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SUMMARY

[0004] The present disclosure provides some embodiments of a configuration for operating a substrate transfer mechanism so as to obtain appropriate substrate arrangement.

[0005] According to one or more embodiments of the present disclosure, there is provided a configuration including; a substrate holder configured to hold a plurality of substrates including product substrates and dummy substrates; a transfer mechanism configured to load the plurality of substrates to the substrate holder; a main controller configured to determine substrate-mounting positions for the plurality of substrates according to setting items respectively corresponding to the number of the product substrates to be mounted on the substrate holder, the number of the dummy substrates to be loaded above and below the product substrates, and a number indicating a mounting position of a topmost of the dummy substrates to be loaded to the substrate holder; and a transfer controller configured to operate the transfer mechanism according to the determined substrate-mounting positions.

[0006] According to the present disclosure, it is possible to operate the substrate transfer mechanism so as to obtain appropriate substrate arrangement.

BRIEF DESCRIPTION OF DRAWINGS

[0007] FIG. 1 is a perspective view of a substrate processing apparatus according to embodiments of the present disclosure.

FIG. 2 is a side perspective view of the substrate processing apparatus according to the embodiments of the present disclosure.

FIG. 3 is a configuration example of a controller and a storage part of the substrate processing apparatus according to the embodiments of the present disclosure.

FIG. 4A is a view for explaining first embodiments of the present disclosure.

FIG. 4B is a view for explaining first embodiments of the present disclosure.

FIG. 5 is an example of a setting screen for setting predetermined items according to second and

start order or start time of the job, and the like. The matching uses an automatically generated ID called a job ID. For example, the job storage part 24 stores the job ID, the recipe name "Test," and the serial number "002" indicating the start order or the start time "14:00" in matching. Hereinafter, the job may be referred to as a process recipe.

[0031] Next, the substrate arrangement sequence in the present embodiments will be described with reference to FIG. 7. In the present embodiments, the substrate transfer to the boat 217 is executed, but the substrate processing (process recipe) after the substrate transfer may also be executed.

[0032] (S1) When at least a predetermined number of product substrates 200 are loaded into the substrate processing apparatus 100 and the controller 10 receives an instruction to process the product substrates 200 from a host computer or the operation part 31, the substrate arrangement sequence in the present embodiments is started.

[0033] (S2) The controller 10 acquires, from the storage part 20, various data for arranging (laying out) substrates on the boat 217. Specifically, the controller 10 acquires data including an appropriate transfer condition among the data stored in the WAP storage part 22. Alternatively, the controller 10 may appropriately display a setting table shown in FIG. 4A or 5 to be described below on the display part 32 to obtain data for substrate layout preparation from the operator.

[0034] (S3) After acquiring various data in S2, the controller 10 checks whether or not a setting table of a setting item (parameter) corresponding to the number of product substrates 200 is valid. Specifically, the controller 10 checks from which setting table of the example of the setting table shown in FIG. 4A or 5 to be described later, the data for arranging the substrates is acquired.

[0035] The controller 10 proceeds to (S7) when NO in S3 (acquiring data in the example of the setting table shown in FIG. 4A). In this case, regardless of the number of product substrates 200, the arrangement of the substrates is determined according to the contents of the setting item (parameter). Specifically, when processing the product substrates 200, the arrangement of the substrates is determined according to a combination of the head slot No., the number of upper

dummy substrates, and the number of lower dummy substrates.

[0036] (S4) When YES in S3 (acquiring data in the example of the setting table shown in FIG. 5), the controller 10 determines the arrangement of the substrates according to the contents of setting item (parameter) according to the number of product substrates 200. First, the number of product substrates 200 is checked. (S5) Next, the number of dummy substrates and the head position according to the number of product substrates 200 are selected from the setting table.

[0037] (S6) The controller 10 compares the number of dummy substrates and the head position with the data for substrate layout preparation acquired in (S2). In this case, the arrangement of the substrates is determined according to the contents of setting item (parameter) according to the number of product substrates 200 as they are. Specifically, (S7) the controller 10 determines the arrangement of the substrates according to a combination of the number of product substrates, the head slot No., the number of upper dummy substrates, and the number of lower dummy substrates when processing the product substrates 200.

[0038] (S8) The controller 10 sends to the transfer controller 15 the arrangement of the substrates determined according to the combination of the number of product substrates, the head slot No., the number of upper dummy substrates, and the number of lower dummy substrates when processing the product substrates 200. The transfer controller 15 controls the wafer transfer mechanism 125 to transfer the substrates 200 to the boat 217 according to the determined substrate-mounting position.

[0039] Although not shown, after the transfer step (S8) of transferring the substrates 200 to the boat 217, the controller 10 acquires a process recipe from the recipe storage part 21 and executes the process recipe to perform a step of processing the substrates 200.

(First Example)

[0040] Next, a first Example in which at least one is selected from a group consisting of the type of substrate 200 to be transferred to the boat 217, the mounting position of the substrate 200, and the number of substrates 200 and the wafer transfer mechanism 125 is controlled according to the selected condition will be described with reference to FIGS. 4A and 4B. FIG. 4A is an example of a

dummy substrates 200c are fixed in advance.

[0042] FIG. 4B shows a state in which the substrate holder 217 is controlled by the control of the controller 10 based on the setting value input in the present Example, and a substrate is transferred to a set substrate transfer position.

[0043] According to the first Example described above, regardless of the number of product substrates, since the head slot No. which is the mounting start position of the upper dummy substrate, the number of upper dummy substrates, and the number of lower dummy substrates are registered in advance in the storage part 20 (the WAP storage part 22), it is possible to suppress input miss of parameters by the operator.

(Second Example)

[0044] Next, a second Example in which the mounting position and the number of dummy substrates are determined in accordance with the number of product substrates will be described with reference to FIGS. 5 and 6. FIG. 5 shows a table in which the number of product substrates, the head slot No. at which the mounting of the upper dummy substrate is started, the number of upper dummy substrates, and the number of lower dummy substrates are set. The operator selects the number of product substrates from the operation part 31. Based on the head slot No. at which the mounting of the dummy substrate is started, the number of upper dummy substrates, and the number of lower dummy substrates according to the selected number of product substrates, the main controller 11 controls the transfer mechanism 125 to mount the dummy substrates and the product substrates. FIG. 6A shows an example in which the number of product substrates is selected to be 25, FIG. 6B shows an example in which the number of product substrates is selected to be 75, and FIG. 6C shows an example in which the number of product substrates is set to be 110. Even in the process according to the Example, as shown in FIGS. 6A to 6C, the product substrate 200b is mounted between the dummy substrate 200a on the upper end side and the dummy substrate 200c on the lower end side. For example, when receiving the material information including at least the substrate transfer position determined with the number of product substrates designated by the operation by the operator, the main

supplementary dummy substrate 100f are transferred in addition to the third Example. As shown in FIG. 8, the supplementary dummy substrate 200f is transferred to each slot of the boat 217, and various substrates are transferred to all slots of the boat 217.

[0054] The fourth Example will be described mainly with reference to the flowchart shown in FIG. 7 in conjunction with FIGS. 4A, 4B, and 5 as appropriate. Explanation of the same contents as in the first to third Example will be omitted.

[0055] (S1) When at least a predetermined number of product substrates 200 are loaded to the substrate processing apparatus 100 and the controller 10 receives an instruction to process the product substrates 200 from a host computer or the operation part 31, the substrate arrangement sequence in the present embodiments is started.

[0056] (S2) The controller 10 acquires, from the storage part 20, various data for arranging (laying out) substrates on the boat 217. Specifically, the controller 10 acquires data including an appropriate condition among the data stored in the WAP storage part 22. Alternatively, the controller 10 may appropriately display both the setting tables shown in FIGS. 4A, 4B, and 5 on the display part 32 to obtain data for substrate layout preparation from the operator.

[0057] (S3) When the parameter setting table (FIG. 5) according to the number of product substrates is not acquired (No in S3), the controller 10 determines that the process is abnormal, forcibly terminates this flowchart, and issues an alarm to notify the occurrence of the abnormality. When YES in S3, the process proceeds to the next step.

[0058] (S4) When YES in S3 (acquiring data in the example of the setting table shown in FIG. 5), the controller 10 determines the arrangement of the substrates according to the contents of setting item (parameter) according to the number of product substrates 200. First, the number of product substrates 200 is checked. (S5) Next, the number of pattern dummy substrates and the head position of the pattern dummy substrates according to the number of product substrates 200 are selected from the setting table shown in FIG. 5.

[0059] (S6) The controller 10 compares the number of pattern dummy substrates and the head position of the pattern dummy substrates with data for substrate arrangement layout preparation

based on the setting table shown in FIG. 4A, acquired in (S2), and determines the arrangement of pattern wafers and pattern dummy substrates in accordance with the contents of the setting item (parameter) corresponding to the number of product substrates 200.

[0060] (S7) The controller 10 determines the arrangement of the substrates according to a combination of the head slot No. at which various substrates specified in the setting table shown in FIG. 4A are mounted, the number of upper and lower side dummy substrates, the head slot No. of the pattern dummy substrates shown in FIG. 5, the number of product substrates, and the number of upper and lower pattern dummy substrates. Further, in the fourth Example, the data acquired in (S2) includes information using a supplementary dummy substrate, and as shown in FIG. 8, it is determined to arrange a supplementary dummy substrate in a slot between a side dummy substrate and a pattern dummy substrate.

[0061] (S8) The controller 10 sends to the transfer controller 15 the arrangement of the substrates determined according to a combination of the head slot No. of the upper side dummy, the number (10) of upper side dummy substrates, the number (5) of lower side dummy substrates, the presence and number of supplementary dummy substrates, the number of product substrates 200b to be processed, the head slot No. of the upper side pattern dummy substrate, the number of upper pattern dummy substrates, and the number of lower pattern dummy substrates. The transfer controller 15 controls the wafer transfer mechanism 125 to transfer the substrates 200 to the boat 217 according to the determined substrate-mounting position.

[0062] According to the fourth Example, the effects of the first and third Examples can be obtained.

[0063] Furthermore, according to the fourth Example, the process gas can be stabilized more than that in the third Example without generating convection of the process gas in the process furnace 202 by the supplementary dummy substrate, thereby improving the substrate-processing quality.

[0064] The present disclosure is not limited to the above-described embodiments, and it goes without saying that various modifications can be made without departing from the scope of the

WHAT IS CLAIMED IS:

1. A substrate processing apparatus comprising:

a substrate holder configured to hold a plurality of substrates including product substrates and dummy substrates;

a transfer mechanism configured to load the plurality of substrates to the substrate holder;

a main controller configured to determine substrate-mounting positions for the plurality of substrates according to setting items respectively corresponding to a number of the product substrates to be mounted on the substrate holder, a number of the dummy substrates to be loaded above and below the product substrates, and a number indicating a mounting position of a topmost of the dummy substrates to be loaded to the substrate holder; and

a transfer controller configured to operate the transfer mechanism according to the determined substrate-mounting positions.

2. The substrate processing apparatus of Claim 1, further comprising: a storage part configured to store a setting table including the setting items,

wherein, when receiving material information including at least the number of the product substrates, the main controller is configured to acquire the setting table corresponding to the material information.

3. The substrate processing apparatus of Claim 2, wherein the main controller is configured to check the number of the product substrates, select the setting items defined in the setting table according to the number of the product substrates, and determine substrate-mounting positions for the substrates according to the setting items.

4. The substrate processing apparatus of Claim 1, wherein the setting items are configured such that the number of the dummy substrates loaded above and below the product substrates are changed according to the number of the product substrates.

5. The substrate processing apparatus of Claim 4, wherein the setting items are configured such that a number of the dummy substrates to be mounted on an upper side of the product substrates is larger than a number of the dummy substrates to be mounted on a lower side of the product substrates.

6. The substrate processing apparatus of Claim 2, wherein the setting items are configured to be registered in advance in the storage part.

7. The substrate processing apparatus of Claim 1, further comprising: a setting screen on which the setting items for loading the plurality of substrates to the substrate holder are set according to the number of the product substrates,

wherein the main controller is configured to enable the setting items to be set on the setting screen.

8. The substrate processing apparatus of Claim 1, wherein the main controller is further configured to determine the substrate-mounting positions for the plurality of substrates according to setting items respectively corresponding to a number indicating a substrate-mounting position of an upper end of the plurality of substrates to be mounted on the substrate holder, a number of side dummy substrates mounted from the substrate-mounting position of the upper end, the number of side dummy substrates mounted from a substrate-mounting position of a lower end of the plurality of substrates to be mounted on the substrate holder, and a presence or absence of a supplementary dummy substrate.

9. The substrate processing apparatus of Claim 8, wherein the number of the side dummy substrates is fixed.

10. The substrate processing apparatus of Claim 1, wherein the dummy substrates are pattern dummy substrates.

11. A method of manufacturing a semiconductor device, comprising:

determining substrate-mounting positions for a plurality of substrates including product substrates and dummy substrates according to setting items respectively corresponding to a number of the product substrates to be mounted on a substrate holder that holds the plurality of substrates, a number of the dummy substrates to be loaded above and below the product substrates, and a number indicating a mounting position of a topmost of the dummy substrates to be loaded to the substrate holder;

transferring the plurality of substrates to the substrate holder according to the determined substrate-mounting positions; and

loading the substrate holder to a process furnace and processing the substrates held by the substrate holder.

12. A program for controlling a substrate processing apparatus by causing a computer to execute a process comprising:

determining substrate-mounting positions for a plurality of substrates including product substrates and dummy substrates according to setting items respectively corresponding to a number of the product substrates to be mounted on a substrate holder that holds the plurality of substrates, a number of the dummy substrates to be loaded above and below the product substrates, and a number indicating a mounting position of a topmost of the dummy substrates to be loaded to the substrate holder;