TEACHING METHOD AND PROCESSING SYSTEM

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ABSTRACT
A teaching method for storing in a controller a target moving position of a transfer mechanism in a processing system includes the steps of temporarily stopping the transfer mechanism in the middle of a moving route to a temporary moving destination position so as to make sure that the transfer mechanism does not interfere with another member at a potential interference location where there is a possibility that the transfer mechanism interferes with said another member, resuming to move the temporarily stopped transfer mechanism by inputting a moving instruction, repeating the temporarily stopping step and the resuming step, and when the pick reaches the temporary moving destination position, storing, as the target moving position, in the controller a position of the pick after adjusting and moving or without adjusting and moving the position of the pick.
FIG. 8

START

PRESS GO BUTTON

TEMPORARY MOVING DESTINATION POSITION? S2

YES

AUTOMATICALLY MOVE TO POTENTIAL INTERFERENCE LOCATION S4

NO

ANY POSSIBILITY OF INTERFERING WITH ANOTHER MEMBER? S3

YES

MANUALLY ADJUST AND MOVE IT BY MICRO-DISTANCE TO POSITION NOT INTERFERING WITH ANOTHER MEMBER

NO

MANUALLY ADJUST AND MOVE IT BY MICRO-DISTANCE TO TARGET MOVING POSITION S6

PRESS SAVE BUTTON S7

STORE POSITION COORDINATE DATA

END
TEACHING METHOD AND PROCESSING SYSTEM

[0001] This application is a Continuation Application of PCT International Application No. PCT/JP03/11734 filed on Sep. 12, 2003, which designated the United States.

FIELD OF THE INVENTION

[0002] The present invention relates to a processing system for performing a pre-specified processing on an object to be processed such as a semiconductor wafer and a teaching method of a transfer mechanism employed in such a processing system.

BACKGROUND OF THE INVENTION

[0003] In general, in order to manufacture a semiconductor integrated circuit, various processes such as film forming, etching, oxidation and diffusion are performed on a wafer. Further, in order to improve a throughput and a yield along with the trend of miniaturization and high integration of the semiconductor integrated circuit, a semiconductor processing system known as a so-called cluster tool has been developed, wherein a plurality of processing apparatuses performing either a same process or different processes are coupled to each other via a common transfer chamber such that various processes can be successively executed without exposing a wafer to the atmosphere.

[0004] In such a processing system for example, a semiconductor wafer is unloaded from a cassette container installed at an inlet port for an object to be processed, which is disposed at a front end of the processing system, and then carried into an inlet side transfer chamber of the processing system by a transfer mechanism. Next, the wafer is subjected to a position alignment process carried out by an orienter and then is loaded into a vacuum evacuable loadlock chamber. By another transfer mechanism, the wafer is then loaded into a common vacuum transfer chamber whose peripheral portions are connected to a plurality of vacuum processing chambers, and then sequentially loaded into the vacuum processing chambers via the common transfer chamber located at the center so that the wafer can be processed continuously. Thereafter, the processed wafer returns to the original cassette container along the original path, for example.

[0005] As described above, such a processing system includes therein a single or a plurality of transfer mechanisms and delivery/reception and transfer of the wafer are automatically performed by such transfer mechanisms.

[0006] Such a transfer mechanism has, e.g., a horizontally movable, stretchable, bendable, revolvable and elevatable multi-joint arm and serves to transfer the wafer to a specified position by horizontally moving to a transfer location while directly holding the wafer on a pick provided at a leading end of such arm.

[0007] In this case, there arises a need to prevent the arm, the pick, and/or the wafer held thereon from interfering or colliding with another member while operating the transfer mechanism. And also, the wafer disposed at a specified position needs to be transferred to a target position while being properly held, and then delivered and received at a proper location with high accuracy, e.g., with high positional accuracy not larger than ±0.20 mm.

[0008] Accordingly, in case an apparatus is assembled or extensively reconstructed for example, a so-called teaching is carried out. Specifically, the teaching is an operation for storing, in a controller of a computer for controlling an operation of the transfer mechanism, position coordinates of important positions, e.g., locations at which the delivery/reception of the wafer W is carried out, in a moving route of the pick of the transfer mechanism.

[0009] The teaching is performed in almost every case for performing the wafer delivery/reception to store position coordinates indicating, e.g., a relationship between positions of a transfer mechanism and a cassette container, that between vertical positions of a pick for holding the wafer and each mounting rack of the cassette container, that between positions of a mounting table in a load-lock chamber and the pick, that between positions of the pick and an orienter, and that between positions of the pick and a susceptor in each processing chamber. Further, it is to be noted that every driving unit is equipped with an encoder or the like for specifying driving positions thereof.

[0010] Specifically, a teaching operation is carried out as follows. First, position coordinates of all positions that need teaching in an apparatus are obtained from design values of the apparatus by setting a predetermined point in the moving route of the transfer mechanism as an absolute reference. Then, the position coordinates are inputted to and stored in the controller as temporary position coordinates. In this case, each of the temporary position coordinates is inputted by considering a specified margin so as to make sure that the pick does not interfere with another member.

[0011] Next, when the pick is moved close to a teaching reference position by operating the transfer mechanism based on each of the temporary position coordinates, the operation of the transfer mechanism is converted into a nonautomatic (hereinafter, also referred to as “manual”) mode, and the transfer mechanism is slowly moved manually while keeping with naked eye the pick from interfering with another member. Further, the transfer mechanism is operated while being checked with the naked eye to make sure that a position aligning substrate previously installed at a predetermined position in the cassette container is in contact with the pick at a proper position. Then, the coordinates thereof are stored in the controller as position coordinates, thereby performing the teaching.

[0012] Moreover, in case the teaching is performed for a mounting table and/or a susceptor in a load-lock chamber and/or each processing chamber, a position aligning substrate is installed at each center thereof. Then, a corresponding pick is automatically moved to a position close to the position aligning substrate where it is safe from any interference. Thereafter, the pick is manually moved so that both of them can be precisely aligned with each other as described above and, then, position coordinates at that instant are stored in the controller. Furthermore, the position aligning substrate is made of, e.g., a transparent plate having thereon pre-drawn contours of a pick, a mounting table and/or the like that should be aligned therewith.

[0013] Further, the term nonautomatic (manual) operation denotes an operation for moving the arm including the pick or the like by inputting a direction (+/-) and a magnitude of movement into the controller with the use of a keyboard and/or a joystick.
In a prior art reference of Japanese Patent Laid-open Application No. 2000-127069, an orienter is used to achieve a labor reduction and a high accuracy of the teaching operation. However, there remains a drawback in that the manual operation is required in a part of the teaching operation.

SUMMARY OF THE INVENTION

In the aforementioned teaching method, the transfer mechanism itself is automatically moved to a safe enough position near a teaching destination position and, then, while being checked on safety with the naked eye, the pick is manually moved by a micro-distance in a horizontal direction and a vertical direction to thereby be moved to the destination position.

Accordingly, even if the pick is automatically moved to a sufficiently safe position near the destination position initially, a section for manually moving the pick by a minute distance becomes quite long, which results in a considerably long teaching operation time. Especially, such a teaching operation should be performed for almost all the delivery/reception positions of a semiconductor wafer as described above; and, thus, there is a drawback in that the teaching operation time becomes quite long.

The present invention has been conceived to effectively solve the aforementioned drawback. An object of the present invention is to provide a teaching method and a processing system capable of drastically reducing and shortening a teaching operation time.

The inventors have intensively conducted a research on a time reduction of a teaching operation and found that even after a transfer mechanism has been automatically moved near a destination position, there still exists some room for a pick automatically to be moved before reaching the destination position if the pick of the transfer mechanism is maneuvered to move while watching out for specific locations. The present invention has been conceived from the above observation.

In accordance with one aspect of the invention, there is provided a teaching method for storing in a controller a target moving position of a transfer mechanism in a processing system provided with the transfer mechanism for transferring an object to be processed by supporting same with a pick, the teaching method including the steps of: temporarily stopping the transfer mechanism in the middle of a moving route to a temporary moving destination position so as to make sure that the transfer mechanism does not interfere with another members at a potential interference location where there is a possibility that the transfer mechanism interferes with said another member; resuming to move the temporarily stopped transfer mechanism by inputting a moving instruction; repeating the temporarily stopping step and the resuming step; and when the pick reaches the temporary moving destination position, storing, as the target moving position, in the controller a position of the pick after adjusting and moving or without adjusting and moving the position of the pick.

The transfer mechanism is temporarily stopped only at a location where there is a possibility of interference with another member and then adjusted and moved if necessary. On the other hand, the transfer mechanism is automatically moved in a location where there is no possibility of interference with another member. Accordingly, a teaching operation time can be greatly reduced.

In this case, the transfer mechanism can be adjusted and moved to a location where there is no possibility of interference with another member in case there is a possibility that the temporarily stopped transfer mechanism interferes with said another member.

Further, the potential interference location can be calculated and obtained in advance by the controller based on design values of the processing system.

Furthmore, the controller can display on a display unit a message for informing an operator of a potential interference whenever the transfer mechanism is temporarily stopped.

Since the display unit displays thereon the message for informing the potential interference, the operator recognizes the message and, accordingly, it is possible to more effectively prevent the transfer mechanism from interfering with another member.

Moreover, an arm of the transfer mechanism is preferably a stretchable, bendable and revolvable multi-joint arm.

Besides, the target moving position is preferably a position in an inlet port for loading the object to be processed into the processing system.

In accordance with another aspect of the invention, there is provided a processing system including a processing chamber for performing a processing on an object to be processed; an inlet port for introducing the object to be processed; an orienter for performing a position aligning of the object to be processed; a transfer mechanism, having a pick for supporting the object to be processed, for transferring the object to be processed; and a controller for controlling an operation of the transfer mechanism, wherein the controller is configured to perform the steps of: temporarily stopping the transfer mechanism in the middle of a moving route to a temporary moving destination position so as to make sure that the transfer mechanism does not interfere with another member at a potential interference location where there is a possibility that the transfer mechanism interferes with said another member; resuming to move the temporarily stopped transfer mechanism by inputting a moving instruction; repeating the temporarily stopping step and the resuming step; and when the pick reaches the temporary moving destination position, storing, as the target moving position, in the controller a position of the pick after adjusting and moving or without adjusting and moving the position of the pick.

In this case, the controller can calculate and obtain in advance the potential interference location based on design values of the processing system.

Further, the controller can be connected to a display unit and display on the display unit a message for informing an operator of a potential interference whenever the transfer mechanism temporarily is stopped.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects and features of the present invention will become apparent from the following
description of preferred embodiments, given in conjunction with the accompanying drawings, in which:

[0031] FIG. 1 is a diagram for showing an exemplary processing system for performing a teaching method of the present invention;

[0032] FIG. 2 shows a schematic diagram of the processing system illustrated in FIG. 1;

[0033] FIG. 3 illustrates a schematic diagram depicting an inlet port;

[0034] FIG. 4 depicts a schematic diagram describing an orienter;

[0035] FIG. 5 describes a schematic diagram showing a load-lock chamber;

[0036] FIG. 6 provides a top view illustrating an operating unit;

[0037] FIG. 7A presents a diagram depicting a first potential interference location, as an example in which a teaching operation is performed for the inlet port in accordance with a first preferred embodiment of a method of the present invention;

[0038] FIG. 7B represents a diagram depicting a second potential interference location, as an example in which the teaching operation is performed for the inlet port in accordance with the first preferred embodiment of the method of the present invention;

[0039] FIG. 7C offers a diagram depicting a third potential interference location, as an example in which the teaching operation is performed for the inlet port in accordance with the first preferred embodiment of the method of the present invention;

[0040] FIG. 7D is a diagram showing a temporary moving destination position, as an example in which the teaching operation is performed for the inlet port in accordance with the first preferred embodiment of the method of the present invention;

[0041] FIG. 7E shows a diagram illustrating a target moving position, as an example in which the teaching operation is performed for the inlet port in accordance with the first preferred embodiment of the method of the present invention;

[0042] FIG. 8 illustrates a flowchart depicting a flow of the teaching method of the present invention;

[0043] FIG. 9 depicts a diagram describing an example in which a teaching operation is performed for the orienter in accordance with a second preferred embodiment of the present invention;

[0044] FIG. 9A presents a diagram showing a first potential interference location, as an example in which the teaching operation is performed for the orienter in accordance with the second preferred embodiment of the present invention;

[0045] FIG. 9B represents a diagram illustrating a second potential interference location, as the example in which the teaching operation is performed for the orienter in accordance with the second preferred embodiment of the present invention;

[0046] FIG. 9C provides a diagram depicting a temporary moving destination position, as the example in which the teaching operation is performed for the orienter in accordance with the second preferred embodiment of the present invention;

[0047] FIG. 9D offers a diagram describing a target moving position, as the example in which the teaching operation is performed for the orienter in accordance with the second preferred embodiment of the present invention;

[0048] FIG. 10A is a diagram showing a first potential interference location, as an example in which a teaching operation is performed for the load-lock chamber in accordance with a third preferred embodiment of the present invention;

[0049] FIG. 10B shows a diagram illustrating a second potential interference location, as the example in which the teaching operation is performed for the load-lock chamber in accordance with the third preferred embodiment of the present invention;

[0050] FIG. 10C depicts a diagram describing a third potential interference location, as the example in which the teaching operation is performed for the load-lock chamber in accordance with the third preferred embodiment of the present invention;

[0051] FIG. 10D provides a diagram depicting a fourth potential interference location, as the example in which the teaching operation is performed for the load-lock chamber in accordance with the third preferred embodiment of the present invention; and

[0052] FIG. 10E sets forth a diagram illustrating a temporary moving destination position, as the example in which the teaching operation is performed for the load-lock chamber in accordance with the third preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0053] Hereinafter, a teaching method and a preferred embodiment of a processing system in accordance with the present invention will be described with reference to the accompanying drawings.

[0054] FIG. 1 is a diagram for showing an exemplary processing system for performing a teaching method of the present invention; FIG. 2 shows a schematic diagram of the processing system illustrated in FIG. 1; FIG. 3 illustrates a schematic diagram depicting an inlet port; FIG. 4 depicts a schematic diagram describing an orienter; FIG. 5 describes a schematic diagram showing a load-lock chamber; and FIG. 6 provides a top view illustrating an operating unit.

[0055] First, the processing system will be described.

[0056] As shown in FIG. 1, a processing system 2 has a plurality of, e.g., four, processing chambers 4A, 4B, 4C and 4D; an approximately hexagon shaped common transfer chamber 6; a first and a second load-lock chamber 8A and 8B having a load-lock function; and a narrow and long inlet side transfer chamber 10.

[0057] Specifically, each of the processing chambers 4A to 4D is connected to one of four sides of the approximately hexagon shaped common transfer chamber 6, and the first
and the second load-lock chamber 8A and 8B are connected to other two sides thereof, respectively. Further, the inlet side transfer chamber 10 is connected to both the first and the second load-lock chamber 8A and 8B.

[0058] The four processing apparatuses 4A to 4D and the first and the second load-lock chamber 8A and 8B are respectively connected to the common transfer chamber 6 via air-tight openable/closable gate valves G, thereby forming a cluster tool. They can communicate with an inside of the common transfer chamber 6, if necessary. Further, the first and the second load-lock chamber 8A and 8B are connected to the inlet side transfer chamber 10 via air-tight openable/closable gate valves G, respectively.

[0059] The four processing apparatuses 4A to 4D respectively have therein susceptors 12A to 12D, each for mounting thereon a semiconductor wafer as an object to be processed and, further, are designed in a way that a same process or different processes are performed on the semiconductor wafer W as an object to be processed. A second transfer mechanism 14 having stretchable, bendable, elevatable and revolvable multi-joint arms is provided at a position accessible to any of the two load-lock chambers 8A and 8B and the four processing chambers 4A to 4D. The second transfer mechanism 14 has two picks 81 and 82 that are independently movable in opposite directions and, thus, can carry two wafers at a time. Further, the second transfer mechanism 14 having a single pick can be used.

[0060] The inlet side transfer chamber 10 is of a horizontally lengthened box. Formed at one side of the horizontally lengthened box is a single or a plurality of, e.g., three in this embodiment, loading ports 16 each having an openable/closable opening/closing door 21. Further, inlet ports 18A to 18C are disposed correspondingly to the loading ports 16, respectively. Cassette containers 20 can be mounted on the inlet ports 18A to 18C, respectively. Each of the cassette containers 20 can accommodate therein a plurality of, e.g., 25, wafers W mounted in multi-levels at an equal pitch. An opening/closing cover 20A (see FIG. 3) is attached to each of the cassette containers 20. Referring to FIG. 3, there is illustrated a central inlet port 18B among the three inlet ports 18A to 18C at which a driving unit 21A of the opening/closing door 21, which is movable up and down and also forward and backward for opening and closing the opening/closing cover 20A of the cassette container 20, is installed.

[0061] Provided in the inlet side transfer chamber 10 is a first transfer mechanism 22 for transferring the wafer W in a length direction thereof. The first transfer mechanism 22 is slidably supported on a guide rail 24 extending in the length direction in a central portion of the inlet side transfer chamber 10. The guide rail 24 has therein, e.g., a linear motor having an encoder as a moving mechanism, and the first transfer mechanism 22 moves along the guide rail 24 by the linear motor.

[0062] Further, the first transfer unit 22 has two multi-joint arms 32 and 34 installed in two vertical steps. Bifurcated picks A1 and A2 are attached to leading ends of the multi-joint arms 32 and 34, respectively, and a wafer W is directly held on each of the picks A1 and A2. Each of the multi-joint arms 32 and 34 is stretchable, bendable in a radial direction and elevatable, and the stretching and bending of the multi-joint arms 32 and 34 can be individually controlled. Respective rotation axes of the multi-joint arms 32 and 34 are rotatably connected to a base 36 in a coaxial shape and, for example, can rotate as a single body in a revolving direction relative to the base 36. Further, a single pick can be provided instead of the two picks A1 and A2.

[0063] Disposed at the other end of the inlet side transfer chamber 10 is an orienter 26 for performing a position aligning of the wafer. Provided in the middle of the length direction of the inlet side transfer chamber 10 are the two load-lock chambers 8A and 8B via the openable/closable gate valves G, respectively.

[0064] As shown in FIG. 4, the orienter 26 has a rotatable table 28 rotated by a driving motor 27 and rotates while having the wafer W mounted thereon. Provided at an outer circumferential portion of the rotatable table 28 is an optical sensor 30 for detecting a peripheral portion of the wafer W. Accordingly, the optical sensor 30 can detect a location/direction of a position determiner, e.g., a notch or an orientation flat, and a misalignment of a center of the wafer W.

[0065] Further, respectively installed in the first and the second load-lock chamber 8A and 8B are mounting tables 38A and 38B having a diameter smaller than a wafer diameter, for temporarily mounting the wafer W thereon (see FIG. 5). Moreover, operations of the processing system 2, e.g., operations of the transfer mechanisms 14 and 22 and the orienter 26 and the like, are entirely controlled by the controller 40 having a microcomputer or the like. Connected to the controller 40 is an operating unit 41 provided with a display unit 42 including a liquid crystal display unit for informing an operator of a specific message and a key set 44 such as ten keys for input. Further, by employing a touch panel for the display unit 42, a function of the key set 44 can also be served by the display unit 42. The teaching operation is performed with the use of the operating unit 41 while observing the pick or the like.

[0066] Hereinafter, a teaching method performed in the processing system configured as described above will be described.

[0067] Above all, a target moving position of each of the transfer mechanisms 14 and 22 for transferring and transporting the semiconductor wafer W is not determined by merely setting up the aforementioned processing system 2 and, therefore, there is a need to store the target moving position as coordinates in a control system thereof. Such operation is referred to as a teaching. In this case, due to an assembly error of the processing system 2 or an error in an initial setting of each of the transfer mechanisms 14 and 22, a temporary moving destination position determined by a calculation based on design values of each unit is generally a little bit different from a target moving position in the assembled processing system 2.

[0068] Therefore, if the transfer mechanism including the pick is automatically moved to the target moving position obtained by the calculation based on the design values of the processing system in order to carry out the teaching operation, there is a possibility of interference with another member on a moving route. Accordingly, in the conventional teaching operation, the transfer mechanism is automatically moved to an immediate front of the temporary moving destination position obtained by the calculation, i.e., a position free from any interference with another member.
and at the same time nearest to the temporary moving destination position. Thereafter, as described above, the transfer mechanism is moved by a micro-distance by the manual operation while being checked with naked eyes to make sure that there is no interference with another member, thereby finally positioning the pick at a proper position and storing coordinates thereof as a target moving position. However, in such conventional teaching operation, a considerable time is required to move the transfer mechanism by the manual operation while checking with the naked eyes, which results in a long teaching operation time.

[0069] Thus, the teaching method of the present invention includes the steps of temporarily stopping the transfer mechanism in the middle of a moving route to a temporary moving destination position so as to make sure that the transfer mechanism does not interfere with another member at a potential interference location where a possibility of interference with another member is anticipated; resuming to move the temporarily stopped transfer mechanism by inputting a moving instruction; repeating the temporarily stopping step and the resuming step; and when the pick reaches the temporary moving destination position, storing, as the target moving position, in the controller a position of the pick, after adjusting and moving or without adjusting and moving the position of the pick. In other words, a position where the transfer mechanism may interfere or collide with another member in the middle of the moving route to the temporary moving destination position obtained based on the design values of the processing system is obtained in advance as a potential interference location. In order to obtain such potential interference location, a size and a revolving radius of a multi-joint arm and a pick of the transfer mechanism and the like are additionally required.

Such potential interference location is influenced by the assembly error of the processing system and/or the error in the initial setting of a driving unit of the transfer mechanism, and is a location (a spot) where the transfer mechanism including the pick and another member are as close as, e.g., about 1 cm. Further, in case such adjustment and movement has been performed, coordinates of a next potential interference location where the transfer mechanism temporarily stops are increased/decreased by a magnitude of the adjustment and movement.

[0070] As described above, once a potential interference locations is obtained by the calculation, an automatic operation of the transfer mechanism is actually performed. In this case, whenever the transfer mechanism reaches the potential interference location, the transfer mechanism temporarily stops and, then, it is checked with the naked eye whether or not the transfer mechanism interferes with another member even in a next step. At this time, if the possibility that the transfer mechanism interferes with another member is anticipated, the operator adjusts and moves the transfer mechanism by the manual operation to a position free from the interference with another member.

[0071] Next, the operator inputs a moving instruction, thereby automatically moving the transfer mechanism to a next potential interference location. Further, the aforementioned confirmation by naked eyes that there is no interference, the adjustment and movement performed if necessary, and the input of the moving instruction are sequentially and iteratively performed.

[0072] Moreover, if the pick reaches the temporary moving destination position obtained based on the design values of the processing system and the like, if necessary, the operator adjusts and moves the pick to an optimal position by the manual operation while checking with naked eyes and, then, stores such position in the controller as a target moving position. Accordingly, the teaching operation for an original target moving position is completed.

First Preferred Embodiment

[0073] Hereinafter, an exemplary teaching operation performed for an inlet port will be described with reference to FIGS. 7A to 7E and FIG. 8.

[0074] FIGS. 7A to 7E show an exemplary teaching operation performed for the inlet port in accordance with a first preferred embodiment of a method of the present invention, and FIG. 8 illustrates a flowchart depicting a flow of a teaching method of the present invention. Referring to FIGS. 7A to 7E, there is illustrated a case where a teaching operation of one pick A1 of the first transfer mechanism 22 is performed for a central inlet port 18B among three inlet ports 18A to 18C. In this case, a position aligning substrate W formed in the same size and shape of a semiconductor wafer is mounted on a lowest supporting bracket (not shown) of the cassette container 20, and a position (FIG. 7D) where the pick A1 accesses right under the position aligning substrate W is assumed to be a temporary moving destination position. Further, if the position of the pick relative to the position aligning substrate mounted on the lowest supporting bracket is determined, the pick will be able to have an access to each supporting bracket based on a specified pitch of the supporting bracket.

[0075] First, as described above, a potential interference location where the transfer mechanism 22 is anticipated to interfere with another member in the middle of the moving route from the reference position of the first transfer mechanism 22 to the temporary moving destination position illustrated in FIG. 7D is obtained in advance based on the design values of the processing system and the size and the revolving radius of the multi-joint arms of the transfer mechanism 22. In such case, the position where the transfer mechanism 22 and another member are as close as, e.g., 1 cm based on the design values is determined to be a potential interference location, and such information is stored in the controller 40. In FIGS. 7A to 7E, three positions of the arm, which are illustrated in FIGS. 7A to 7C, are obtained as respective potential interference locations. Further, a position of a right end portion of the guide rail 24 shown in FIG. 2 is assumed to be a reference position (home position) 50 of the first transfer mechanism 22.

[0076] In a state that the first transfer mechanism 22 is positioned at the reference position 50 (see FIG. 2), the operator inputs the moving instruction by pressing a go button 44A (see FIG. 6) of the key set 44 connected to the controller 40 shown in FIG. 1 (step S1). If so, since a current position of the first transfer mechanism 22 is not a temporary moving destination position (NO in step S2), the controller 40 controls an operation of the first transfer mechanism 22 to move the transfer mechanism 22 to a location corresponding to the inlet port 18B in, e.g., a horizontal direction. Then, by moving the multi-joint arm in a vertical direction and a revolving direction and, at the same time, stretching and
bending the multi-joint arm (for example, extending the multi-joint arm in the horizontal direction), the pick A1 temporarily stops at a first potential interference location automatically, as described in FIG. 7A (step S3).

[0077] The first potential interference location is where a distance X1 between a leading end of the pick A1 and that of the position aligning substrate W is about 1 cm based on the design values of the processing system. When the first transfer mechanism 22 temporarily stops, the display unit 42 displays thereon a message such as “Do not pick the like interfere with another member?” to inform the operator of a potential interference of the pick, as shown in FIG. 6. Further, simultaneously or independently, the same message can be transferred from a speaker or the like in a voice.

[0078] At this time, the operator checks with naked eyes whether or not the pick A1 is positioned lower than a lower portion of another member, i.e., the position aligning substrate W by about 2 to 3 mm in a vertical direction, e.g., whether or not there is a possibility of the interference with the position aligning substrate W even if the pick A1 moves forward (step S4). In case the possibility that the position aligning substrate W interferes with the pick A1 is anticipated (YES in step S4), the operator adjusts and moves the pick A1 by a micro-distance to a position free from the interference with the position aligning substrate W by the manual operation so that the pick A1 can be positioned lower than the lower portion of the position aligning substrate W by about 2 to 3 mm (step S5). Such adjustment and movement is carried out by operating a move button 44C of the key set 44.

[0079] If the adjustment and movement of the pick A1 is completed, or if the operator determines in the step S4 that there is no possibility that the pick A1 interferes with another member (NO in step S4), the operator inputs the moving instruction by pressing the go button 44A (step S1). If so, the pick A1 of the first transfer mechanism 22 is slightly and automatically moved forward to a position where a distance X2 that the leading end of the pick A1 overlaps a peripheral portion of the position aligning substrate W is about 5 mm, i.e., to a second potential interference location, and then temporarily stops, as illustrated in FIG. 7B (NO in step S2 and step S3). Also in the case the pick A1 temporarily stops, the display unit 42 displays thereon the message for informing the potential interference of the pick. At this time, the operator checks that the leading end of the pick A1 has entered under the position aligning substrate W. A reason that the pick A1 temporarily stops at the position where an overlapped distance between the pick A1 and the position aligning substrate W is about 5 mm is to minimize damages if the pick A1 interferes with the position aligning substrate W.

[0080] Furthermore, if the operator inputs the moving instruction by pressing the go button (step S1), the pick A1 of the first transfer mechanism 22 is slightly and automatically moved forward to a location where a horizontal distance X3 between a base portion of the pick A1 and a top portion of the opening/closing door 21 (see FIG. 3) is about 1 cm based on the design values, as illustrated in FIG. 7C, i.e., to a third potential interference location, and then temporarily stops. At this time, the display unit 42 displays thereon the message for informing the potential interference of the pick. In this case, the operator checks the pick A1 such that the base portion thereof does not interfere with the opening/closing door 21 even if the pick A1 is moved forward. If the operator determines that there is a possibility for the interference of the base portion of the pick A1, the pick A1 is slightly adjusted upwardly by the manual operation, as described above.

[0081] Further, if the operator inputs the moving instruction by pressing the go button, the pick A1 of the first transfer mechanism 22 automatically moves forward again to a temporary moving destination position based on the design values and then temporarily stops, as shown in FIG. 7D. Besides, in case there is the adjustment and movement in the middle of a moving route by the manual operation, the temporary moving destination position is shifted by a magnitude of the adjustment and movement.

[0082] Accordingly, if the pick A1 has been moved forward to the temporary moving destination position (YES in step S2), the operator checks whether or not the position is appropriate for the position aligning substrate W. Thereafter, if necessary, i.e., if the position is misaligned, the pick A1 is adjusted and moved to a target moving position by a micro-distance by the manual operation, so that the pick A1 can be positioned right under the position aligning substrate W, as illustrated in FIG. 7E (step S6). FIG. 7E shows a state that the pick A1 has been moved upwardly by the micro-distance. In addition, if the position of the pick A1 in the temporary moving destination position shown in FIG. 7D is a proper position as shown in FIG. 7E, the adjustment and movement in the step S6 becomes unnecessary.

[0083] If the pick A1 has reached the proper position, i.e., the target moving position, a save button 44B (see FIG. 6) of the key set 44 is pressed, thereby storing position coordinate data of the pick A1 in the controller 40 (step S8). Accordingly, the teaching operation is completed.

[0084] By storing the position coordinates of the target moving position in the controller 40, the pick A1 can automatically be moved to the target moving position without interfering with another member. In case the wafer is lifted in the cassette container 20, the wafer is received at a position away from the target moving position by a specific height. Further, in case the wafer is received from another supporting bracket, since the supporting brackets provided in multi-levels have a predetermined pitch as described above, a height corresponding to the number of the supporting brackets can be easily calculated.

[0085] Such teaching operation is equally performed for a pick A2 and, further, for the picks A1 and A2 of other inlet ports 18A and 18C. By comparison, in the conventional teaching method, after the pick A1 is automatically moved to the first potential interference location illustrated in FIG. 7A, the pick A1 is slightly moved to the location shown in FIG. 7B by the manual operation.

[0086] Therefore, in the method of the present invention, the pick is temporarily stopped only at a potential interference location where there is a possibility that the pick or the like interferes with another member. Further, whenever the pick is temporarily stopped, if necessary, the pick is adjusted and moved by the manual operation and then is automatically moved to a next potential interference location. As a result, a moving time of the pick along an entire transfer path becomes short and, thus, the teaching operation can be quickly carried out in a short period of time.
Second Preferred Embodiment

Although the exemplary teaching operation performed for the inlet port has been described in the first preferred embodiment, an exemplary teaching operation performed for an orienter will be described in a second preferred embodiment.

FIGS. 9A to 9D show the exemplary teaching operation performed for the orienter in accordance with the second preferred embodiment of the present invention. Further, FIGS. 9A to 9D partially provide top views. Also in the second embodiment, a teaching operation for the pick A1 of the first transfer mechanism 22 will be described. Further, whenever the pick A1 is temporarily stopped at a potential interference location, the display unit displays thereon a message for informing the operator of a potential interference and the description thereof will be omitted.

As in the first preferred embodiment, a potential interference location and a temporary moving destination position for the orienter 26 are obtained in advance based on the design values of the processing system 2 and then stored in the controller 40. In the illustrated example, FIGS. 9A and 9B illustrate the potential interference locations, and FIG. 9C provides the temporary moving destination position.

First, if a moving instruction is inputted by pressing the go button 44A (see FIG. 6) in a state that the first transfer mechanism 22 is positioned at the reference position 50 (see FIG. 2), the first transfer mechanism 22 is automatically operated and, further, the pick A1 is temporarily stopped at a first potential interference location, as illustrated in FIG. 9A. The first potential interference location is a position where a horizontal distance Y1 between a bulkhead 10A of the inlet side transfer chamber 10 to which the orienter 26 is attached and a leading end of the pick A1 is, e.g., about 1 cm based on the design values of the processing system. Accordingly, the leading end of the pick A1 can be prevented from colliding with the bulkhead 10A even if a height of an opening of the orienter 26 is as short as about 3.6 cm. At the first potential interference location, the operator vertically adjusts and moves the pick A1 by the manual operation, if necessary, so that the pick A1 can enter into the orienter 26 without the interference.

Next, if the operator inputs the moving instruction by pressing the go button, the pick A1 is automatically moved in the horizontal direction and then temporarily stopped at a second potential interference location, as depicted in FIG. 9B. The second potential interference location is a position where a horizontal distance Y2 between a peripheral portion of a rotatable table 28 and the pick A1 is, e.g., about 1 cm based on the design values of the processing system. At the second potential interference location, if necessary, the operator adjusts the position of the pick A1 in the horizontal direction by the manual operation so that the rotatable table 28 can be adequately surrounded by the pick A1 from the top view when the pick A1 is further moved. In other words, the position thereof is adjusted by the manual operation so that the pick does not interfere with the rotatable table 28 when the pick A1 is further moved.

Thereafter, if the operator inputs the moving instruction by pressing the go button, thepick A1 is automatically moved in the horizontal direction and then reaches a temporary moving destination position, as shown in FIG. 9C.

Further, if necessary, the operator adjusts and moves the pick A1 to a proper position, i.e., a target moving position, by the manual operation, as illustrated in FIG. 9D. Furthermore, by pressing the save button 44B (see FIG. 6), position coordinate data thereof are stored in the controller 40. In this case, before the save button 44B is pressed, for example, a transparent position aligning substrate W is mounted on the pick A1, as shown in the top view of FIG. 9D and, then, it is checked that the rotatable table 28 is positioned at an approximately central portion of the position aligning substrate W.

In FIG. 9D, since the pick A1 is positioned under the rotatable table 28 at the temporary moving destination position (see FIG. 9C), the pick A1 is adjusted and moved upwardly by the manual operation and, further, properly positioned by using the position aligning substrate W.

Also in the second preferred embodiment, the pick is temporarily stopped only at a potential interference location where a possibility that the pick or the like interferes with another member is anticipated. Further, whenever the pick is temporarily stopped, if necessary, the pick is adjusted and moved by the manual operation, and then is automatically moved to a next potential interference location. Therefore, a moving time of the pick along the entire transfer path is shortened and, accordingly, the teaching operation can be quickly performed in a short period of time.

Third Preferred Embodiment

Hereinafter, a teaching operation performed for a load-lock chamber in accordance with a third preferred embodiment will be described.

FIGS. 10A to 10E illustrate an exemplary teaching operation performed for the load-lock chamber in accordance with the third preferred embodiment of the present invention.

Herein, an operation for teaching the pick A1 with respect to the load-lock chamber 8A between two load-lock chambers 8A and 8B will be described as an example. The position aligning substrate W is mounted in advance on the mounting table 38A in the load-lock chamber 8A. Further, four potential interference locations shown in FIGS. 10A to 10D are obtained based on the design values of the processing system. FIG. 10E presents a temporary moving destination position. Moreover, since the display on the display unit is same as in the aforementioned case, the description thereof will be omitted.

First, if a moving instruction is inputted by pressing the go button 44A (see FIG. 6) in a state that the first transfer mechanism 22 is positioned at the reference position 50 (see FIG. 2), the first transfer mechanism 22 is automatically operated and, further, the pick A1 is temporarily stopped at a first potential interference location, as shown in FIG. 10A. The first potential interference location is a position where a horizontal distance Z1 between a bulkhead 10B of the inlet side transfer chamber 10 to which the load-lock chamber 8A is attached and the leading end of the pick A1 is, e.g., about 1 cm based on the design values of the processing system. Accordingly, the leading end of the pick A1 can be prevented from colliding with the bulkhead 10B even if a height of an opening of the load-lock chamber 8A is as short as about 4.9 cm. At the first potential interference location...
location, the operator vertically adjusts and moves the pick A1 by the manual operation, if necessary, so that the pick A1 can enter into the load-lock chamber 8A without the interference.

[0100] Next, if the operator inputs the moving instruction by pressing the go button, the pick A1 is automatically moved in the horizontal direction and then temporarily stopped at a second potential interference location, as depicted in FIG. 10B. The second potential interference location is a position where a horizontal distance Z2 between a peripheral portion of the position aligning substrate W mounted on the mounting table 38A and the pick A1 is, e.g., about 1 cm based on the design values of the processing system. At the second potential interference location, if necessary, the operator adjusts the position of the pick A1 in the vertical and the horizontal direction by the manual operation, so that the mounting table 38A can be adequately surrounded by the pick A1 when the pick A1 is further moved. In other words, the position thereof is adjusted by the manual operation so that the pick A1 does not interfere with the mounting table 38A and the position aligning substrate W when the pick A1 is further moved.

[0101] Thereafter, if the operator inputs the moving instruction by pressing the go button, the pick A1 is slightly and automatically moved in the horizontal direction and then temporarily stopped at a third potential interference location, as illustrated in FIG. 10D. The third potential interference location is a position where a horizontal distance Z4 between a top portion of an open gate valve G and a base of the pick A1 is, e.g., about 1 mm based on the design values of the processing system. The reason for temporarily stopping the pick A1 is to minimize damages if they interfere. At this time, if necessary, the position of the pick A1 is adjusted by the manual operation such that the pick A1 does not interfere with another member by a next movement.

[0102] Next, if the operator inputs the moving instruction by pressing the go button, the pick A1 is slightly and automatically moved in the horizontal direction and then temporarily stopped at a fourth potential interference location, as illustrated in FIG. 10D. The fourth potential interference location is a position where a horizontal distance Z4 between a top portion of an open gate valve G and a base of the pick A1 is, e.g., about 1 mm based on the design values of the processing system. The reason for temporarily stopping the pick A1 is to prevent the base portion of the pick A1 from colliding with the open gate valve G. At this time, if necessary, the position of the pick A1 is adjusted by the manual operation so that the pick A1 does not interfere with another member by a next movement.

[0103] Then, if the operator adjusts and moves the pick A1 to a proper position, i.e., a target moving position by the manual operation, if necessary. Further, by pressing the save button 44B (see FIG. 6), position coordinate data thereof are stored in the controller 40. In this case, before the save button 44D is pressed, it is checked that the pick A1 is properly positioned relative to, e.g., the transparent position aligning substrate W mounted on the mounting table 38A.

[0105] Also in the third preferred embodiment, the pick is temporarily stopped only at a potential interference location where the pick or the like is anticipated to interfere with another member is anticipated. Further, whenever the pick is temporarily stopped, if necessary, the pick is adjusted and moved by the manual operation, and then automatically moved to a next potential interference location. Therefore, the moving time of the pick along the entire transfer path is shortened and, accordingly, the teaching operation can be quickly performed in a short period of time.

[0106] Furthermore, the aforementioned teaching operation is performed for the picks A1 and A2 with respect to the load-lock chambers 8A and 8B.

[0107] The teaching method of the first transfer mechanism 22, which has been described in each of the above-described embodiments, is equally carried out for both picks B1 and B2 of the second transfer mechanism 14 in the common transfer chamber 6 with respect to the processing chambers 4A to 4D and the load-lock chambers 8A and 8B.

[0108] Actually, after the teaching method is performed, the position aligning substrate W installed at each of the determined target moving positions is automatically transferred to the orienter 26 and, further, coordinate data of the target moving positions are further corrected based on a micro-variation of the position of the position aligning substrate W.

[0109] Since the aforementioned configurations of the processing system 1 and the transfer mechanisms 14 and 22 are only examples, the teaching method of the present invention can be applied to every transfer mechanism installed in an atmosphere of an atmospheric pressure and a vacuum.

[0110] Further, although a semiconductor wafer has been described as an example of an object to be processed, the method of the present invention can be applied to a glass substrate, an LCD substrate or the like without being limited thereto.

[0111] As described above, the teaching method and the processing system of the present invention can provide following effects.

[0112] In accordance with the present invention, a transfer mechanism is temporarily stopped only at a spot (a location) where there is a possibility of interference with another member and then adjusted and moved if necessary. On the other hand, the transfer mechanism is automatically moved in a location where there is no possibility of interference with another member. Accordingly, a teaching operation time can be greatly reduced.

[0113] Further, in accordance with the present invention, since a display unit displays thereon a message for informing a potential interference, an operator recognizes the message and, accordingly, the transfer mechanism can be prevented from interfering with another member more effectively.

[0114] While the invention has been shown and described with respect to the preferred embodiments, it will be understood by those skilled in the art that various changes and modifications may be made without departing from the spirit and scope of the invention as defined in the following claims.
What is claimed is:

1. A teaching method for storing in a controller a target moving position of a transfer mechanism in a processing system provided with the transfer mechanism for transferring an object to be processed by supporting same with a pick, the teaching method comprising the steps of:

   temporarily stopping the transfer mechanism in the middle of a moving route to a temporary moving destination position so as to make sure that the transfer mechanism does not interfere with another member at a potential interference location where there is a possibility that the transfer mechanism interferes with said another member;

   resuming to move the temporarily stopped transfer mechanism by inputting a moving instruction;

   repeating the temporarily stopping step and the resuming step; and

   when the pick reaches the temporary moving destination position, storing, as the target moving position, in the controller a position of the pick after adjusting and moving or without adjusting and moving the position of the pick.

2. The teaching method of claim 1, wherein the transfer mechanism is adjusted and moved to a location where there is no possibility of interference with another member in case there is a possibility that the temporarily stopped transfer mechanism interferes with said another member.

3. The teaching method of claim 1, wherein the potential interference location is calculated and obtained in advance by the controller based on design values of the processing system.

4. The teaching method of claim 1, wherein the controller displays on a display unit a message for informing an operator of a potential interference whenever the transfer mechanism is temporarily stopped.

5. The teaching method of claim 1, wherein an arm of the transfer mechanism is a stretchable, bendable and revolvable multi-joint arm.

6. The teaching method of claim 1, wherein the target moving position is a position in an inlet port for loading the object to be processed into the processing system.

7. The teaching method of claim 2, wherein the potential interference location is calculated and obtained in advance by the controller based on design values of the processing system.

8. The teaching method of claim 2, wherein the controller displays on a display unit a message for informing an operator of a potential interference whenever the transfer mechanism is temporarily stopped.

9. The teaching method of claim 2, wherein an arm of the transfer mechanism is a stretchable, bendable and revolvable multi-joint arm.

10. The teaching method of claim 2, wherein the target moving position is a position in an inlet port for loading the object to be processed into the processing system.

11. A processing system comprising

   a processing chamber for performing a processing on an object to be processed;

   an inlet port for introducing the object to be processed;

   an orienter for performing a position aligning of the object to be processed;

   a transfer mechanism, having a pick for supporting the object to be processed, for transferring the object to be processed; and

   a controller for controlling an operation of the transfer mechanism,

   wherein the controller is configured to perform the steps of:

   temporarily stopping the transfer mechanism in the middle of a moving route to a temporary moving destination position so as to make sure that the transfer mechanism does not interfere with another member at a potential interference location where there is a possibility that the transfer mechanism interferes with said another member;

   resuming to move the temporarily stopped transfer mechanism by inputting a moving instruction;

   repeating the temporarily stopping step and the resuming step; and

   when the pick reaches the temporary moving destination position, storing, as the target moving position, in the controller a position of the pick after adjusting and moving or without adjusting and moving the position of the pick.

12. The processing system of claim 11, wherein the controller calculates and obtains in advance the potential interference location based on design values of the processing system.

13. The processing system of claim 11, wherein the controller is connected to a display unit and displays on the display unit a message for informing an operator of a potential interference whenever the transfer mechanism temporarily is stopped.

14. The processing system of claim 12, wherein the controller is connected to a display unit and displays on the display unit a message for informing an operator of a potential interference whenever the transfer mechanism temporarily is stopped.

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