

SUBSTRATE PROCESSING APPARATUS AND DISPLAY METHOD THEREOF

TECHNICAL FIELD

[0001] The present disclosure relates to a substrate processing apparatus for processing a substrate and a display method thereof, and relates to, for example, recognizing a production status of a semiconductor manufacturing apparatus that performs a film-forming process on a substrate.

BACKGROUND

[0002] In the semiconductor manufacturing field, a substrate accommodator (e.g., FOUP) storing a wafer (hereinafter, also referred to as a "substrate") to be processed is put into an apparatus, and a film-forming process or the like is performed on the wafer under a specified condition. For example, an instruction of a process (hereinafter, also referred to as a "process job") including a film-forming process or the like is issued by an operator of a customer host computer, an operation part, or the like. Then, a processing status of the wafer is displayed on a screen of the operation part together with a screen image of a semiconductor manufacturing apparatus, and for example, a production status is displayed for each process chamber. When the film-forming process is completed, it is accumulated as production information in a storage part. The accumulation is registered in the order of processing completion and displayed in a list form.

[0003] For example, in Patent Document 1, a processing status of a substrate is displayed on an operation screen for each process chamber together with an image of a semiconductor manufacturing apparatus as viewed from above. Further, in Patent Document 2, a progress status or the like of a currently running process job is displayed, and the contents of a process recipe executed in the process job and production history information are displayed on the operation screen.

[0004] However, it is not known when each reserved process job will start running and when it

will end. This makes it difficult for the operator to predict a time when the apparatus will be in a specific state, causing an idle time in setup of the apparatus and leading to a delay in the apparatus setup work.

[Prior Art Documents]

[0005] Patent Documents

Patent Document 1: Japanese laid-open publication No. 2000-077288

Patent Document 2: Japanese laid-open publication No. 2011-077435

SUMMARY

[0006] The present disclosure provides some embodiments of a configuration capable of displaying an execution schedule of a job in chronological order.

[0007] According to one embodiment of the present disclosure, there is provided a configuration including: a display having an operation screen including a two-dimensional space in which one axis indicates reservation statuses of various jobs executed by the apparatus including a current job being executed by the apparatus, and the other axis indicates a predetermined monitoring period; and a display controller configured to: acquire various information including a start time and a scheduled end time of the current job being executed by the apparatus, or including a scheduled start time and a scheduled end time of a job reserved by the apparatus; calculate a scheduled execution time of the current job based on the acquired start time and the acquired scheduled end time of the current job, and/or a scheduled execution time of the reserved job based on the acquired scheduled start time and the acquired scheduled end time of the reserved job; and display a chart as an image indicating the scheduled execution time of the current job and the scheduled execution time of the reserved job on the display.

[0008] With such configuration, it is possible to recognize an execution plan of unprocessed jobs by displaying a chart of jobs scheduled to be executed.

BRIEF DESCRIPTION OF DRAWINGS

[0009] FIG. 1 is an example of a cross sectional view illustrating a substrate processing apparatus suitably used in an embodiment of the present disclosure.

FIG. 2 is an example of a vertical cross sectional view illustrating the substrate processing apparatus suitably used in an embodiment of the present disclosure.

FIG. 3 is an example of a vertical cross sectional view illustrating a process furnace of the substrate processing apparatus suitably used in an embodiment of the present disclosure.

FIG. 4 is a diagram illustrating a functional configuration of a controller suitably used in an embodiment of the present disclosure.

FIG. 5 is a diagram illustrating a process flow of chart display suitably used in an embodiment of the present disclosure.

FIG. 6 is a diagram illustrating an example displayed in the process flow of FIG. 5.

FIG. 7 is a diagram illustrating another form of the diagram illustrating the example of FIG. 6.

FIG. 8 is a diagram when a recovery condition waiting has occurred in a currently running recipe displayed in the process flow of FIG. 5.

FIG. 9 is a diagram illustrating an example of displaying details of a recovery condition waiting icon displayed in FIG. 8.

FIG. 10 is a diagram illustrating a process flow of chart display suitably used in an embodiment of the present disclosure.

FIG. 11 is a diagram illustrating an example displayed in the process flow of FIG. 10.

FIG. 12 is a diagram illustrating an icon indicating differences in recipe types according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

(Outline of the Substrate Processing Apparatus)

[0010] An embodiment of the present disclosure will now be described with reference to FIGS. 1 and 2. In an embodiment to which the present disclosure is applied, a substrate processing apparatus is configured as, for example, a substrate processing apparatus that implements a

processing apparatus in a method of manufacturing a semiconductor device (IC). Further, in the following description, a case where a vertical apparatus (hereinafter, simply referred to as a "processing apparatus") that performs an oxidation process, a diffusion process, a CVD process or the like on a substrate is applied as the substrate processing apparatus will be described.

[0011] As illustrated in FIGS. 1 and 2, a substrate processing apparatus 10 includes processing modules as two adjacent process furnaces 202 as described hereinbelow. The processing modules are vertical processing modules that process dozens of wafers 200 as substrates at a time.

[0012] Transfer chambers 6A and 6B as preparation chambers are arranged below the process furnaces 202. A transfer chamber 8 having a transfer mechanism 125 for transferring the wafers 200 as substrates is arranged adjacent to the transfer chambers 6A and 6B on the front side of the transfer chambers 6A and 6B. Furthermore, in the present embodiments, it is described that the process furnaces 202 as described hereinbelow are respectively installed above the transfer chambers 6A and 6B.

[0013] A storage chamber 9 (pod transfer space) for storing pods (FOUPs) 110 as accommodation vessels that accommodate a plurality of wafers 200 is installed on the front side of the transfer chamber 8. Load ports 22 as I/O ports are installed on the entire surface of the storage chamber 9, and the pods 110 are loaded and unloaded into and from a processing apparatus 2 through the load ports 22.

[0014] Gate valves 90A and 90B as isolation portions are installed on boundary walls (adjacent surfaces) between the transfer chambers 6A and 6B and the transfer chamber 8. Pressure detectors are respectively installed in the transfer chamber 8 and the transfer chambers 6A and 6B so that the internal pressure of the transfer chamber 8 is set to be lower than that of the transfer chambers 6A and 6B. In addition, oxygen concentration detectors are respectively installed in the transfer chamber 8 and the transfer chambers 6A and 6B, and the oxygen concentrations in the transfer chamber 8A and the transfer chambers 6A and 6B are kept lower than the oxygen concentration in the atmosphere. The oxygen concentrations in the transfer

chamber 8A and the transfer chambers 6A and 6B may be kept at 30 ppm or less in some embodiments.

[0015] A clean unit (not shown) for supplying clean air into the transfer chamber 8 is installed in a ceiling portion of the transfer chamber 8, in which it is configured so that, for example, an inert gas, is circulated as the clean air in the transfer chamber 8. By circulating and purging the interior of the transfer chamber 8 with the inert gas, it is possible to make the interior of the transfer chamber 8 in a clean atmosphere.

[0016] With this configuration, it is possible to suppress particles or the like in the transfer chambers 6A and 6B from being mixed into the process furnaces 202 (not shown) in the transfer chamber 8, and to suppress a natural oxide film from being formed on each of the wafers 200 in the transfer chamber 8 and the transfer chambers 6A and 6B.

[0017] A plurality of pod openers, for example, three pod openers 21, which open and close lids of the pods 110 are arranged at the rear of the storage chamber 9 and at the boundary wall between the storage chamber 9 and the transfer chamber 8. The wafers 200 in the pods 110 are loaded and unloaded into and from the transfer chamber 8 by opening the lids of the pods 110 by the pod openers 21.

[0018] As illustrated in FIG. 2, the substrate processing apparatus 10, which accommodates the plurality of wafers 200 made of silicon or the like and uses the pods 110, includes a housing 111 used as a substrate processing apparatus main body.

[0019] A front maintenance port (not shown) as an opening installed so as to be maintainable is installed in a front portion of the front wall of the housing 111, and front maintenance doors for opening and closing the front maintenance port are erected therein. In addition, a pod loading/unloading port is installed on the front wall so as to communicate the inside and outside of the housing 111. The pod loading/unloading port may be configured to be opened and closed by a front shutter (not shown).

[0020] The load ports 22 used as loading/unloading parts are installed in the pod loading/unloading port, and are configured to mount and align the pods 110. It is configured so

that the pods 110 are loaded onto the load ports 22 by an in-process transfer device, and are unloaded from the load ports 22.

[0021] Storage shelves (pod shelves) 105 are installed on front/rear sides of the housing 111 in a matrix form over the upper and lower or left and right sides around the pod loading/unloading port. Mounting parts 140 as accommodation parts, on which the pods are mounted, are installed in the pod shelves 105. Each of the accommodation parts is configured by the corresponding mounting part 140 and a horizontal transfer mechanism (horizontal storage shelf transfer mechanism) for horizontally moving the mounting part 140 between a waiting position where the pods 110 are stored and a delivery position where the pods 110 are delivered. A plurality of independent mounting parts 140 arranged on the same straight line in the horizontal direction constitute one stage of the pod shelves 105, in which the pod shelves are installed in multiple stages along a vertical direction. The respective mounting part 140 may be independently moved horizontally without being synchronized with the mounting parts 140, which are adjacent to each other on the upper and lower or left and right sides, and the other mounting parts 140. In addition, a pod transfer device 130 is configured to transfer the pods 110 among the load ports 22, the pod shelves 105, and the pod openers 121.

[0022] Pod shelves (storage shelves) 105 are installed on the front side of a sub-housing 119 in the housing 111 in a matrix form over the upper and lower or left and right sides. Similar to the pod shelves 105 on the front/rear sides of the housing 111, mounting parts 140 as accommodation parts for mounting pods of the respective pod shelves 105 can be horizontally moved, and can be independently moved horizontally without being synchronized with the mounting parts 140 adjacent to each other on the upper and lower or left and right sides. The pod shelves 105 are configured to keep the pods 110 respectively mounted on the plurality of mounting parts 140 one by one.

[0023] A pair of wafer loading/unloading ports 120 for loading and unloading the wafers 200 into and from the sub-housing 119 is vertically arranged in upper and lower two stages on the front wall 119a of the sub-housing 119, and a pair of pod openers 21 are respectively installed at

the upper and lower wafer loading/unloading ports 120. In the present embodiments, the pod openers 21 are installed in the upper and lower two stages, but two openers may be installed on left and right sides in the horizontal direction. Each of the pod openers 21 includes a mounting table 122 for mounting the pod 110, and a cap attaching/detaching mechanism 123 for attaching and detaching a cap of the pod 110 used as a seal member. The pod opener 21 is configured to open and close the wafer loading/unloading port of the pod 110 by attaching and detaching the cap of the pod 110 mounted on the mounting table 122 by the cap attaching/detaching mechanism 123.

[0024] The sub-housing 119 constitutes the transfer chamber 8 fluidly isolated from the installation space of the pod transfer device 130 and the pod shelves 105. The wafer transfer mechanism 125 is installed in a front region of the transfer chamber 8. The wafer transfer mechanism 125 is configured by a wafer transfer device 125a capable of rotating or linearly moving the wafers 200 in the horizontal direction, and a wafer transfer device elevator 125b for moving the wafer transfer device 125a up and down. By continuous operation of the wafer transfer device elevator 125b and the wafer transfer device 125a, tweezers (substrate support bodies) 125c of the wafer transfer device 125a are configured to charge and discharge the wafers 200 into and from a boat (substrate support) 217 as a mounting part of the wafers 200.

[0025] In a rear region of the transfer chamber 8, a transfer chamber 6 is configured as a waiting part that accommodates the boat 217 via a gate valve 90 and put on standby. The process furnaces 202 having process chambers therein are installed above the transfer chamber 6. A lower end portion of each of the process furnaces 202 is configured to be opened and closed by a furnace opening shutter 147.

[0026] The boat 217 is moved up and down by a boat elevator 115 (not shown) and is introduced into the process furnace. A seal cap 219 as a lid is horizontally installed on an arm (not shown) as a connecting port connected to an elevating table of the boat elevator 115, in which the lid 219 is configured to vertically support the boat 217 and close the lower end portion of the process furnace 202. The boat 217 includes a plurality of holding members, and is configured to

horizontally support the plurality of wafers 200, in such a state that the wafers 200 are arranged along the vertical direction with the centers of the wafers 200 aligned with one another.

[0027] Next, an operation of the substrate processing apparatus 10 will be described. An example of performing a substrate processing using the aforementioned substrate processing apparatus 10, which is one of the processes for manufacturing a semiconductor device, will be described. In the present embodiments, when an execution processing start time of a reserved process job is reached, a controller 121 controls operations of the respective parts constituting the substrate processing apparatus 10 to start the substrate processing. Here, the process job is configured by three steps of pre-processing, main processing, and post-processing. First, a transfer process of the wafers 200 as the pre-processing is performed by the controller 121. In the present embodiments, the transfer of the wafers 200 to the boat 217 corresponds to the transfer process. Hereinafter, the pre-processing will be mainly described.

[0028] When the pod 110 is supplied to the load port 22, the pod 110 on the load port 22 is loaded into the housing 111 from the pod loading/unloading port by the pod loading device. The loaded pod 110 is automatically transferred to a designated mounting part 140 of the pod shelf 105 by the pod transfer device 130 and received by it, temporarily stored, and then transferred from the pod shelf 105 to one pod opener 21 and received by it and mounted on the mounting table 122, or directly transferred to the pod opener 21 and mounted on the mounting table 122.

[0029] An opening side end surface of the pod 110 mounted on the mounting table 122 is pressed against an opening edge of the wafer loading/unloading port 120 on the front wall 119a of the sub-housing 119, and the cap thereof is removed by the cap attaching/detaching mechanism 123 to open the wafer loading/unloading port. When the pod 110 is opened by the pod opener 21, the wafers 200 are picked up from the pod 110 via the wafer loading/unloading port by the tweezers 125c of the wafer transfer device 125a, transferred to the transfer chamber 6 behind the transfer chamber 8 via the gate valve 90, and charged on the boat 217. At this time, the wafers may be charged after matching them by a notch matcher (not shown). The wafer

transfer device 125a, which has transferred the wafers 200 to the boat 217, is returned to the pod 110 and charges subsequent wafers 200 on the boat 217.

[0030] During the charging operation of the wafers on the boat 217 by the wafer transfer mechanism 125 in the pod opener 21 on this one side (upper stage or lower stage), another pod 110 is transferred from the pod shelf 105 to the pod opener 21 on the other side (lower stage or upper stage) by the pod transfer device 130 and mounted, and the opening operation of the pod 110 by the pod opener 21 is simultaneously performed.

[0031] If a predetermined number of wafers 200 is charged on the boat 217, the pre-processing is completed, and the main processing (here, a process recipe) is executed. The process recipe executed in the main processing of the process job is a recipe for processing a substrate, and is controlled by the controller 121. When this process recipe starts, the lower end of the process furnace 202 closed by the furnace opening shutter 147 is opened by the furnace opening shutter 147. Subsequently, the boat 217 supporting a group of wafers 200 is loaded into the process furnace 202 by moving the seal cap 219 up by the boat elevator 115.

[0032] After the loading, arbitrary processing is performed on the wafers 200 in the process furnace 202. After the processing, the wafers 200 and the pod 110 are unloaded to the outside of the housing in reverse order of the aforementioned operation. At this time, the process recipe (main processing) is completed.

(Process Furnace of the Substrate Processing Apparatus)

[0033] As illustrated in FIG. 3, the process furnace 202 includes a heater 207 as a heating means (heating mechanism). The heater 207 has a cylindrical shape and is supported by a heat base (not shown) as a holding plate so as to be vertically installed. The heater 207 functions as an activation mechanism (an excitation part) configured to thermally activate (excite) a processing gas.

[0034] A reaction tube 203 constituting a reaction vessel (process vessel) is disposed inside the heater 207 to be concentric with the heater 207. The reaction tube 203 is made of a heat

resistant material, e.g., quartz (SiO_2), silicon carbide (SiC) or the like, and has a ceiling shape with its lower end opened and its upper end closed by a flat wall body. A cylinder part 209 having a cylindrical shape, a nozzle disposition chamber 222 partitioned between the cylinder part 209 and the reaction tube 203, a gas supply slit 235 as a gas supply port formed in the cylinder part 209, a first gas exhaust port 236 formed in the cylinder part 209, and a second gas exhaust port 237 formed in the cylinder part 209 and formed below the first gas exhaust port 236 are included inside the reaction tube 203. The cylinder part 209 has a ceiling shape with its lower end opened and its upper end closed by a flat wall body. Furthermore, the cylinder part 209 is installed just near the wafers 200 so as to surround the wafers 200. A process chamber 201 is formed in the cylinder part 209 of the reaction tube 203. The process chamber 201 is configured to process the wafers 200 as substrates. In addition, the process chamber 201 is configured to accommodate the boat 217 serving as a substrate support capable of supporting the wafers 200 arranged in a horizontal posture and in multiple stages along the vertical direction.

[0035] A lower end of the reaction tube 203 is supported by a cylindrical manifold 226. The manifold 226 is made of metal such as, e.g., a nickel alloy, stainless steel or the like, or is made of a heat resistant material such as quartz or SiC . A flange is formed at an upper end of the manifold 226, and the lower end portion of the reaction tube 203 is installed and supported on the flange. A seal member 220 such as an O-ring or the like is interposed between the flange and the lower end portion of the reaction tube 203 to make the inside of the reaction tube 203 hermetical.

[0036] A seal cap 219 is hermetically attached to a lower end opening of the manifold 226 through the seal member 220 such as an O-ring or the like, and is configured to hermetically seal the lower end opening of the reaction tube 203, i.e., the opening of the manifold 226. The seal cap 219 is made of metal such as, e.g., a nickel alloy or stainless steel, and is formed in a disc shape. The seal cap 219 may be configured to cover its outer side with a heat resistant material such as quartz (SiO_2), silicon carbide (SiC) or the like.

[0037] A boat support table 218 configured to support the boat 217 is installed on the seal cap

219. The boat support table 218 is made of a heat resistant material such as, e.g., quartz or SiC, and functions as a heat insulating part and also as a support body for supporting the boat. The boat 217 is erected on the boat support table 218. The boat 217 is made of a heat resistant material such as, e.g., quartz or SiC. The boat 217 has a bottom plate fixed to the boat support table and a top plate disposed above the bottom plate (not shown), and has a configuration in which a plurality of posts are bridged between the bottom plate and the top plate. The plurality of wafers 200 are supported by the boat 217. The plurality of wafers 200 are supported by the posts of the boat 210 stacked in multiple stages along an axial direction of the reaction tube 203, in a state in which the wafers 200 are arranged in a horizontal posture and in a spaced-apart relationship with the centers of the wafers 200 aligned with one another.

[0038] A boat rotation mechanism 267 configured to rotate the boat is installed at the opposite side of the seal cap 219 from the process chamber 201. A rotary shaft 265 of the boat rotation mechanism 267, which penetrates the seal cap, is connected to the boat support table 218. By the boat rotation mechanism 267, the wafers 200 are rotated by rotating the boat 217 through the boat support table 218.

[0039] The seal cap 219 is configured to be vertically moved up and down by the boat elevator 115 which is an elevator mechanism installed outside the reaction tube 203, so that the boat 217 can be loaded and unloaded into and from the process chamber 201.

[0040] Nozzle support parts 350a to 350d configured to support nozzles 340a to 340d as gas nozzles for supplying a processing gas into the process chamber 201 are installed in the manifold 226 so as to penetrate the manifold 226. Here, four nozzle support parts 350a to 350d are installed. The nozzle support parts 350a to 350d are made of a material such as, e.g., a nickel alloy or stainless steel. Gas supply pipes 310a to 310c for supplying a gas into the process chamber 201 are respectively connected to one ends of the nozzle support parts 350a to 350c on the reaction tube 203 side. In addition, a gas supply pipe 310d for supplying a gas to a gap S formed between the reaction tube 203 and the cylinder part 209 is connected to one end of the nozzle support part 350d on the reaction tube 203 side. Furthermore, the nozzles 340a to 340d

are respectively connected to the other ends of the nozzle support parts 350a to 350d. The nozzles 340a to 340d are made of a heat resistant material such as, e.g., quartz or SiC.

[0041] A first processing gas supply source 360a for supplying a first processing gas, a mass flow controllers (MFC) 320a, which is a flow rate controller (flow rate control part), and a valve 330a, which is an opening/closing valve, are installed in the gas supply pipe 310a sequentially from the corresponding upstream side. A second processing gas supply source 360b for supplying a second processing gas, an MFC 320b, and a valve 330b are installed in the gas supply pipe 310b sequentially from the corresponding upstream side. A third processing gas supply source 360c for supplying a third processing gas, an MFC 320c, and a valve 330c are each installed in the gas supply pipe 310c sequentially from the corresponding upstream side. An inert gas supply source 360d for supplying an inert gas, an MFC 320d, and a valve 330d are each installed in the gas supply pipe 310d sequentially from the corresponding upstream side. Gas supply pipes 310e and 310f, which supply an inert gas, are respectively connected to the gas supply pipes 310a and 310b at the downstream side of the valves 330a and 330b. MFCs 320e and 320f and valves 330e and 330f are respectively installed in the gas supply pipes 310e and 310f sequentially from the corresponding upstream sides.

[0042] A first processing gas supply system is mainly configured by the gas supply pipe 310a, the MFC 320a, and the valve 330a. The first processing gas supply source 360a, the nozzle support part 350a, and the nozzle 340a may be regarded as being included in the first processing gas supply system. Furthermore, a second processing gas supply system is mainly configured by the gas supply pipe 310b, the MFC 320b, and the valve 330b. The second processing gas supply source 360b, a nozzle support part 350b, and a nozzle 340b may be regarded as being included in the second processing gas supply system. In addition, a third processing gas supply system is mainly configured by the gas supply pipe 310c, the MFC 320c, and the valve 330c. The third processing gas supply source 360c, the nozzle support part 350c, and the nozzle 340c may be regarded as being included in the third processing gas supply system. Furthermore, an inert gas supply system is mainly configured by the gas supply pipe 310d, the MFC 320d, and

the valve 330d. The inert gas supply source 360d, the nozzle support part 350d, and the nozzle 340d may be regarded as being included in the inert gas supply system.

[0043] An exhaust port 230 is formed in the reaction tube 203. The exhaust port 230 is formed below the second gas exhaust port 237 and is connected to an exhaust pipe 231. A vacuum pump 246 as a vacuum exhaust device is connected to the exhaust pipe 231 via a pressure sensor 245 as a pressure detector which detects the internal pressure of the process chamber 201 and an auto pressure controller (APC) valve 244 as a pressure regulation part, and is configured to vacuum-exhaust the interior of the process chamber 201 so that the internal pressure of the process chamber 201 becomes equal to a desired pressure. The exhaust pipe 231 at the downstream side of the vacuum pump 246 is connected to an exhaust gas processing device (not shown) or the like. Furthermore, the APC valve 244 is an opening/closing valve configured so that a vacuum exhaust of the interior of the process chamber 201 and a vacuum exhaust stop can be performed by opening and closing the APC valve 244 and so that the internal pressure of the process chamber 201 can be adjusted by adjusting an opening degree of the APC valve 244 to adjust its conductance. An exhaust system serving as an exhaust part is mainly configured by the exhaust pipe 231, the APC valve 244, and the pressure sensor 245. The vacuum pump 246 may be regarded as being included in the exhaust system.

[0044] A temperature sensor (not shown) serving as a temperature detector is installed in the reaction tube 203. Based on temperature information detected by the temperature sensor, the power supply to the heater 207 is adjusted such that the interior of the process chamber 201 has a desired temperature distribution.

[0045] In the process furnace 202 described above, the boat 217 is supported by the boat support table 218 and inserted into the process chamber 201, in such a state that the plurality of wafers 200 to be processed at a time are arranged in multiple stages on the boat 217, so that the heater 207 heats the wafers 200 inserted into the process chamber 201 to a desired temperature.

(Controller Configuration)

[0046] As illustrated in FIG. 4, the controller 121, which is a controller (control means), may be configured as a computer including a central processing unit (CPU) 121a as an execution part that executes various programs, and a random access memory (RAM) 121b, a memory device 121c as a storage part, and an I/O port 121d. The RAM 121b configured as a memory area (work area) in which a program, data or the like read by the CPU 121a is temporarily stored, the memory device 121c and the I/O port 121d are configured to exchange data with the CPU 121a via an internal bus 121e. In addition, an input/output device 122 as a display formed of, e.g., a touch panel or the like, is connected to the controller 121.

[0047] The memory device 121c is configured by, for example, a flash memory, a hard disk drive (HDD), or the like. A control program for controlling operations of a substrate processing apparatus, a process recipe for specifying sequences and conditions of substrate processing, or the like is readably stored in the memory device 121c. The process recipe functions as a program for causing the controller 121 to execute each sequence in the substrate processing, as described hereinbelow, to obtain a predetermined result. In addition, a maintenance recipe is a recipe for causing the controller 121 to execute each sequence in a state in which the wafers 200 are not loaded into the apparatus. For example, the maintenance recipe serves to maintain components and functions as a program. The maintenance recipe may also be executed as the present process. Furthermore, device data generated by operating the respective parts constituting the apparatus when a job is executed is stored in the memory device 121c. Time data is added to the device data by a time stamp function as a clocking part of the controller 121.

[0048] The device data used herein is data collected when a job is executed as described above. For example, the device data is data generated by operating the respective components when the substrate processing apparatus processes the wafers 200, such as data (e.g., set values or measured values) related to the substrate processing such as a processing temperature, a processing pressure, a flow rate of processing gas or the like when the substrate processing apparatus 10 processes the wafers 200, data related to a quality (e.g., data on a thickness of a film as formed, an accumulated value of the film thickness, or the like) of manufactured product

substrate, or data (e.g., set values or measured values) on the components (the reaction tube, the heater, the valves, the MFCs, and the like) of the substrate processing apparatus 1, or the like.

[0049] In addition, measured values of specific intervals collected during recipe execution, for example, measured value data from the start of a recipe to the end thereof and statistical data of each step in the recipe may be referred to as process data. This process data is also included in the device data. The statistical data includes a maximum value, a minimum value, an average value, and the like. In addition, event data indicating an apparatus event indicating the start or end of a recipe, or event data (e.g., data indicating a maintenance history) indicating an apparatus event when a process recipe is not executed (for example, during an idle in which no substrate is loaded into the apparatus) is also included in the device data. Also, data indicating an alarm (abnormality) and event (occurrence or recovery) that an alert has occurred is included in the device data.

[0050] In addition, a chart display program, a screen transition program, or the like according to the present embodiments is stored in the memory device 121c. The CPU 121a is configured to execute these programs according to an input of an operation command from the input/output device 122 or the like. In the present embodiments, the CPU 121a functions as a display controller. Furthermore, various screen files including screen files for chart display according to the present embodiments, such as a schedule screen, a production information screen or the like, are also stored in the memory device 121c.

[0051] When the term "program" is used herein, it may indicate a case of including only the process recipe (maintenance recipe), a case of including only the control program, or a case of including both the process recipe and the control program.

[0052] The I/O port 121d is connected to the MFCs 320a to 320f, the valves 330a to 330f, the pressure sensor 245, the APC valve 244, the vacuum pump 246, the heater 207, the temperature sensor 263, the boat rotation mechanism 267, the boat elevator 115, and the like, as described above.

[0053] The CPU 121a is configured to read the control program from the memory device 121c

and execute the same. The CPU 121a also reads the process recipe (maintenance recipe) from the memory device 121c according to an input of an operation command from the input/output device 122. In addition, the CPU 121a is configured to control, according to the contents of the process recipe read through the I/O port 121d, the flow rate adjusting operation of various kinds of gases by the MFCs 320a to 320f, the opening/closing operation of the valves 330a to 330f, the opening/closing operation of the APC valve 244, the pressure regulating operation performed by the APC valve 244 based on the pressure sensor 245, the driving and stopping of the vacuum pump 246, the temperature adjusting operation performed by the heater 207 based on the temperature sensor 263, the operation of rotating the boat 217 with the boat rotation mechanism 267 and adjusting the rotation speed of the boat 217, the operation of moving the boat 217 up and down with the boat elevator 115, and the like.

[0054] Next, a substrate processing corresponding to the main processing of the process job will be described with reference to FIG. 3. In the present embodiments, the substrate processing is performed by executing the process recipe by the controller 121. The process recipe is a recipe for processing a substrate to be executed in the main processing, and is controlled by the controller 121. Thereafter, the controller 121 controls operations of the respective parts constituting the substrate processing apparatus 10 to perform a predetermined process on a wafer 200.

(Substrate Processing)

[0055] The boat 217 on which a predetermined number of wafers 200 are mounted is inserted into the reaction tube 203, and the reaction tube 203 is hermetically sealed by the seal cap 219. The wafers 200 are heated in the hermetically sealed reaction tube 203, and a processing gas is supplied into the reaction tube 203 to perform a predetermined process on the wafers 200.

[0056] In the predetermined process, for example, a SiN film is formed on a wafer 200 by alternately supplying an NH₃ gas as a first processing gas, an HCDS gas as a second processing gas, and an N₂ gas as a third processing gas.

[0057] First, an HCDS gas is supplied from the gas supply pipe 310b of the second processing gas supply system into the process chamber 201 via gas supply holes 234b of the nozzle 340b and the gas supply slit 235. Specifically, the valves 330b and 330f are opened to start the supply of an HCDS gas from the gas supply pipe 310b into the process chamber 201 together with a carrier gas. At this time, the internal pressure of the process chamber 201 is kept at a predetermined pressure by adjusting the opening degree of the APC valve 244. When a predetermined time has elapsed, the valve 330b is closed to stop the supply of the HCDS gas.

[0058] The HCDS gas supplied into the process chamber 201 is supplied to the wafer 200, flows in parallel over the wafer 200, and then flows through the gap S from the upper portion to the lower portion thereof via the first gas exhaust port 236, and is exhausted from the exhaust pipe 231 via the second gas exhaust port 237 and the exhaust port 230.

[0059] Furthermore, when the valve 330e of the inert gas supply pipe connected to the gas supply pipe 310a, and the valves 330c and 330d of the gas supply pipes 310c and 310d are opened to allow an inert gas such as N_2 or the like to flow while supplying the HCDS gas into the process chamber 201, it is possible to prevent the HCDS gas from being returned to the gas supply pipes 310a, 310c, and 310d.

[0060] After the valve 330b is closed and the supply of the HCDS gas into the process chamber 201 is stopped, the interior of the process chamber 201 is exhausted, and the HCDS gas, the reaction product or the like remaining within the process chamber 201 is removed. At this time, when an inert gas such as N_2 or the like is supplied from the gas supply pipes 310a, 310b, 310c and 310d into the process chamber 201 and the gap S to purge them, it is possible to improve the effect of removing the residual gas within the process chamber 201 and from the gap S.

[0061] Next, an NH_3 gas is supplied from the gas supply pipe 310a of the first processing gas supply system into the process chamber 201 via gas supply holes 234a of the nozzle 340a and the gas supply slit 235. Specifically, the valves 330a and 330e are opened to start the supply of an NH_3 gas from the gas supply pipe 310a into the process chamber 201 is started together with a carrier gas. At this time, the internal pressure of the process chamber 201 is kept at a

predetermined pressure by adjusting the opening degree of the APC valve 244. After a predetermined time has elapsed, the valve 330a is closed to stop the supply of the NH_3 gas.

[0062] The NH_3 gas supplied into the process chamber 201 is supplied to the wafer 200, flows in parallel over the wafer 200, and then flows through the gap S from the upper portion to the lower portion thereof via the first gas exhaust port 236, and is exhausted from the exhaust pipe 231 via the gas exhaust port 237 and the exhaust port 230.

[0063] Furthermore, when the valve 330f of the inert gas supply pipe connected to the gas supply pipe 310b, and the valves 330c and 330d are opened to allow an inert gas such as N_2 or the like to flow while supplying the N_3 gas into the process chamber 201, it is possible to prevent the N_3 gas from being returned into the gas supply pipes 310b, 310c and 310d.

[0064] After the valve 330a is closed and the supply of the HCDS gas into the process chamber 201 is stopped, the interior of the process chamber 201 is exhausted, and the NH_3 gas, the reaction product or the like remaining within the process chamber 201 is removed. At this time, when an inert gas such as N_2 or the like is supplied from the gas supply pipes 310a, 310b, 310c and 310d into the process chamber 201 and the gap S to purge them, it is possible to improve the effect of removing the residual gas within the process chamber 201 and from the gap S.

[0065] When the processing of the wafer 200 is completed, the boat 217 is unloaded from the interior of the reaction tube 203 in reverse order of the aforementioned operation.

[0066] In the aforementioned embodiments, there has been described a case where the first processing gas and the second processing gas are alternately supplied, but the present disclosure may be applied to a case where the first processing gas and the second processing gas are simultaneously supplied.

(Example 1)

[0067] FIG. 5 is a process flow illustrating a chart display program for displaying a schedule of a job according to the present embodiments.

[0068] When the controller 121 is activated, the chart display program starts and the controller

121 acquires a current time at first. Next, the storage part 121c is searched to confirm whether there is a job scheduled to be executed by the apparatus. If there is no job, the process is terminated or a waiting state is kept. In either case, when an update button as described hereinbelow is depressed, the program is restarted to start from acquiring the current time.

[0069] When a job is searched, the controller 121 acquires information on the job. In addition to the job information (a name, a recipe name, a scheduled start time, a scheduled end time, or the like), at least recipe information (a name, a type, a process chamber, process data, or the like) executed by the job is acquired.

[0070] Next, it is determined whether the job is reserved or is currently running. Specifically, it is determined based on whether the current time has exceeded the scheduled start time by comparing the acquired current time with the scheduled start time of the job, or based on the presence or absence of device data indicating the job start (time data indicating the job execution start time).

[0071] When the job is reserved, a pre-processing scheduled time from a pre-processing start time and a pre-processing end time of pre-processing, a main processing scheduled time from a main processing start time and a main processing end time of main processing, and a post-processing scheduled time from a post-processing start time and a post-processing end time of post-processing are calculated from the job information, and the calculated pre-processing scheduled time, main processing scheduled time, and post-processing scheduled time are added to calculate a scheduled execution time of the job. The pre-processing scheduled time, the main processing scheduled time, and the post-processing scheduled time may be displayed in a distinguishable manner, for example, in different colors. Furthermore, for example, when all jobs are reserved, a pre-processing scheduled time of a job to be first executed is calculated so as to fall between the current time and the pre-processing end time.

[0072] When the job is currently running, the controller 121 confirms which of the pre-processing, the main processing, and the post-processing is running. Specifically, the controller 121 determines whether the current time falls in which of between the scheduled start time and

the scheduled end time of the pre-processing, between the scheduled start time and the scheduled end time of the main processing, and between the scheduled start time and the scheduled end of the post-processing, for example, based on the presence or absence of time data indicating each of the pre-processing start, the main processing start, and the post-processing start from the acquired device data. For example, when there is time data of the pre-processing start, it is determined that the pre-processing is running.

[0073] When it is determined that the pre-processing is running, then the controller 121 compares the current time with the scheduled end time of the pre-processing, and when the current time exceeds the scheduled end time, a time from the start time of the job to the current time is calculated as the pre-processing execution time, and when the current time is before the scheduled end time, a time from the start time of the job to the scheduled ending time of the pre-processing is calculated as the pre-processing execution time.

[0074] Then, the controller 121 adds the pre-processing execution time, the main processing scheduled time, and the post-processing scheduled time to calculate a scheduled execution time of the job. Even when the currently running job is during the main processing and the post-processing, a scheduled execution time thereof may be calculated in the same manner.

Therefore, although details are omitted, when the current time is during the main processing, a main processing execution time calculated by comparing the current time and the scheduled end time is added to each of the pre-processing execution time and the post-processing scheduled time to be calculated as the scheduled execution time of the job.

[0075] Next, it is determined whether or not a recovery condition waiting for a job has occurred. For example, in confirming whether or not the recovery condition waiting in the pre-processing has occurred, the controller 121 determines that the recovery condition waiting is occurring if an alarm that requires the recovery operation is occurring from the acquired device data to acquire recovery determination waiting information.

[0076] When the calculation of the scheduled execution time of one job (chart calculation process) is completed, the controller 121 similarly performs the chart calculation process for a

next job, calculates scheduled job execution times for all searched jobs, and acquires the scheduled job execution times as chart processing result information. Here, the execution times or scheduled execution times of the pre-processing, the main processing, and the post-processing of each job are also acquired as the chart processing result information.

[0077] Then, based on various device data such as the acquired current time, job information, recipe information, chart processing result information, recovery condition waiting information or the like, the controller 121 is configured to create a schedule screen file (for example, illustrated in FIG. 6) and display each job as a chart. Furthermore, the controller 121 is configured to display a line icon corresponding to the current time on the schedule screen.

[0078] As described above, according to the chart display program of the present embodiments, when a processing start time and a processing end time are stored in the job information, at first, a scheduled execution time of a corresponding job is calculated from the processing start time and the processing end time of a first job or a currently running job to calculate a scheduled end time of the first job. The scheduled execution time of a reserved job can be calculated by reflecting the scheduled end time of the first job on a job scheduled to be executed next and repeating it by the number of searched jobs.

[0079] In addition, when the recovery condition waiting information for the currently running job is acquired, as illustrated in FIG. 8, the controller 121 is configured to display an icon indicating that the recovery condition waiting has occurred in a predetermined space of the schedule screen. Furthermore, for example, when a factor button, as described hereinbelow, displayed in a predetermined region of the schedule screen is depressed, the controller 121 is configured to display details of a factor for which the recovery condition waiting has been made on the display.

[0080] FIG. 6 illustrates an example of a schedule screen displayed on the operation screen of the input/output device 122 by executing the chart display program by the controller 121. A schedule screen 500 illustrated in FIG. 6 includes a two-dimensional space in which the vertical axis indicates an item number cell 501 indicative of an order number of reservation of various

jobs executed by the apparatus including a currently running job by the apparatus, and the horizontal axis indicates a job name cell 502, a PM cell 503, job information including a recipe name or scheduled end time cell 504, and a date/time 505 indicative of a predetermined monitoring period. Here, PM is an abbreviation PM of a processing module.

[0081] In addition, a line 506 indicating the current time, a currently running job 507 displayed as an icon indicating the execution time or the scheduled execution time of the job, a reserved job 508 displayed by an icon indicating the scheduled start time to the scheduled end time are displayed on the two-dimensional space of the schedule screen 500, in which the currently running job 507 and the reserved job 508 are displayed as a chart. Furthermore, a recipe name (process recipe 1) is displayed on the recipe name or scheduled end time cell 504.

[0082] In addition, a pre-processing step 508a, a main processing step 508b, and a post-processing step 508c of the reserved job 508 are displayed on the two-dimensional space of the schedule screen 500, in which the respective steps are respectively displayed in predetermined colors. Furthermore, although it is not clear from the drawing, similarly, for the currently running job 507, the pre-processing step, the main processing step and the post-processing step are independently displayed, and are respectively displayed in predetermined colors.

[0083] FIG. 7 is a diagram illustrating a time when switching to a scheduled end time is made by depressing the recipe name or scheduled end time cell 504 on the schedule screen illustrated in FIG. 6.

[0084] FIG. 8 is a display example of an icon 510 indicating that a recovery condition waiting has occurred on the schedule screen. It can be seen that the currently running recipe 507 has different display colors by the boundary of the current time 506. A trouble has occurred in the pre-processing (or main processing), and the next main processing (or post-processing) is waiting for recovery process from the trouble. When the recovery process is performed, the icon 510 is not displayed. When the icon 510 is displayed and the factor button illustrated in FIG. 9 is depressed, it is configured so that a detailed factor with the icon 510 displayed is displayed.

[0085] FIG. 9 is a factor detailed screen 600 displayed on the display 122 when a factor button 511 on the schedule screen is depressed. The factor detailed screen 600 is a screen when a condition A is depressed (selected) among recovery condition waiting factors. The condition A includes four conditions of "EFEM", "maintenance", "PM1" and "PM2". "EFEM", "PM1" and "PM2" respectively indicate waiting for maintenance state release of EFEM as the storage chamber 9, a processing module 1 as the process furnace 202, and a processing module 2 as the process furnace 202, and "maintenance" indicates a schedule pause for maintenance. In addition, when the recovery condition waiting occurs, the factor button 511 may be displayed in a different color on the schedule screen.

[0086] An occurrence factor (maintenance state release waiting) of "EFEM" and a coping method for the factor are described below the factor detailed screen 600. When the search cell is depressed, a screen for selecting the four conditions of "EFEM", "maintenance", "PM1" and "PM2" is displayed. Therefore, it may be changed by selecting another condition other than "EFEM". Furthermore, although not clearly indicated in FIG. 8, the cells of condition for which the recovery condition waiting has occurred are displayed in different colors. When a lower OK button is depressed, it is configured so that the display of the factor detailed screen 600 is canceled, and it is returned into the schedule screen 500.

[0087] In addition, when the update button 509 displayed on the schedule screen 500 is depressed, the chart display is updated. That is, the chart display program illustrated in FIG. 5 is restarted, and a new current time is acquired. Then, the process flow illustrated in FIG. 5 is executed from this current time, and the schedule screen illustrated in FIG. 6 is updated.

[0088] Specifically, when it is detected that the update button 509 is depressed, the controller 121 is configured to execute the process flow illustrated in FIG. 5 and update the new current time, job information, and recipe information, and accordingly recalculate a scheduled end time of the currently running job and a scheduled start time and a scheduled end time of the reserved job, and based on the calculated scheduled start time and scheduled end time, calculate an execution time and a scheduled execution time of the currently running job and a scheduled

execution time of the reserved job, and update and display the schedule screen illustrated in FIG. 6.

[0089] As illustrated in FIG. 12, it is configured so that an icon is displayed on the item number cell 501 so as to clearly display a difference between a production job (process job) and a maintenance job (cleaning job in FIG. 12). Furthermore, for example, it may be configured so that an icon for identifying whether the recipe executed in the job is a process recipe (a recipe for processing a substrate) or a maintenance recipe (a recipe for maintaining a component such as a cleaning recipe) is displayed on the item number cell 501.

(Example 2)

[0090] FIG. 10 is a process flow illustrating a chart display program of a job after the execution of the present example, and FIG. 11 illustrates an example of a production information screen displayed on the operation screen of the input/output device 122 by executing the chart display program.

[0091] When a button for switching to the production information screen is depressed, it is configured so that the chart display program of an executed job starts. First, the controller 121 acquires the current time. Next, the storage part 121c is searched to confirm whether there is a job (executed job) executed by the apparatus. If there is no executed job, the process is terminated. Alternatively, when an update button (not shown) is depressed, it may be configured so that the program is restarted to start from acquiring the current time.

[0092] When the executed job is searched, the controller 121 acquires information on the executed job. In addition to the job information (the name, recipe name, scheduled start time, scheduled end time, or the like), at least recipe information (the name, type, process chamber, process data, production information, or the like) executed by the job is acquired. Furthermore, device data including the production information collected when the job is executed and stored in the storage part 121c is also achieved.

[0093] Furthermore, the controller 121 calculates a pre-processing execution time from a pre-

processing start time and a pre-processing end time, a main processing execution time from a main processing start time and a main processing end time, and a post-processing execution time from a post-processing start time and a post-processing end time from the job information, and adds these calculated execution times to calculate an execution time of the executed job. Then, an execution time is calculated for all executed jobs. The execution time, pre-processing execution time, main processing execution time, and post-processing execution time of all the executed jobs are respectively acquired as chart processing result information.

[0094] Next, the controller 121 is configured to create a production information screen file and display a chart of each executed job (illustrated in FIG. 11) based on various device data including the chart processing result information such as the acquired current time, job information, recipe information, and execution time of the executed jobs, or the like.

[0095] A production information screen 700 illustrated in FIG. 11 includes a two-dimensional space in which the vertical axis indicates an item number cell 701 indicative of an order number of various jobs executed by the apparatus, and the horizontal axis indicates job information including a job name cell 702, a PM cell 703, and a recipe name cell 704, and a date/time 705 indicative of a predetermined monitoring period. Here, as in FIG. 5, PM is an abbreviation PM of a processing module.

[0096] In addition, an executed job 706 displayed by an icon indicating an execution time of a job is displayed as a chart on the two-dimensional space of the production information screen 700, in which the executed job 706 has a pre-processing step 706a, a main processing step 706b and a post-processing step 706c, in which the respective steps are respectively displayed in predetermined colors.

[0097] Furthermore, the controller 121 is configured to display an abnormality icon 707 on the item number cell 701 of the executed job in which abnormality data has occurred when the acquired device data includes the abnormality data indicating that an abnormality has occurred. Also, even when a trouble has occurred in the job running on the schedule screen illustrated in FIG. 6, an abnormality icon may be similarly created in the item number cell 501.

[0098] In addition, as illustrated in FIG. 12, it may be configured so that an icon is displayed on the item number cell 701 so as to clearly display a difference between a production job (process job) and a maintenance job (cleaning job in FIG. 12).

[0099] According to the present embodiments, one or more effects of (1) to (7) as set forth below may be achieved.

[0100] (1) According to the present embodiments, by displaying the chart, it is possible to easily recognize a progress status of a job selected from a group consisting of: during reservation; during pre-processing; during main processing; and during post-processing, and to recognize the processing order of all the reserved jobs.

(2) According to the present embodiments, by displaying the chart, since the start time and the scheduled end time of all the reserved jobs can be recognized, it is possible to make a job execution plan, and as a result, to efficiently perform a setup work.

(3) According to the present embodiments, since factor information indicating that a job is waiting for recovery condition is stored on a job basis, it is possible to know the job for which the recovery condition waiting has occurred and to recognize the factor.

(4) According to the present embodiments, by displaying the chart, it is possible not only to recognize job execution results such as a usage frequency and a usage interval for each processing module, but also to recognize a relationship of results with other processing modules.

(5) According to the present embodiments, by displaying the chart, since a relationship between a troubled job and jobs that were executed before and after it can be recognized, troubleshooting becomes easier.

(6) According to the present embodiments, since the production job and the maintenance job can be identified at a glance, it is possible to determine whether a regular maintenance job or the like is normally executed.

(7) According to the present embodiments, when the processing start time and the processing end time are stored in the job information and the start time of a first job is determined, since the scheduled execution time of the job is determined from the processing start time and the

processing end time, it is possible to calculate a scheduled end time of the job. By reflecting the scheduled end time of the job on a job scheduled to be executed and repeating it, it is possible to calculate a scheduled execution time of a reserved job.

[0101] The controller 121 according to embodiments of the present disclosure is not limited to being configured as a dedicated computer, but may be configured as a general-purpose computer. For example, the controller 121 of the present embodiments may be configured by installing an external memory device 123 (e.g., a semiconductor memory such as a USB memory or the like) storing the aforementioned program, and installing the program on the general-purpose computer using the external memory device 123. However, means for supplying the program to the computer is not limited to a case of supplying it using the external memory device 123. For example, the program may be supplied using a communication means such as the Internet or a dedicated line, instead of using the external memory device 123. The memory device 121c or the external memory device 123 is configured as a computer-readable recording medium. The memory device 121c and the external memory device 123 will be generally and simply referred to as a "recording medium." When the term "recording medium" is used herein, it may indicate a case of including only the memory device 121c, a case of including only the external memory device 123, or a case of including both the memory device 121c and the external memory device 123.

[0102] In addition, the substrate processing apparatus 1 according to an embodiment of the present disclosure may be applied not only to a semiconductor manufacturing apparatus for manufacturing a semiconductor, but also to an apparatus for processing a glass substrate such as a liquid crystal display (LCD) device. Moreover, it is needless to say that the present disclosure may be applied to various substrate processing apparatuses such as an exposure apparatus, a lithography apparatus, a coating apparatus, a processing apparatus using plasma and the like.

INDUSTRIAL USE OF THE PRESENT DISCLOSURE

[0103] The progress statuses of various recipes executed by a job can be displayed on a screen,

and the present disclosure may be applied to a substrate processing apparatus that manages the progress of the job on the screen.

EXPLANATION OF REFERENCE NUMERALS

[0104] 10: substrate processing apparatus, 200: wafer

WHAT IS CLAIMED IS:

1. A substrate processing apparatus, comprising:
 - a display having an operation screen including a two-dimensional space in which one axis indicates reservation statuses of various jobs executed by the apparatus including a current job being executed by the apparatus, and the other axis indicates a predetermined monitoring period; and
 - a display controller configured to:
 - acquire various information including a start time and a scheduled end time of the current job being executed by the apparatus, or including a scheduled start time and a scheduled end time of a job reserved by the apparatus;
 - calculate a scheduled execution time of the current job based on the acquired start time and the acquired scheduled end time of the current job, and/or a scheduled execution time of the reserved job based on the acquired scheduled start time and the acquired scheduled end time of the reserved job; and
 - display a chart as an image indicating the scheduled execution time of the current job and the scheduled execution time of the reserved job on the display.
2. The apparatus according to Claim 1, wherein the display controller is further configured to acquire a current time, and to display a line indicating the current time on the display.
3. The apparatus according to Claim 1, wherein when the various information acquired by the acquisition part includes information indicating a recovery condition waiting, the display controller is further configured to display an icon indicating the recovery condition waiting on the display.
4. The apparatus according to Claim 3, wherein when a depression of a factor button

installed on the display is detected, the display controller is configured to display a factor for the recovery condition waiting.

5. The apparatus according to Claim 1, wherein when a depression of an update button installed on the display is detected, the display controller is configured to recalculate the scheduled end time of the current job, recalculate the scheduled start time and the scheduled end time of the reserved job, and display the current job and the reserved job on the display based on the calculated scheduled start time and the calculated scheduled end times.

6. The apparatus according to Claim 1, wherein when a depression of an update button installed on the display is detected, the display controller is configured to update a current time and to display the updated current time on the display.

7. The apparatus according to Claim 1, wherein the display controller is configured to display an icon for identifying whether a recipe executed in the job is a recipe for processing a substrate or a recipe for maintaining a component on an item number cell installed in the display.

8. A substrate processing apparatus, comprising:

a display having an operation screen including a two-dimensional space in which one axis indicates an execution order number of the jobs and the other axis indicates a predetermined monitoring period;

a storage part configured to store various information including a start time and an end time of a job including a pre-processing step, a main processing step and a post-processing step executed by the apparatus; and

a display controller configured to calculate an execution time of each of the pre-processing step, the main processing step, and the post-processing step acquired from the storage part, and display a chart as an image indicating the execution time of the executed job on the

display while identifiably displaying the job for each step.

9. The apparatus according to Claim 8, wherein the display controller is configured to display an item number cell installed in the display in different colors according to a presence or absence of data indicating an abnormality that has occurred during execution of the recipe from the device data.

10. The apparatus according to Claim 8, wherein the display controller is configured to display an icon for identifying whether a recipe executed in the job is a recipe for processing a substrate or a recipe for maintaining a component on an item number cell installed in the display.

11. A display method for a substrate processing apparatus having an operation screen including a two-dimensional space in which one axis indicates reservation statuses of various jobs executed by the apparatus including a current job being executed by the apparatus, and the other axis indicates a predetermined monitoring period, the method comprising:

acquiring various information including a start time and a scheduled end time of the current job being executed by the apparatus, or including a scheduled start time and a scheduled end time of a job reserved by the apparatus;

calculating a scheduled execution time of the current job based on the acquired start time and the acquired scheduled end time of the current job, and/or a scheduled execution time of the reserved job based on the acquired scheduled start time and the acquired scheduled end time of the reserved job; and

displaying a chart as an image indicating the scheduled execution time of the current job and the scheduled execution time of the reserved job.

12. A display method of a substrate processing apparatus having an operation screen including a two-dimensional space in which one axis indicates an execution order number of the

jobs and the other axis indicates a predetermined monitoring period, the method comprising:

storing various information including a start time and an end time of a job including a pre-processing step, a main processing step and a post-processing step executed by the apparatus;

calculating an execution time of each of the pre-processing step, the main processing step, and the post-processing step; and

displaying a chart as an image indicating the execution time of the executed job while identifiably displaying the job for each step.