

SUBSTRATE PROCESSING APPARATUS AND CONTROL METHOD FOR  
SUBSTRATE PROCESSING APPARATUS

FIELD

**[0001]** The present disclosure relates to a substrate processing apparatus and its control method.

BACKGROUND

**[0002]** Conventionally, there has been known a technology for making a processing recipe that allows overlaps of the timing of the use of a plurality of supply units of a substrate processing apparatus that includes a plurality of process units for processing substrates by using processing liquid and a plurality of supply units for supplying heated processing liquid to the plurality of process units.

**[0003]** Patent Literature 1: Japanese Laid-open Patent Publication No. 2008-218449

**[0004]** The present disclosure provides a technology capable of reducing the drop in operation rate caused by a drop in temperature of processing liquid.

SUMMARY

**[0005]** According to an aspect of an embodiment, a control method for controlling a substrate processing apparatus having a plurality of processing units that

execute substrate processing by using processing liquid and at least one supply unit that supplies heated processing liquid to the plurality of processing units, the method includes: acquiring first log information that indicates a status of an execution of the substrate processing of each of the plurality of processing units; based on the first log information, specifying a non-operating interval during which the plurality of processing units does not execute the substrate processing; and changing processing time of a temperature control process for maintaining temperature of the heated processing liquid in such a manner that the non-operating interval is shortened regarding the supply unit corresponding to processing liquid to be used for an unexecuted substrate processing during the non-operating interval.

#### BRIEF DESCRIPTION OF DRAWINGS

**[0006]** FIG. 1 is diagram illustrating a schematic configuration of a substrate processing system according to an embodiment;

FIG. 2 is a schematic diagram illustrating a configuration of a process unit according to the embodiment;

FIG. 3 is a block diagram illustrating a configuration of a control device according to the embodiment;

FIG. 4 is a diagram illustrating an example of first log information according to the embodiment;

FIG. 5 is a diagram illustrating an example of second log information according to the embodiment;

FIG. 6 is a diagram illustrating an example of third log information according to the embodiment;

FIG. 7 is a diagram illustrating a specific example of specifying a non-operating interval according to the embodiment;

FIG. 8 is a diagram illustrating a specific example of changing a processing time interval of a temperature control process according to the embodiment; and

FIG. 9 is a flowchart indicating procedures of an acquiring process, a specifying process and a changing process of the substrate processing system according to the embodiment.

#### DESCRIPTION OF EMBODIMENT

**[0007]** An exemplary embodiment of a substrate processing apparatus and its control method disclosed in the present application (hereinafter referred to as "the embodiment") will be described below in detail with reference to the accompanying drawings. In addition, the illustrative embodiment disclosed below is not intended to limit the present invention.

**[0008]** Embodiment

Configuration of Substrate Processing System

A schematic configuration of a substrate processing system 1 (one example of the substrate processing apparatus) according to the embodiment will be described with reference to FIG. 1. FIG. 1 is a diagram illustrating a schematic configuration of the substrate processing system 1 according to the embodiment. Hereinafter, in order to make a positional relationship clear, X-axis, Y-axis, and Z-axis will be defined to be perpendicular to each other and the positive Z-axis direction is regarded as a vertically upward direction.

**[0009]** As illustrated in FIG. 1, the substrate processing system 1 includes a carry-in/out station 2 and a processing station 3. The carry-in/out station 2 and the processing station 3 are provided adjacent to each other.

**[0010]** The carry-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 are placed to horizontally accommodate a plurality of substrates, namely, semiconductor wafers (hereinafter, wafer W) in the embodiment.

**[0011]** The transfer section 12 is provided adjacent to the carrier placing section 11, and includes therein a substrate transfer device 13 and a delivery unit 14. The

substrate transfer device 13 includes a wafer holding mechanism configured to hold the wafer W. The substrate transfer device 13 is movable horizontally and vertically and is pivotable around a vertical axis, and transfers the wafer W between the corresponding carrier C and the delivery unit 14 by using the wafer holding mechanism.

**[0012]** The processing station 3 is provided 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 at both sides of the transfer section 15.

**[0013]** The transfer section 15 includes therein a substrate transfer device 17. The substrate transfer device 17 includes a wafer holding mechanism configured to hold the wafer W. The substrate transfer device 17 is movable horizontally and vertically and is pivotable around the vertical axis, and transfers the wafer W between the delivery unit 14 and the corresponding processing unit 16 by using the wafer holding mechanism.

**[0014]** Each of the processing units 16 performs a substrate processing on the wafer W transferred by the substrate transfer device 17. The processing units 16 performs the substrate processing using processing liquid.

**[0015]** The substrate processing system 1 further includes a control device 4. The control device 4 is, for

example, a computer. The control device 4 includes a controller 18 and a storage 19. The storage 19 stores therein a program for controlling various types of processes that are performed in the substrate processing system 1. The controller 18 reads out and executes the program stored in the storage 19 to control operations of the substrate processing system 1.

**[0016]** The program may be recorded in a computer-readable recording medium and thus may be installed into the storage 19 of the control device 4 from the recording medium. A computer-readable recording medium includes, for example, a hard disk (HD), a flexible disk (FD), a compact disc (CD), a magneto-optical disk (MO), and a memory card.

**[0017]** In the substrate processing system 1 configured as described above, the substrate transfer device 13 of the carry-in/out station 2 first takes out the wafer W from one of the carriers C placed in the carrier placing section 11, and places the taken wafer W on the delivery unit 14. The wafer W placed on the delivery unit 14 is taken out from the delivery unit 14 by the substrate transfer device 17 of the processing station 3, and is carried into one of the processing units 16.

**[0018]** The wafer W carried into the processing unit 16 is processed by the processing unit 16, and then is carried out from the processing unit 16 and placed on the delivery

unit 14 by using the substrate transfer device 17. Then, the processed wafer W placed on the delivery unit 14 is returned to the corresponding carrier C in the carrier placing section 11 by using the substrate transfer device 13.

**[0019]** Summary of Processing Unit

Next, summary of the processing unit 16 will be described with reference to FIG. 2. FIG. 2 is a diagram illustrating the schematic configuration of the processing unit 16. The processing unit 16 includes a chamber 20, a substrate holding mechanism 30, a processing liquid supply unit 40, and a recovery cup 50.

**[0020]** The chamber 20 accommodates the substrate holding mechanism 30, the processing liquid supply unit 40, and the recovery cup 50. A fan filter unit (FFU) 21 is provided on a ceiling of the chamber 20. The FFU 21 forms a downflow within the chamber 20.

**[0021]** The substrate holding mechanism 30 includes a holding unit 31, a supporting unit 32, and a driving unit 33. The holding unit 31 horizontally holds the wafer W. The supporting unit 32 is a vertically extending member, and includes a bottom end rotatably supported by the driving unit 33 and a leading end horizontally supporting the holding unit 31. The driving unit 33 rotates the supporting unit 32 around the vertical axis.

**[0022]** The substrate holding mechanism 30 rotates the supporting unit 32 by using the driving unit 33 to rotate the holding unit 31 supported by the supporting unit 32, and consequently rotates the wafer W held on the holding unit 31.

**[0023]** The processing liquid supply unit 40 supplies processing liquid onto the wafer W. The processing liquid supply unit 40 is connected to processing liquid supply sources 70a, 70b and 70c (one example of a supply unit). Hereinafter, the processing liquid supply sources 70a, 70b and 70c may be collectively called "processing liquid supply source 70" in a case where the processing liquid supply sources 70a, 70b and 70c are not necessary to be distinguished. The processing liquid supply source 70 includes a heater (not shown in the drawings) and supplies heated processing liquid to a plurality of the processing units 16. The processing liquid supply source 70a is a deionized water supply unit for supplying heated deionized water. The processing liquid supply source 70b is a chemical liquid supply unit for supplying heated chemical liquid. The processing liquid supply source 70c is an ozone water supply unit for supplying heated ozone water. The number of the processing liquid supply source 70 is not limited to three but may be one, two, four or more than four.

**[0024]** The recovery cup 50 is arranged to surround the holding unit 31, and collects processing liquid scattered from the wafer W due to the rotation of the holding unit 31. A drain port 51 is formed at a bottom of the recovery cup 50. The processing liquid collected by the recovery cup 50 is discharged from the drain port 51 to the outside of the processing unit 16. In addition, an exhaust port 52 is formed at the bottom of the recovery cup 50 to discharge gas supplied from the FFU 21 to the outside of the processing unit 16.

**[0025]** The substrate processing system 1 executes a preparation process for heating the processing liquid by the processing liquid supply source 70 up to a target temperature that is suitable for the substrate processing before executing the substrate processing by the plurality of the processing units 16. After executing the preparation process by the processing liquid supply source 70, an operation rate of the substrate processing system 1 could be reduced since the substrate processing by each of the plurality of the processing units 16 may not be executed temporarily.

**[0026]** To deal with this issue, the substrate processing system 1 may execute a temperature control process for maintaining the temperature of the heated processing liquid by the processing liquid supply source 70 in order to

reduce the temperature drop of the processing liquid. In this temperature control process, the processing liquid supply source 70 continues to heat the processing liquid for a predetermined period after finishing the substrate processing by turning on a heater. Accordingly, processing time of the preparation process by the processing liquid supply source 70 can be reduced.

**[0027]** On the other hand, in a case where the processing time period of the temperature control process of the processing liquid supply source 70 is not proper, the temperature of the processing liquid falls to cause longer processing time of the preparation process. In this case, the substrate processing by each of the processing units 16 is not executed efficiently and the operation rate may decrease.

**[0028]** To deal with this problem, the substrate processing system 1 of the embodiment changes the processing time period of the temperature control process appropriately to reduce the temperature drop of the processing liquid in order to reduce the decrease of the operation rate caused by the temperature drop of the processing liquid.

**[0029]** Configuration of Control Device

Next, the configuration of the control device 4 will be explained with reference to FIG. 3. FIG. 3 is a block

diagram illustrating the configuration of the control device 4 according to the embodiment. As illustrated in FIG. 3, the control device 4 includes the controller 18 and the storage 19.

**[0030]** The controller 18 is realized to execute, in a RAM as a work area, various programs stored in an internal memory of the control device 4 by, for example, a Central Processing Unit (CPU), a Micro Processing Unit (MPU) or the like. The controller 18 is realized by an integrated circuit such as an Application Specific Integrated Circuit (ASIC), Field Programmable Gate Array (FPGA), etc.

**[0031]** The storage 19 is realized by, for example, a semiconductor memory device such as a Random Access Memory (RAM), a Flash Memory, etc., or a storing device such as a hard disk, an optical disk, etc.

**[0032]** The controller 18 includes an acquiring unit 181, a specifying unit 182 and a changing unit 183 as illustrated in FIG. 3 to realize or execute processing functions and operations explained hereinafter.

**[0033]** The acquiring unit 181 acquires a first log information 191, a second log information 192 and a third log information 193. Specifically, the acquiring unit 181 controls the plurality of the processing units 16 in accordance with recipe information (not shown in FIGs) stored in the storage 19 to execute various kinds of

substrate processing and acquires the first log information 191, the second log information 192 and the third log information 193. The acquiring unit 181 stores the acquired first through third log information 191 to 193 in the storage 19.

**[0034]** The first log information 191 is a log information that indicates a status of the execution of processing of each of the processing units 16. One example of the contents of the first log information 191 will be explained with reference to FIG. 4. FIG. 4 is a diagram illustrating one example of the first log information 191 according to the embodiment. As illustrated in FIG. 4, the item of "date and time" and the item of "execution status of the substrate processing" are associated with each other in the first log information 191.

**[0035]** In the item of "date and time", the date and time when its corresponding "execution status of the substrate processing" was acquired is stored. In the item of "execution status of substrate processing", information indicating whether the substrate processing of each of the processing units 16 is in process or not is stored. For example, the first line of FIG. 4 indicates that the substrate processing of the processing unit 16 of "processing unit #1" is in process and that the substrate processing of the processing unit 16 of "processing unit

#2" is not in process at the date and time of "20xx/yy/zz 00:01:00".

**[0036]** The second log information 192 is a log information that indicates a starting date and time and finishing date and time of each of the processing recipe of the substrate processing that is already completed among the plurality of the processing units 16. One example of the contents of the second log information 192 will be explained with reference to FIG. 5. FIG. 5 is a diagram illustrating one example of the second log information 192 according to the embodiment. As illustrated in FIG. 5, the items of "execution-completed substrate processing ID", "processing recipe name", "starting date and time" and "finishing date and time" are associated with each other in the second log information 192.

**[0037]** The item of "execution-completed substrate processing ID" stores an identifier that identifies an executed substrate processing. The item of "processing recipe name" stores a title of a processing recipe corresponding to the "execution-completed substrate processing ID". The item of "starting date and time" stores date and time when the substrate processing corresponding to the "execution-completed substrate processing ID" has started according to the processing recipe of the "processing recipe name". The item of

"finishing date and time" stores date and time when the substrate processing corresponding to the "execution-completed substrate processing ID" has finished according to the processing recipe of the "processing recipe name". For example, the first line in FIG. 5 indicates that the substrate processing corresponding to the execution-completed substrate processing ID "PJ1" has started on the starting date and time "20xx/yy/zz 23:44:25" and ended on the finishing date and time "20xx/yy/zz 23:57:18" according to the processing recipe of the processing recipe name "R1".

**[0038]** The third log information 193 is a log information of each of the processing liquid supply source 70 for indicating an event that disturbs the supply of the processing liquid. One example of the contents of the third log information 193 will be explained with reference to FIG. 6. FIG. 6 is a diagram illustrating one example of the third log information 193 according to the embodiment. As illustrated in FIG. 6, the item of "date and time" and the item of "event" of each of the processing liquid supply source 70 are associated with each other in the third log information 193.

**[0039]** In the item of "date and time", the date and time when its corresponding "event" occurred is stored. In the item of "event", information indicating an event that

occurred at each of the processing liquid supply sources 70a, 70b and 70c and that disturbs the supply of the processing liquid is stored. For example, the first line of FIG. 6 indicates that the supply of the processing liquid from the processing liquid supply source 70a was disturbed because the preparation process for heating the processing liquid by the processing liquid supply source 70a up to a target temperature suitable for the substrate processing was not completed at the date and time of "20xx/yy/zz 06:05:41". The first line of FIG. 6 also indicates that there was no event to disturb the supply of the processing liquid for each of the processing liquid supply sources 70b and 70c at the date and time of "20xx/yy/zz 06:05:41". In the item of "event", an item of "trouble" that means a trouble occurred in the processing liquid supply source 70 is stored in a case where the trouble occurred in the processing liquid supply source 70.

**[0040]** A specifying unit 182 specifies, based on the first log information 191, a non-operating interval during which the substrate processing is not executed by all of the plurality of the processing units 16.

**[0041]** Specifying the non-operating interval by the specifying unit 182 will be explained with reference to FIG. 7. FIG. 7 is a diagram illustrating a specific example of specifying a non-operating interval according to

the embodiment. As illustrated in FIG. 7, the specifying unit 182 generates plot data based on the first log information 191. The plot data is plotted data indicating a status of the execution of the substrate processing for each of the processing units 16 proportional to elapsed time. For example, a plot (the black plot in FIG. 7) is recorded in the plot data for each of the processing units 16 during the execution of the substrate processing. The specifying unit 182 specifies a time interval  $\Delta T$  as the non-operating interval in which any plot corresponding to all processing units 16 (the processing units #1-#12 in FIG. 7) does not exist in the plot data.

**[0042]** The changing unit 183 changes the processing time of the temperature control process for maintaining the temperature of the heated processing liquid in such a manner that the non-operating interval  $\Delta T$  is shortened regarding a processing liquid supply source 70 corresponding to the processing liquid to be used for an "unexecuted substrate processing at the non-operating interval  $\Delta T$ " among the plurality of processing liquid supply sources 70.

**[0043]** Specifically, the changing unit 183 determines the substrate processing executed right after the non-operating interval  $\Delta T$  as the "unexecuted substrate processing at the non-operating interval  $\Delta T$ " based on the

non-operating interval  $\Delta T$  and the second log information 192. For example, the changing unit 183 determines the substrate processing having the earliest starting date and time after the non-operating interval  $\Delta T$  as the "unexecuted substrate processing at the non-operating interval  $\Delta T$ " by referring to the second log information 192. Then, the changing unit 183 specifies an event during the non-operating interval  $\Delta T$  regarding the processing liquid supply source 70, among the plurality of the processing liquid supply sources 70, that supplies the processing liquid to be used for the earliest executed substrate processing after the non-operating interval  $\Delta T$  based on the non-operating interval  $\Delta T$  and the third log information 193. Then, the changing unit 183 changes the processing time of the temperature control process in such a manner that the non-operating interval  $\Delta T$  is shortened in a case where the specified event indicates that the preparation process for heating the processing liquid up to the target temperature is not completed yet.

**[0044]** Changing the processing time of the temperature control process by the changing unit 183 will be explained with reference to FIG. 8. FIG. 8 is a diagram illustrating a specific example of changing the processing time of the temperature control process according to the embodiment. As illustrated in FIG. 8, the processing liquid supply

source 70 continues to heat the processing liquid after the end of the substrate processing by turning on the heater for a predetermined time interval  $\Delta T1$ . Accordingly, the processing time of the preparation process of the processing liquid supply source 70 is shortened.

**[0045]** However, in a case where the processing time interval  $\Delta T1$  of the temperature control process by the processing liquid supply source 70 is not long enough, the temperature of the processing liquid falls to cause longer processing time of the preparation process by the processing liquid supply source 70. In this case, the substrate processing by each of the processing units 16 is not efficiently executed and the operation rate may drop.

**[0046]** In the embodiment, the changing unit 183 changes from the processing time interval  $\Delta T1$  of the temperature control process by the processing liquid supply source 70 to a processing time interval  $\Delta T2$  that is longer than the processing time interval  $\Delta T1$ . Thus, the processing liquid after the end of the substrate processing is heated longer by the processing liquid supply source 70 to reduce the temperature drop in the processing liquid. Accordingly, the processing time of the preparation process by the processing liquid supply source 70 is shortened or omitted. As a result of it, the substrate processing by each of the processing units 16 is efficiently executed and the non-

operating interval  $\Delta T$  is shortened.

**[0047]** As described above, according to the embodiment, the changing unit 183 changes the processing time  $\Delta T_1$  of the temperature control process in such a manner that the non-operating interval  $\Delta T$  is shortened regarding a processing liquid supply source 70 corresponding to the processing liquid to be used for an "unexecuted substrate processing at the non-operating interval  $\Delta T$ " among the plurality of processing liquid supply sources 70. Thus, the drop in the operation rate of the substrate processing system 1 caused by the temperature drop of the processing liquid can be reduced.

**[0048]** According to the embodiment, the changing unit 183 calculates time intervals between a plurality of executed substrate processing, and changes the processing time  $\Delta T_1$  of the temperature control process in such a manner that the processing time  $\Delta T_1$  of the temperature control process is equal to or less than a maximum time interval calculated by the changing unit 183 based on the non-operating interval  $\Delta T$  and the second log information 192. Thus, increase in power consumption of the processing liquid supply source 70 caused by changing the processing time of the temperature control process can be reduced.

**[0049]** Processing Flow of Substrate Processing System

Next, procedures of the acquiring process, the

specifying process and the changing process of the substrate processing system 1 according to the embodiment will be described with reference to FIG. 9. FIG. 9 is a flowchart indicating procedures of the acquiring process, the specifying process and the changing process of the substrate processing system 1 according to the embodiment. Processes indicated in FIG. 1 are executed under the control of the control device 4.

**[0050]** Firstly, the substrate processing system 1 executes the acquiring process. Specifically, the controller 18 acquires the first log information 191 to the third log information 193 by controlling a plurality of the processing units 16 and executing various kinds of substrate processing according to a recipe information (not shown) stored in the storage 19 (Step S101). The controller 18 stores the acquired first through third log information 191 to 193 in the storage 19.

**[0051]** Next, the substrate processing system 1 executes the specifying process. Specifically, the controller 18 generates, based on the first log information 191, the plot data that is plotted data indicating execution status of the substrate processing of each of the processing units 16 proportional to elapsed time (Step S102).

**[0052]** The controller 18 specifies the time interval  $\Delta T$  as the non-operating interval in which any plot

corresponding to the plurality of processing units 16 does not exist in the plot data (Step S103).

**[0053]** In a case where the non-operating interval  $\Delta T$  is not specified (No in Step S104), the controller 18 ends the specifying process.

**[0054]** On the other hand, in a case where the non-operating interval  $\Delta T$  is specified (Yes in Step S104), the substrate processing system 1 executes the changing process. Specifically, the controller 18 specifies the earliest substrate processing executed right after the non-operating interval  $\Delta T$  as the "unexecuted substrate processing at the non-operating interval  $\Delta T$ " based on the non-operating interval  $\Delta T$  and the second log information 192 (Step S105).

**[0055]** The controller 18 specifies an event during the non-operating interval  $\Delta T$  regarding the processing liquid supply source 70, among the plurality of the processing liquid supply sources 70, that supplies the processing liquid to be used for the earliest executed substrate processing right after the non-operating interval  $\Delta T$  based on the non-operating interval  $\Delta T$  and the third log information 193 (Step S106).

**[0056]** The controller 18 determines whether the specified event indicates that the preparation process for heating the processing liquid up to the target temperature

is completed or not (Step S107).

**[0057]** In the Step S107, in a case where the contents of the specified event do not indicate that the preparation process for heating the processing liquid up to the target temperature is not completed yet (No in Step S107), the controller 18 executes a process according to the contents of the specified event (Step S108). For example, in a case where the contents of the specified event indicate a trouble of the processing liquid supply source 70, the controller 18 controls to output warning information such as a warning panel on a display and a warning sound from a sound output device (not shown).

**[0058]** In the Step S107, in a case where the contents of the specified event indicate that the preparation process for heating the processing liquid up to the target temperature is not completed yet (Yes in Step S107), the controller 18 changes the processing time of the temperature control process in such a manner that the non-operating interval  $\Delta T$  is shortened (Step S109).

**[0059]** In a case where the process of Step S108 or Step S109 ends, the controller 18 ends the changing process.

**[0060]** As described above, a substrate processing apparatus of the embodiment (the substrate processing system 1 as one example) includes a plurality of processing units (the processing unit 16 as one example), one or more

supply unit(s) (the processing liquid supply sources 70a, 70b and 70c as one example) and a controller (the controller 18 as one example). The plurality of processing units execute the substrate processing by using the processing liquid. The one or more supply unit(s) supply the heated processing liquid to the plurality of processing units. The controller executes the acquiring process, the specifying process and the changing process. The acquiring process acquires the first log information (the first log information 191 as one example) that indicates the execution status of the substrate processing of each of the processing units. The specifying process specifies, based on the first log information, the non-operating interval (the non-operating interval  $\Delta T$  as one example) that indicates that the substrate processing is not executed by all of the plurality of processing units. The changing process changes the processing time of the temperature control process for maintaining the temperature of the heated processing liquid in such a manner that the non-operating interval is shortened regarding the supply unit that supplies the processing liquid to be used for an "unexecuted substrate processing at the non-operating interval" among the plurality of supply units. Accordingly, the drop in the operation rate caused by the temperature drop of the processing liquid is reduced.

**[0061]** The acquiring process may further acquire the second log information (the second log information 192 as one example) indicating the starting date and time and the finishing date and time for each of the processing recipe of the executed substrate processing of the plurality of the processing units and the third log information (the third log information 193 as one example) indicating the event that disturbs the supply of the processing liquid for each of the supply units. The changing process may determine the substrate processing executed right after the non-operating interval as the "unexecuted substrate processing at the non-operating interval" based on the non-operating interval and the second log information. The changing process may specify an event during the non-operating interval regarding the supply unit, among the plurality of the supply units, that supplies the processing liquid to be used for the earliest executed substrate processing after the non-operating interval based on the non-operating interval and the third log information. The changing process may change the processing time of the temperature control process in such a manner that the non-operating interval is shortened in a case where the content of the specified event indicates that the preparation process for heating the processing liquid up to the target temperature is not completed yet. Accordingly, processing

time of the preparation process by the supply unit may be shortened or the preparation process by the supply unit may be omitted. Thus, the efficiency of the substrate processing by the processing units may be improved. As a result of it, the length of the non-operating interval  $\Delta T$  may be shortened.

**[0062]** The changing process may calculate time intervals between a plurality of executed substrate processing, and may change the processing time of the temperature control process in such a manner that the processing time of the temperature control process is equal to or less than a maximum time interval calculated in the changing process based on the non-operating interval and the second log information. Thus, increase in power consumption of the supply unit caused by changing the processing time of the temperature control process can be reduced.

**[0063]** The specifying process may generate plot data, based on the first log information, that is plotted data indicating the status of the execution of the substrate processing for each of the processing unit proportional to elapsed time. The specifying process may specify a time interval as the non-operating interval in which any plot corresponding to all processing units does not exist in the plot data. Accordingly, the non-operating interval can be easily specified.

**[0064]** The one or more of the supply unit(s) may include at least one of a deionized water supply unit that supplies heated deionized water, a chemical liquid supply unit that supplies heated chemical liquid and an ozone water supply unit that supplies heated ozone water. Accordingly, a drop in the operation rate caused by the temperature drop of deionized water, chemical liquid and/or ozone water can be reduced.

**[0065]** According to the present disclosure, it may be possible to reduce the drop in operation rate caused by a drop in temperature of processing liquid.

## CLAIMS

What is claimed is:

1. A control method for controlling a substrate processing apparatus having a plurality of processing units that execute substrate processing by using processing liquid and at least one supply unit that supplies heated processing liquid to the plurality of processing units, the method comprising:

acquiring first log information that indicates a status of an execution of the substrate processing of each of the plurality of processing units;

based on the first log information, specifying a non-operating interval during which the plurality of processing units does not execute the substrate processing; and

changing processing time of a temperature control process for maintaining temperature of the heated processing liquid in such a manner that the non-operating interval is shortened regarding the supply unit corresponding to processing liquid to be used for an unexecuted substrate processing during the non-operating interval.

2. The control method according to claim 1, wherein

acquiring the first log information further comprises:

acquiring second log information that indicates a

starting date and time and a finishing date and time of the substrate processing for each processing recipe of the substrate processing executed by the plurality of processing units; and

acquiring third log information that indicates an event that disturbs a supply of the processing liquid for each of the supply units, and

changing processing time of the temperature control process for maintaining temperature of the heated processing liquid further comprises:

based on the non-operating interval and the second log information, determining a substrate processing having an earliest starting date and time after the non-operating interval as the unexecuted substrate processing at the non-operating interval;

based on the non-operating interval and the third log information, specifying the event during the non-operating interval regarding the supply unit corresponding to the processing liquid to be used for an earliest executed substrate processing after the non-operating interval; and

in a case where a content of the specified event indicates that a preparation process for heating the processing liquid up to a target temperature is not completed, changing processing time of the temperature

control process in such a manner that the non-operating interval is shortened.

3. The control method according to claim 2, wherein changing the processing time of the temperature control process for maintaining temperature of the heated processing liquid further comprises:

based on the non-operating interval and the second log information, calculating time intervals between a plurality of executed substrate processing; and

changing the processing time of the temperature control process in such a manner that the processing time of the temperature control process is equal to or less than a maximum of the calculated time intervals.

4. The control method according to claim 1, wherein specifying the non-operating interval further comprises:

based on the first log information, generating plot data obtained by plotting data indicating the status of the execution of the substrate processing for each of the processing units with respect to elapsed time; and

in the plot data, specifying the time interval in which any plot corresponding to the plurality of processing units does not exist, as the non-operating interval.

5. The control method according to claim 1, wherein  
the supply unit further includes at least one of a  
deionized water supply unit that supplies heated deionized  
water, a chemical liquid supply unit that supplies heated  
chemical liquid, and an ozone water supply unit that  
supplies heated ozone water.

6. A substrate processing apparatus comprising:  
a plurality of processing units that execute substrate  
processing by using processing liquid;  
at least one supply unit that supplies heated  
processing liquid to the plurality of processing units; and  
a controller that controls the plurality of processing  
units and the supply unit, wherein  
the controller is configured to:  
acquire first log information that indicates a  
status of an execution of the substrate processing of each  
of the plurality of processing units;  
based on the first log information, specify a  
non-operating interval during which the plurality of the  
processing units does not execute the substrate processing;  
and  
change processing time of a pretreatment of  
heating the processing liquid before executing the

substrate processing regarding the supply unit  
corresponding to processing liquid to be used for an  
unexecuted substrate processing at the non-operating  
interval in such a manner that the non-operating interval  
is shortened.