

SUBSTRATE PROCESSING APPARATUS

TECHNICAL FIELD

[0001] The present invention relates to a substrate processing apparatus.

BACKGROUND ART

[0002] In recent years, substrate processing apparatuses have been used to perform various treatments on substrates such as semiconductor wafers. Examples of the substrate processing apparatus include a CMP (Chemical Mechanical Polishing) apparatus for performing polishing treatment on substrates.

[0003] The CMP apparatus is provided with, for example, a polishing unit for performing polishing treatment on substrates, a cleaning unit for performing cleaning and drying treatments on substrates, and a load/unload unit for transferring substrates to the polishing unit and receiving substrates cleaning and drying-treated by the cleaning unit. The CMP apparatus is also provided with a transporting unit for transporting substrates within the polishing unit, the cleaning unit and the load/unload unit. The CMP apparatus sequentially performs various treatments, including polishing, cleaning and drying, while transporting substrates with the transporting unit.

[0004] Incidentally, a standby state of substrates may occur due to, for example, a wait for the treatment of preceding substrates or a wait for the unoccupied state of a treatment section shared by substrates transported through different

routes, in a case where a plurality of substrates are continuously transported in the CMP apparatus. For example, if the standby state of substrates occurs due to temporal change (such as corrosion) or disturbance (such as dust) during a period from when polishing treatment is started to when cleaning treatment is finished, the condition of substrates may become unstable. In a case, in particular, where copper (Cu) is contained in a portion of a substrate to be polished, a greater effect of corrosion results if a prolonged standby time is taken before the start of cleaning after polishing is completed.

[0005] In this regard, the related art proposes reducing the waiting time of substrates to be transported from the polishing unit to the cleaning unit by predicting the starting time of cleaning in the cleaning unit.

CITATION LIST

PATENT LITERATURE

[0006] Patent Literature 1: Japanese Patent No. 5023146

[0007] In the substrate processing apparatus high in the degree of freedom of cleaning treatment and transportation routing in the cleaning unit, however, the related art does not take into consideration the reduction of the standby state of substrates in a period from when the substrates are loaded into the CMP apparatus to when cleaning treatment is completed.

[0008] That is, the related art assumes that the substrate processing apparatus successively cleans substrates polishing-treated by the polishing unit using a plurality of cleaning sections of the cleaning unit, and then dries and returns the

substrates to the load/unload unit. Accordingly, in the related art, a standby state of substrates may occur within the cleaning unit if substrate transportation routes within the cleaning unit are complicated by including, for example, a plurality of cleaning sections capable of concurrently performing cleaning treatment in the cleaning unit. Once a standby state of substrates occurs within the cleaning unit, a standby state may also occur in subsequent substrates scheduled to pass through a location where the abovementioned substrates are situated.

[0009] Hence, it is an object of the present invention to reduce the standby state of substrates in a period from when the substrates are loaded into a CMP apparatus to when cleaning treatment is completed in a substrate processing apparatus high in the degree of freedom of cleaning treatment and transportation routing in a cleaning unit.

SUMMARY

[0010] In one aspect, the substrate processing apparatus is provided with a polishing unit including at least one polishing section configured to polish a substrate; a cleaning unit including at least one cleaning section configured to clean a substrate polished by the polishing unit; a load/unload unit configured to transfer a substrate to the polishing unit and receive a substrate from the cleaning unit; and a transporting unit including at least one transporting section configured to transport the substrate,

the substrate processing apparatus being provided with a control section configured to control the timing of loading the substrate into the substrate processing apparatus, wherein the control section is configured to create a time table containing or scheduled treatment ending times in the polishing section, the cleaning section and the transporting section for each plurality of substrates to be loaded into the substrate processing apparatus and controls the timing of loading the plurality of substrates into the substrate processing apparatus on the basis of the time table, so that a standby state does not occur in a period from when the substrate is loaded into the substrate processing apparatus to when cleaning treatment is completed, wherein the control section is configured to:

- calculate provisional times of arrival of a substrate to be newly loaded at the polishing section, the cleaning section and the transporting section when creating the time table for the substrate to be newly loaded into the substrate processing apparatus,

- compare the provisional arrival times at the polishing section, the cleaning section and the transporting section; and the scheduled treatment ending times of a substrate precedently loaded into the substrate processing apparatus in the polishing section, the cleaning section and the transporting section, respectively,

- add a difference between earlier provisional arrival times and the scheduled treatment ending times to the provisional times of arrival at the polishing section, the cleaning section and the transporting section, if any

provisional arrival time earlier than the scheduled treatment ending times exists in the same or a conflicting treatment section, to create finalized arrival times, and thus

create the time table on the basis of the finalized arrival times.

[0011] In another embodiment of the substrate processing apparatus, the control section can create the time table on the basis of historical records of time taken in treatment in at least one of the polishing section and the cleaning section and time taken in transportation from the polishing unit to the cleaning unit in the transporting section.

[0012] In yet another embodiment of the substrate processing apparatus, the control section calculates the provisional times of arrival of a substrate to be newly loaded at the polishing section, the cleaning section and the transporting section when creating the time table for the substrate to be newly loaded into the substrate processing apparatus, compares the provisional arrival times and the treatment ending times or the scheduled treatment ending times of a substrate precedently loaded into the substrate processing apparatus in

the polishing section, the cleaning section and the transporting section, adds a difference between the earlier provisional arrival times and the treatment ending times or the scheduled treatment ending times to the provisional times of arrival at the polishing section, the cleaning section and the transporting section, if any provisional arrival time earlier than the treatment ending times or the scheduled treatment ending times exists in the same or a conflicting treatment section, to create actual arrival times, and can thus create the time table on the basis of the actual arrival times.

[0013] In still another embodiment of the substrate processing apparatus, the control section adds the largest of differences among the earlier provisional arrival times and the treatment ending times or the scheduled treatment ending times to the provisional times of arrival at the polishing section, the cleaning section and the transporting section, if a plurality of the earlier provisional arrival times exist, to create actual arrival times, and can thus create the time table on the basis of the actual arrival times.

[0014] In still another embodiment of the substrate processing apparatus, the control section can create the time table on the basis of the provisional arrival times if any provisional arrival time earlier than the treatment ending times or the scheduled treatment ending times does not exist in the same or the conflicting treatment section.

[0015] According to various embodiments described above, it is possible to reduce the standby state of substrates in a

period from when the substrates are loaded into the CMP apparatus to when cleaning treatment is completed in the substrate processing apparatus high in the degree of freedom of cleaning treatment and transportation routing in the cleaning unit.

BRIEF DESCRIPTION OF DRAWINGS

[0016] FIG. 1 is a plan view illustrating the overall configuration of a substrate processing apparatus according to one embodiment of the present invention;

FIG. 2 is a schematic view illustrating one example of routes of wafer transportation in a period from when a wafer is loaded into a CMP apparatus to when cleaning treatment is completed;

FIG. 3 is a schematic view illustrating another example of routes of wafer transportation in a period from when a wafer is loaded into a CMP apparatus to when cleaning treatment is completed;

FIG. 4 is a flowchart showing the operation of a CMP apparatus of the present embodiment;

FIG. 5 is a schematic view used to describe a process of creating time tables;

FIG. 6 is a tabular view illustrating one example of a time table; and

FIG. 7 is a schematic view illustrating one example of a graphed time table.

DESCRIPTION OF EMBODIMENTS

[0017] Hereinafter, a substrate processing apparatus according to one embodiment of the present invention will be

described based on the accompanying drawings. In the following, a CMP apparatus will be described as one example of the substrate processing apparatus, though the substrate processing apparatus is not limited to this CMP apparatus. Also in the following, a substrate processing apparatus provided with a load/unload unit 2, a polishing unit 3 and a cleaning unit 4 will be described, though the substrate processing apparatus is not limited to this apparatus.

[0018] The configuration of the CMP apparatus will be described first, and then a description will be made of the reduction of a standby state of substrates.

[0019] <Substrate Processing Apparatus>

FIG. 1 is a plan view illustrating the overall configuration of the substrate processing apparatus according to one embodiment of the present invention. As illustrated in FIG. 1, this CMP apparatus is provided with a substantially rectangular housing 1. The interior of the housing 1 is partitioned into a load/unload unit 2, a polishing unit 3 and a cleaning unit 4 by bulkheads 1a and 1b. The load/unload unit 2, the polishing unit 3 and the cleaning unit 4 are assembled independent of one another and evacuated separately. The cleaning unit 4 includes a control section 5 used to control substrate treatment actions. While configured to control the overall operation of the CMP apparatus, the control section 5 controls the timing of loading substrates into the polishing unit 3 in particular in the present embodiment. Details on this operation will be described later.

[0020] <Load/Unload Unit>

The load/unload unit 2 is provided with two or more (four in the present embodiment) front load sections 20 on which wafer cassettes for containing a multitude of wafers (substrates) are mounted. These front load sections 20 are disposed adjacently to the housing 1 and laid out along the width direction (direction perpendicular to the longitudinal direction) of the substrate processing apparatus. An open cassette, a SMIF (Standard Manufacturing Interface) pod, or a carrier, such as a FOUP (Front-Opening Unified Pod), used to store wafers can be mounted on each front load section 20. Here, the SMIF and FOUP are airtight containers capable of maintaining an environment independent of an external space by being covered with bulkheads with wafer cassettes housed in the containers.

[0021] The load/unload unit 2 is also provided with an ITM (In-line Thickness Monitor) 24 serving as a measuring section for measuring a film thickness on a wafer surface. A transport robot (a loader and a transport mechanism) 22 movable along the array direction of the front load section 20 is mounted on the load/unload unit 2. The transport robot 22 can gain access to wafer cassettes mounted on the front load sections 20. Each transport robot 22 is provided with two hands on the upper and lower sides thereof. The upper hand is used when a treated wafer is returned to a wafer cassette. The lower hand is used when a wafer before treatment is taken out of a wafer cassette. In addition, the lower hand of each transport robot 22 is configured to rotate around the axis thereof to be able to turn over a wafer.

[0022] The load/unload unit 2 is an area that needs to be maintained in the cleanest state. Accordingly, the internal pressure of the load/unload unit 2 is constantly kept higher than the external pressure of the CMP apparatus and the internal pressures of the polishing unit 3 and the cleaning unit 4. The polishing unit 3 uses slurry as a polishing liquid and is, therefore, the most unclean area. Accordingly, a negative pressure is formed inside the polishing unit 3 and is kept lower than the internal pressure of the cleaning unit 4. A filter fan unit (not illustrated) including a clean air filter, such as a HEPA filter, an ULPA filter or a chemical filter, is disposed in the load/unload unit 2. Clean air from which particles, toxic vapor and toxic gas have been removed blows out constantly from this filter fan unit.

[0023] <Polishing Unit>

The polishing unit 3 is an area where a wafer is polished (planarized). The polishing unit 3 is provided with a first polishing section 3A, a second polishing section 3B, a third polishing section 3C and a fourth polishing section 3D. These first polishing section 3A, second polishing section 3B, third polishing section 3C and fourth polishing section 3D are laid out along the longitudinal direction of the substrate processing apparatus, as illustrated in FIG. 1.

[0024] The first polishing section 3A is provided with a polishing table fitted with an abrasive pad. The first polishing section 3A is also provided with a top ring for holding and polishing a wafer, while pressing the wafer against the abrasive pad on the polishing table. The first

polishing section 3A is further provided with a polishing liquid supply nozzle for supplying a polishing liquid and a dressing liquid (for example, pure water) to the abrasive pad. The first polishing section 3A is further provided with a dresser for dressing the polishing surface of the abrasive pad. The first polishing section 3A is further provided with an atomizer for nebulizing and spraying a fluid mixture of a liquid (for example, pure water) and a gas (for example, nitrogen gas) or a liquid (for example, pure water) onto the polishing surface. The second polishing section 3B, the third polishing section 3C and the fourth polishing section 3D have the same configuration as the first polishing section 3A.

[0025] <Transporting Unit>

Next, a description will be made of a transport mechanism (transporting unit) for transporting wafers. As illustrated in FIG. 1, a first linear transporter 6 is disposed adjacently to the first polishing section 3A and the second polishing section 3B. This first linear transporter 6 is a mechanism for transporting wafers among four transport positions (defined as a first transport position LTP1, a second transport position LTP2, a third transport position LTP3 and a fourth transport position LTP4 in order from the load/unload unit side) along the direction in which the polishing sections 3A and 3B are laid out.

[0026] Likewise, a second linear transporter 7 is disposed adjacently to the third polishing section 3C and the fourth polishing section 3D. The second linear transporter 7 is a mechanism for transporting wafers among three transport

positions (defined as a fifth transport position LTP5, a sixth transport position LTP6 and a seventh transport position LTP7 in order from the load/unload unit side) along the direction in which the polishing sections 3C and 3D are laid out.

[0027] Wafers are transported to the polishing sections 3A and 3B by the first linear transporter 6. The top ring of the first polishing section 3A moves between a polishing position and the second transport position LTP2 due to the swinging action of a top ring head. Accordingly, a wafer is transferred to and from the top ring at the second transport position LTP2. Likewise, the top ring of the second polishing section 3B moves between a polishing position and the third transport position LTP3. Thus, a wafer is transferred to and from the top ring at the third transport position LTP3. The top ring of the third polishing section 3C moves between a polishing position and the sixth transport position LTP6. Thus, a wafer is transferred to and from the top ring at the sixth transport position LTP6. The top ring of the fourth polishing section 3D moves between a polishing position and the seventh transport position LTP7. Thus, a wafer is transferred to and from the top ring at the seventh transport position LTP7.

[0028] A lifter 11 for receiving a wafer from a transport robot 22 is disposed in the first transport position LTP1. The wafer is transferred from the transport robot 22 to the first linear transporter 6 by way of this lifter 11. A shutter (not illustrated) is disposed in the bulkhead 1a, so as to locate between the lifter 11 and the transport robot 22.

The shutter is opened at the time of transporting the wafer, so that the wafer is transferred from the transport robot 22 to the lifter 11. In addition, a swing transporter (STP) 12 is disposed among the first linear transporter 6, the second linear transporter 7 and the cleaning unit 4. This swing transporter 12 includes a hand movable between the fourth transport position LTP4 and the fifth transport position LTP5. Wafer transfer from the first linear transporter 6 to the second linear transporter 7 is made by the swing transporter 12. A wafer is transported to the third polishing section 3C and/or the fourth polishing section 3D by the second linear transporter 7. A wafer polished by the polishing unit 3 is transported to the cleaning unit 4 through the swing transporter 12. A temporary pedestal (WS1) 180 for wafers is provided in the transporting unit.

[0029] <Cleaning Unit>

The cleaning unit 4 is partitioned into a first cleaning chamber 190, a first transport chamber 191, a second cleaning chamber 192, a second transport chamber 193, and a third cleaning chamber 194. Two cleaning sections CL1A and CL1B and a temporary pedestal WS2 for wafers are disposed in the first cleaning chamber 190. Two cleaning sections CL2A and CL2B and a temporary pedestal WS3 for wafers are disposed in the second cleaning chamber 192. Two cleaning sections CL3A and CL3B for cleaning substrates are disposed in the third cleaning chamber 194. The cleaning sections CL3A and CL3B are isolated from each other. The cleaning sections CL1A, CL1B, CL2A, CL2B, CL3A and CL3B are cleaning machines used to

clean wafers with a cleaning liquid.

[0030] Transfer robots (transport mechanisms) RB1U and RB1L are disposed in the first transport chamber 191, and a transfer robot RB2 is disposed in the second transport chamber 193. The transfer robots RB1U and RB1L are operable to transport wafers among the temporary pedestal 180, the cleaning sections CL1A and CL1B, the temporary pedestal WS2, and the cleaning sections CL2A and CL2B. The transfer robot RB2 is operable to transport wafers among the cleaning sections CL2A and CL2B, the temporary pedestal WS3, and the cleaning sections CL3A and CL3B. The transport robot RB2 transports a cleaned wafer only, and therefore, includes only one hand. The transport robot 22 takes out a wafer from the cleaning sections CL3A and CL3B and returns the wafer to a wafer cassette.

[0031] <Reduction of Standby State of Substrates>

Next, a description will be made of the reduction of a standby state of substrates in a period from when polishing treatment is started to when cleaning treatment is completed.

[0032] First, a description will be made of causes for the occurrence of a standby state of substrates. FIGS. 2 and 3 are schematic views illustrating one example of routes of wafer transportation in a period from when wafers are loaded into the CMP apparatus to when cleaning treatment is completed. In FIGS. 2 and 3, the description is simplified with regard to the transporting unit for transporting wafers among respective treatment sections.

[0033] As illustrated in FIGS. 2 and 3, the present

embodiment includes two systems each of polishing treatment and cleaning treatment. Accordingly, the present embodiment is high in the degree of freedom of wafer transportation routing. In addition, such a recipe in which cleaning treatment is performed without performing polishing treatment is also available, as illustrated in FIGS. 2 and 3. Yet additionally, complex wafer transportation routing is possible in which, for example, a wafer is back-transferred once after cleaning treatment is completed in the cleaning section CL2A, and then transported to the cleaning section CL2B of another system, as illustrated in FIG. 3.

[0034] As described above, wafer transportation routes within the cleaning unit become complicated if the cleaning unit 4 includes a plurality of cleaning sections capable of concurrently performing cleaning treatment. As a result, a standby state of wafers may occur in the cleaning unit. Once a standby state of substrates occurs within the cleaning unit, a standby state may also occur in subsequent substrates scheduled to pass through a location where the abovementioned substrates are situated.

[0035] In contrast, in the present embodiment, the control section 5 creates a time table, so that a standby state does not occur in a period from when wafers are loaded into the CMP apparatus to when cleaning treatment is completed. The time table is a table correlating treatment ending times or the scheduled treatment ending times in the polishing section, the cleaning section and the transporting section for each plurality of wafers to be loaded into the CMP apparatus. The

control section 5 controls the timing of loading a plurality of wafers into the CMP apparatus on the basis of the time table.

[0036] Details on this operation will be described along with the overall operation of the CMP apparatus. FIG. 4 is a flowchart illustrating the operation of the CMP apparatus of the present embodiment. As illustrated in FIG. 4, the control section 5 first predicts transportation routes for all of wafers to be loaded into the CMP apparatus on the basis of a recipe (step S101).

[0037] Subsequently, the control section 5 predicts operating times for all of wafers to be loaded into the CMP apparatus (step S102). Specifically, the control section 5 predicts an operating time for each wafer on the basis of predicted times set in the recipe or historical record values. This predicted operating time is used when creating the time table. That is, the control section 5 creates the time table on the basis of historical records of time taken in treatment in at least one of the polishing section and the cleaning section and time taken in transportation from the polishing unit 3 to the cleaning unit 4 in the transporting section.

[0038] Subsequently, the control section 5 calculates the times of arrival of each wafer at respective treatment sections (polishing sections, transporting sections, and cleaning sections) on the basis of the operating times of each wafer predicted in step S102 (step S103). Then, the control section 5 calculates the standby time of each wafer in each treatment section (step S104).

[0039] This operation will be described using drawings. FIG. 5 is a schematic view used to describe a process of creating time tables. FIG. 5 illustrates a process of creating a time table for a wafer 4 to be newly loaded into the CMP apparatus, where time tables have already been created for wafers 1 to 3.

[0040] As illustrated in FIG. 5, treatment ending times or scheduled treatment ending times in the polishing section (Poli, A), the cleaning sections (CL1A and CL2A), and the transporting sections (LTP3, WS1, RB1L and RB1U) are correlated in a time table 210 for each of the wafers 1 to 3. On the other hand, the control section 5 calculates the provisional times of the arrival of the newly-loaded wafer 4 at the polishing section, the cleaning section and the transporting section when creating the time table for the wafer 4 to be newly loaded into the CMP apparatus. The scheduled times of arrival of the wafer 4 at the polishing section (Poli, A), the cleaning sections (CL1A and CL2A) and the transporting sections (LTP3, WS1, RB1L and RB1U) are correlated with a provisional arrival time table 220.

[0041] The control section 5 compares the provisional arrival times (provisional arrival time table 220) and the treatment ending times or the scheduled treatment ending times (time table 210) of wafers precedently loaded into the CMP apparatus in the polishing sections, the cleaning sections and the transporting sections. In this example, the control section 5 compares, for example, the scheduled treatment ending time (0:04:35) of the wafer 3 in the RB1U and the scheduled arrival time (0:04:10) of the wafer in the WS1 which

is a treatment section conflicting in treatment with the RB1U. The result is that the scheduled arrival time in the WS1 is 25 seconds earlier. In other words, the wafer 4 stands by in the WS1 for 25 seconds if the wafer 4 is loaded into the CMP apparatus according to the provisional arrival time table 220. Note that the conflicting treatment section refers to a treatment section in such a relationship as the relationship between, for example, the WS1 and the RB1U in which in order for one treatment section (WS1) to operate (transfer a wafer for transportation), the other treatment section (RB1U) has to operate (receive the wafer from the WS1).

[0042] As illustrated in FIG. 4, the control section 5 determines whether or not there are any standby times (step S105). If there are standby times (Yes in step S105), the control section 5 searches for a treatment section having the longest waiting time (step S106).

[0043] For example, a 25-second standby time arises between treatment sections associated with each other, such as the RB1U for the wafer 3 and the WS1 for the wafer 4, as described above in the example of FIG. 5. In addition, the control section 5 compares the scheduled treatment time (0:04:30) of the wafer 3 in the CL1A and the arrival time (0:04:15) of the wafer 4 in the CL1A. The result is that the scheduled arrival time in the CL1A is 15 seconds earlier, and therefore, a 15-second standby time arises.

[0044] In this case, the control section 5 recognizes that the longest waiting time is 25 seconds and a treatment section having the longest waiting time is the WS1 for the wafer 4.

In other words, if there are a plurality of earlier provisional arrival times (for example, 15 and 25 seconds), the control section 5 adds the largest (25 seconds) of differences among the earlier provisional arrival times and the treatment ending times or the scheduled treatment ending times to the provisional times of arrival at the polishing section, the cleaning section and transporting section to create actual arrival times.

[0045] Subsequently, as illustrated in FIG. 4, the control section 5 adds the longest waiting time to the provisional arrival time table 220 to create an actual arrival time table 230 (step S107). That is, the control section 5 adds the longest waiting time (25 seconds) for each treatment section listed on the provisional arrival time table 220, as illustrated in FIG. 5. For example, the time of arrival of the wafer 4 at the LTP3, which is 0:04:00 on the provisional arrival time table 220, changes to 0:04:25 on the actual arrival time table 230. Likewise, the time of arrival of the wafer 4 at the WS1, which is 0:04:10 on the provisional arrival time table 220, changes to 0:04:35 on the actual arrival time table 230.

[0046] In this way, the control section 5 adds a difference between the earlier provisional arrival times and the treatment ending times or the scheduled treatment ending times to the provisional times of arrival at the polishing sections, the cleaning sections and the transporting sections, if any provisional arrival time earlier than the treatment ending times or the scheduled treatment ending times exists in the

same or a conflicting treatment section, to create actual arrival times.

[0047] Subsequently, as illustrated in FIG. 4, the control section 5 creates a time table on the basis of the actual arrival times (actual arrival time table 230) created in step S107 (step S108). That is, the actual arrival time table 230 correlates the times of arrival of the wafer 4 at respective treatment sections. Hence, the control section 5 adds treating times in the respective treatment sections to the actual arrival time table 230 to create a time table correlating treatment ending times or scheduled treatment ending times in the respective treatment sections.

[0048] On the other hand, if the control section 5 determines, in step S105, that there is no standby time (No in step S105), the control section 5 creates a time table on the basis of the provisional arrival time table 220 without creating the actual arrival time table 230 (step S108). That is, the control section 5 creates a time table on the basis of the provisional arrival times if there is no provisional arrival time earlier than the treatment ending times or the scheduled treatment ending times in the same or a conflicting treatment section.

[0049] FIG. 6 is a tabular view illustrating one example of a time table 240. As illustrated in FIG. 6, the time table 240 is a table in which the starting time of a series of treatments (Start), the current positions of wafers (Pos), treatment ending times or scheduled treatment ending times in respective treatment sections are correlated for each

plurality of wafers to be loaded into the CMP apparatus. The time table 240 is used to prevent any standby states from occurring in a period from when wafers are loaded into the CMP apparatus to when cleaning treatment is completed. The time table 240 is created by performing a series of operations shown in FIG. 4. The control section 5 controls the timing of loading a plurality of wafer into the CMP apparatus on the basis of the time table 240.

[0050] As described above, according to the present embodiment, the times of transportation to all of treatment sections present on transportation routes are calculated for all of wafers to be loaded into the CMP apparatus to create a time table. Consequently, the control section 5 of the present embodiment controls the timing of starting transportation and transportation routes, so that a wait for use of each treatment section shared among respective wafers does not occur and that all processes from the start of polishing to the end of cleaning are carried out in the shortest period of time without involving any standby states. The waiting time of wafers within the CMP apparatus is thus reduced. As a result, the present embodiment can prevent wafers from becoming unstable due to temporal change (such as corrosion) or disturbance (such as dust). In a case, in particular, where copper (Cu) is contained in a portion of a wafer to be polished, a greater effect of corrosion results if a prolonged standby time is taken before the start of cleaning after polishing is completed. It is possible, however, to prevent copper from corrosion by reducing the standby time.

[0051] In addition, if, for example, there are any treatment sections incapable of treating wafers due to the maintenance or the like of some of the treatment sections of the CMP apparatus, the CMP apparatus (control section 5) of the present embodiment can create routes that detour around the treatment sections under maintenance or the like.

[0052] Yet additionally, the CMP apparatus of the present embodiment can, as appropriate, update the time table 240 created once. For example, the control section 5 can calculate a difference between the actual time of arrival of a wafer at each treatment section and the predicted arrival time of the wafer to update the time table 240 for subsequent wafers that pass through the treatment sections (wafers to be affected by delay). The control section 5 can also feed delay information back to wafers already loaded into the CMP apparatus. Note that the control section 5 can be configured not to feed back delay information if a difference between the actual arrival time and the predicted arrival time of a wafer is smaller than a threshold (for example, 0.5 seconds), since the time difference can be regarded as an error.

[0053] Still additionally, if the transportation of wafers is temporarily suspended due to the malfunction or the transport stop function of the CMP apparatus, the CMP apparatus (control section 5) of the present embodiment recreates the time table 240 at the restart of transportation and, therefore, can continue controlled transportation. When recreating the time table 240, the control section 5 begins the recreation from the downstream side of a transportation

route of wafers. If a wafer loaded into the CMP apparatus is removed therefrom due to, for example, the anomaly of the wafer, the control section 5 can delete the wafer from the time table 240 to exclude the wafer from the objects of control and recreate the time table 240.

[0054] Still additionally, if wafers share a treatment section, the CMP apparatus (control section 5) of the present embodiment makes calculations and performs control, so that the next wafer is treated after a preceding wafer. On the other hand, if interruption is possible without changing the time table 240, the control section 5 can create a time table 240 to interrupt with, so that subsequent wafers can be treated earlier than the preceding wafer.

[0055] If, for example, a transportation route of wafers is greatly changed due to the maintenance or the like of treatment sections after the time table 240 is created once, the CMP apparatus (control section 5) of the present embodiment takes a prolonged period of time in recreating the time table 240. Hence, in such a case, the control section 5 can stop loading new wafers until wafers within the CMP apparatus are carried out of the CMP apparatus, without recreating the time table 240. In addition, the control section 5 can disable the function of creating or recreating the time table 240 if a prolonged period time is required to create or recreate the time table 240.

[0056] Still additionally, the CMP apparatus (control section 5) of the present embodiment can visualize the state of transportation of a plurality of wafers, so that an

operator or the like can monitor the state of transportation of the plurality of wafers. For example, the control section 5 can display the time table 240 shown in FIG. 6 on an output interface (monitor, or the like) of the CMP apparatus. In addition, the control section 5 can graph the time table 240 and display the graph in real time on the output interface.

[0057] FIG. 7 is a schematic view illustrating one example the time table 240 made into a graph. In FIG. 7, the axis of abscissas (t) represents a time course. As illustrated in FIG. 7, the control section 5 can lay out and display wafer-treating sections in chronological order for each plurality of wafers. In addition, the control section 5 can apply a different color or pattern for each treatment section. Consequently, an operator or the like can easily confirm that the same or a conflicting treatment section is not used at the same point in time. Yet additionally, if a standby state occurs in a wafer for some reason, the control section 5 can display the remaining time of the standby state through an indicator or the like.

REFERENCE SIGNS LIST

- [0058]** 2: Load/unload unit
3: Polishing unit
3A to 3D: Polishing section
4: Cleaning unit
5: Control section
210, 240: Time table
220: Provisional arrival time table
230: Actual arrival time table

CL1A, CL1B, CL2A, CL2B, CL3A, CL3B: Cleaning section

WHAT IS CLAIMED IS:

1. A substrate processing apparatus comprising:
 - a polishing unit including at least one polishing section configured to polish a substrate;
 - a cleaning unit including at least one cleaning section configured to clean a substrate polished by the polishing unit;
 - a load/unload unit configured to transfer a substrate to the polishing unit and receive a substrate from the cleaning unit; and
 - a transporting unit including at least one transporting section configured to transport the substrate,the substrate processing apparatus being provided with a control section configured to control the timing of loading the substrate into the substrate processing apparatus,
 - wherein the control section is configured to:
 - create a time table containing scheduled treatment ending times in the polishing section, the cleaning section and the transporting section for each plurality of substrates to be loaded into the substrate processing apparatus, and
 - control the timing of loading the plurality of substrates into the substrate processing apparatus on the basis of the time table, so that a standby state does not occur in a period from when the substrate is loaded into the substrate processing apparatus to when cleaning treatment is completed, wherein the control section is configured to:
 - calculate provisional times of arrival of a substrate to be newly loaded at the polishing section, the cleaning section and the transporting section when creating the time table for the substrate to be newly loaded into the substrate processing apparatus,

compare the provisional arrival times at the polishing section, the cleaning section and the transporting section; and the scheduled treatment ending times of a substrate precedently loaded into the substrate processing apparatus in the polishing section, the cleaning section and the transporting section, respectively,

add a difference between earlier provisional arrival times and the scheduled treatment ending times to the provisional times of arrival at the polishing section, the cleaning section and the transporting section, if any provisional arrival time earlier than the scheduled treatment ending times exists in the same or a conflicting treatment section, to create finalized arrival times, and thus

create the time table on the basis of the finalized arrival times.

2. The substrate processing apparatus according to claim 1, wherein the control section is configured to create the time table on the basis of historical records of: time taken in treatment in

at least one of the polishing section and the cleaning section; and time taken in transportation from the polishing unit to the cleaning unit in the transporting section.

3. The substrate processing apparatus according to claim 1, wherein the control section is configured to:

add the largest difference among the differences between the earlier provisional arrival times and the scheduled treatment ending times to the provisional times of arrival at the polishing

section, the cleaning section and the transporting section, if a plurality of the earlier provisional arrival times exist, to create finalized arrival times, and thus

create the time table on the basis of the finalized arrival times.

4. The substrate processing apparatus according to any one of claims 1-3, wherein the control section is configured to create the time table on the basis of the provisional arrival times if any provisional arrival time earlier than the scheduled treatment ending times does not exist in the same or the conflicting treatment section.