning step that discharges a second cleaning liquid L2 from the second nozzle 25A to a top surface of a substrate while rotating the substrate and moving the second nozzle 25A from a central part side to a peripheral part side of the substrate.

[0081] As the second nozzle 25A reaches a peripheral part of a wafer W, the processing unit 16 determines whether or not movement of the second nozzle 25A is repeated a predetermined times (step S208). In a case where movement of the second nozzle 25A is not repeated a predetermined times (step S208; No), the processing unit 16 returns a process to step S205 and repeats a process at steps S205 to S207. That is, the processing unit 16 repeats a second cleaning step (a process at steps S205 to S207) a plurality of times after a first cleaning step (a process at steps S201 to S204). Thereby, it is possible for the processing unit 16 to further improve efficiency of eliminating of a foreign substance(s) such as a particle(s) that is/are attached to a lift pin 23H.

[0082] On the other hand, in a case where movement of the second nozzle 25A is repeated a predetermined times (step S208; Yes), the processing unit 16 ends discharging of a second cleaning liquid L2 (step S209) and ends a

cleaning process.

[0083] Additionally, although both of a first cleaning step (a process at steps S201 to S204) and a second cleaning step (a process at steps S205 to S207) are executed in an example of a cleaning process as described above, only one of the first cleaning step and the second cleaning step may be executed. Thereby, it is possible to attain simplification of a process. Furthermore, use of a first cleaning liquid L1 that is a chemical liquid that has a chemical reactivity may be improper depending on a specification of a processing unit 16. In such a case, a processing unit 16 executes only a second cleaning step by using a second cleaning liquid L2 that is a mixed fluid of a functional water and an N_2 gas, so that it is possible to meet a specification of the processing unit 16 that is not suitable for use of a chemical liquid.

[0084] Furthermore, in a process at step S207, after the second nozzle 25A reaches a peripheral part of a wafer W, the second nozzle 25A may be stopped at the peripheral part of the wafer W for a predetermined period of time while continuing discharging of a second cleaning liquid L2 from the second nozzle 25A. Thereby, it is possible to increase an amount of a second cleaning liquid L2 that flows down from the passage unit 65 of the rotating plate 23P toward a lift pin 23H at a peripheral part of a wafer W, so that it

is possible to further improve efficiency of cleaning of the lift pin 23H.

[0085] As a cleaning process at step S102 (see FIG. 6) is ended, a rinse process is executed in the processing unit 16 (step S103). In a rinse process, the processing unit 16 discharges a DIW that is a rinse liquid from a rinse nozzle 24B that is arranged above a wafer W to a central part of the wafer W on a top surface side thereof. A DIW that is discharged to a central part of a wafer W is spread from a central part toward a peripheral part of the wafer W by centrifugal force, so that a cleaning liquid that is left on a top surface of the wafer W is rinsed away with a DIW. Furthermore, in a rinse process, a cleaning liquid that is left on surfaces of a plurality of lift pins 23H is rinsed away with a DIW that flows down from the plurality of passage units 65 of the rotating plate 23P.

[0086] Subsequently, in the processing unit 16, a drying process is executed (step S104). In a drying process, the processing unit 16 increases a rotational speed of a wafer W. Then, the processing unit 16 discharges an N_2 gas from a nozzle for drying 24C to a top surface of a wafer W while rotating the wafer W. Thereby, a liquid that is left on a principal surface of a wafer W is thrown by centrifugal force and is pushed out toward a peripheral part of the wafer W by an N_2 gas so as to dry the wafer W.

[0087] Subsequently, in the processing unit 16, a carrying-out process is executed (step S105). In a carrying-out process, a wafer W is carried out of a housing 21 by a substrate transfer device 17 (see FIG. 1). A wafer W that is carried out of the housing 21 is housed in a carrier C by the substrate transfer device 17.

[0088] As described above, a substrate processing apparatus according to an embodiment (for example, a processing unit 16) includes a rotating plate (for example, a rotating plate 23P), a plurality of supporting units (for example, supporting parts 66), a liquid discharge unit (for example, a first nozzle 24A and a second nozzle 25A), and a plurality of lift pins (for example, lift pins 23H). The rotating plate is rotatable. The plurality of supporting units are provided on the rotating plate and support a substrate (for example, a wafer W). The liquid discharge unit discharges a cleaning liquid (for example, a first cleaning liquid and a second cleaning liquid) to a top surface of the substrate that is supported by the plurality of supporting units. The plurality of lift pins respectively pass through a plurality of passage units (for example, passage units 65) that are provided on the rotating plate and push the substrate upward. A cleaning method for a lift pin according to an embodiment that is executed in such a substrate processing apparatus includes

a supporting step, and a cleaning step. The supporting step supports the substrate by using the plurality of supporting units. The cleaning step discharges the cleaning liquid from the liquid discharge unit to a top surface of the substrate that is supported by the plurality of supporting units in a state where the plurality of lift pins are arranged at positions that are lower than the rotating plate, so as to clean the plurality of lift pins with the cleaning liquid that flows down from the plurality of passage units. Thereby, in a substrate processing apparatus according to an embodiment, it is possible to reduce or prevent contamination in an apparatus and clean a lift pin.

[0089] It should be considered that an embodiment(s) that is/are disclosed herein is/are not limitative but is/are illustrative in all aspects. Indeed, it is possible to implement an embodiment(s) as described above in a wide variety of modes. Furthermore, an embodiment(s) as described above may be omitted, substituted, and/or modified in a wide variety of modes without departing from an appended claim(s) and an essence thereof.

[0090] According to the present disclosure, it is possible to reduce or prevent contamination in an apparatus and clean a lift pin.

[0091] Although the invention has been described with

respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the basic teaching herein set forth.

CLAIM(S)

What is claimed is:

1. A cleaning method for a lift pin in a substrate processing apparatus that includes:

a rotatable rotating plate;

a plurality of supporting units that are provided on the rotating plate and support a substrate;

a liquid discharge unit that discharges a cleaning liquid to a top surface of the substrate that is supported by the plurality of supporting units; and

a plurality of lift pins that respectively pass through a plurality of passage units that are provided on the rotating plate and push the substrate upward, wherein

the cleaning method for a lift pin comprises:

a supporting step that supports the substrate by using the plurality of supporting units; and

a cleaning step that discharges the cleaning liquid from the liquid discharge unit to the top surface of the substrate that is supported by the plurality of supporting units in a state where the plurality of lift pins are arranged at positions that are lower than the rotating plate, to clean the plurality of lift pins with the cleaning liquid that flows down from the plurality of passage units.

2. The cleaning method for a lift pin according to claim 1, wherein:

the substrate processing apparatus includes a plurality of the liquid discharge units;

a plurality of the liquid discharge units include:

a first liquid discharge unit that discharges a first cleaning liquid to the top surface of the substrate that is supported by the plurality of supporting units; and

a second liquid discharge unit that discharges a second cleaning liquid to the top surface of the substrate that is supported by the plurality of supporting units; and

the cleaning step includes:

a first cleaning step that discharges the first cleaning liquid from the first liquid discharge unit to the top surface of the substrate while rotating the substrate that is supported by the plurality of supporting units by using the rotating plate; and

a second cleaning step that discharges the second cleaning liquid from the second liquid discharge unit to the top surface of the substrate while rotating the substrate and moving the second liquid discharge unit from a central part side to a peripheral part side of the substrate after the first cleaning step.

3. The cleaning method for a lift pin according to claim

2, wherein

the cleaning step repeats the second cleaning step a plurality of times after the first cleaning step.

4. The cleaning method for a lift pin according to claim 2, wherein

the second cleaning step increases a movement speed of the second liquid discharge unit as the second liquid discharge unit approaches a predetermined position that does not reach a peripheral part of the substrate from a central part of the substrate and decreases a movement speed of the second liquid discharge unit as the second liquid discharge unit approaches the peripheral part of the substrate from the predetermined position.

5. The cleaning method for a lift pin according to claim 2, wherein

the first cleaning liquid is an alkaline aqueous solution or a mixed liquid of an alkaline aqueous solution and a pure water.

6. The cleaning method for a lift pin according to claim 5, wherein

the alkaline aqueous solution is an inorganic alkaline aqueous solution or an organic alkaline aqueous solution.

7. The cleaning method for a lift pin according to claim 6, wherein:

the inorganic alkaline aqueous solution is a mixed liquid of ammonia and a hydrogen peroxide solution; and

the organic alkaline aqueous solution is a solution that includes at least one of TMAH (tetramethylammonium hydroxide) and an aqueous solution of choline.

8. The cleaning method for a lift pin according to claim 2, wherein

the second cleaning liquid is a mixed fluid of a liquid and a gas.

9. The cleaning method for a lift pin according to claim 8, wherein

the liquid is a solution that is obtained by dissolving at least one of a CO_2 gas, an ammonia gas, and an ammonia water in a pure water.

10. The cleaning method for a lift pin according to claim 8, wherein

the gas is an N_2 gas.

11. The cleaning method for a lift pin according to claim

1, wherein

the cleaning step discharges the cleaning liquid from the liquid discharge unit to the top surface of the substrate while rotating the substrate that is supported by the plurality of supporting units by using the rotating plate and moving the liquid discharge unit from a central part side to a peripheral part side of the substrate.

12. The cleaning method for a lift pin according to claim 11, wherein

the cleaning liquid is a mixed fluid of a liquid and a gas.

13. The cleaning method for a lift pin according to claim 1, wherein

the cleaning step discharges the cleaning liquid from the liquid discharge unit to the top surface of the substrate while rotating the substrate that is supported by the plurality of supporting units by using the rotating plate.

14. The cleaning method for a lift pin according to claim 13, wherein

the first cleaning liquid is an alkaline aqueous solution or a mixed liquid of an alkaline aqueous solution

and a pure water.

15. The cleaning method for a lift pin according to claim 1, wherein:

the substrate is a dummy substrate that is different from a product substrate; and

the supporting step and the cleaning step are executed during a period of time when substrate processing for the product substrate is not executed by the substrate processing apparatus.

16. A substrate processing apparatus, comprising:

a rotatable rotating plate;

a plurality of supporting units that are provided on the rotating plate and support a substrate;

a liquid discharge unit that discharges a cleaning liquid to a top surface of the substrate that is supported by the plurality of supporting units;

a plurality of lift pins that respectively pass through a plurality of passage units that are provided on the rotating plate and push the substrate upward; and

a controller that controls each unit, wherein

the controller supports the substrate by using the plurality of supporting units, and discharges the cleaning liquid from the liquid discharge unit to the top surface of

the substrate in a state where the plurality of lift pins are arranged at positions that are lower than the rotating plate, to clean the plurality of lift pins with the cleaning liquid that flows down from the plurality of passage units.