METHOD OF MANUFACTURING SEMICONDUCTOR DEVICE, SUBSTRATE PROCESSING APPARATUS, AND RECORDING MEDIUM

TECHNICAL FIELD

[0001] The present disclosure relates to a method of manufacturing a semiconductor device, a substrate processing apparatus, and a recording medium.

BACKGROUND

[0002] As miniaturization of a large scale integrated circuit (hereinafter, referred to as an LSI) progresses, miniaturization of a patterning technique also progresses. As the patterning technique, for example, a hard mask or the like is used, but it is difficult to apply a method of exposing a resist to separate an etching region and a non-etching region due to the miniaturization of the patterning technique. For this reason, an epitaxial film such as silicon (Si) or silicon germanium (SiGe) is selectively grown and formed on a substrate such as a silicon (Si) wafer (for example, see Patent Documents 1 and 2).

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0003] Patent Document 1: Japanese laid-open publication No. 2003-100746

Patent Document 2: Japanese laid-open publication No. 2015-122481

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0004] The present disclosure provides a technique capable of selectively forming a film on a substrate.

such as a vacuum state. A housing 101 of the first transfer chamber 103 has, for example, a pentagon in a plane view, and is formed in a box shape with both upper and lower ends closed.

[0012] A first substrate transfer device 112 configured to transfer the wafers 200 is installed in the first transfer chamber 103.

[0013] Spare chambers (load lock chambers) 122 and 123 are connected to a sidewall at the front side out of five sidewalls of the housing 101 via gate valves 126 and 127 respectively. The spare chambers 122 and 123 are configured so that both a function of loading the wafers 200 and a function of unloading the wafers 200 can be used, and each have a structure capable of withstanding a negative pressure.

[0014] A process furnace 202a as a first process unit, a process furnace 202b as a second process unit, a process furnace 202c as a third process unit, and a process furnace 202d as a fourth process unit, in which the substrates are accommodated and desired processing is performed on the accommodated substrates, are connected to four sidewalls at the rear side out of the five sidewalls of the housing 101 of the first transfer chamber 103 while being adjacent to each other via gate valves 70a, 70b, 70c, and 70d respectively.

(Atmosphere Side Configuration)

[0015] A second transfer chamber 104 configured to be capable of transferring the wafers 200 under an atmospheric pressure is connected to the front side of the spare chambers 122 and 123 via gate valves 128 and 129. A second substrate transfer device 124 configured to transfer the wafers 200 is installed at the second transfer chamber 104.

[0016] A notch alignment device 106 is installed at the left side of the second transfer chamber 104. The notch alignment device 106 may also be an orientation flat alignment device. In addition, a clean unit configured to supply clean air is installed above the second transfer chamber 104.

[0017] Substrate loading/unloading ports 134 configured to load and unload the wafers 200 into and from the second transfer chamber 104, and pod openers 108 are installed at the front side of

a housing 125 of the second transfer chamber 104. A load port (IO stage) 105 is installed at the opposite side of the pod openers 108 with the substrate loading/unloading ports 134 interposed therebetween, that is, outside the housing 125. The pod openers 108 each include a closure configured to be capable of opening and closing caps 100a of the pods 100 and closing the substrate loading/unloading ports 134. The wafers 200 can be taken in and out of the pods 100 by opening and closing the caps 100a of the pods 100 placed on the load port 105. Furthermore, the pods 100 are supplied and discharged to the load port 105 by an in-process transfer device (OHT or the like) (not shown).

(Configuration of the Process Furnace 202a)

[0018] FIG. 2 is a vertical cross-sectional view of the process furnace 202a as the first process unit included in the substrate processing apparatus 10, and FIG. 3 is a top cross-sectional view of the process furnace 202a.

In the present embodiment, an example in which a film-forming process is performed in the process furnace 202b as the second process unit will be described after a modification process is performed in the process furnace 202a as the first process unit, but the same substrate processing may be performed in the process furnace 202c as the third process unit and the process furnace 202d as the fourth process unit.

[0019] The process furnace 202a includes a heater 207 as a heating means (a heating mechanism or a heating system). The heater 207 has a cylindrical shape and is supported by a heater base (not shown) as a holding plate to be vertically installed.

[0020] An outer tube 203 constituting a reaction vessel (process vessel) is disposed inside the heater 207 to be concentric with the heater 207. The outer tube 203 is made of a heat resistant material, for example, quartz (SiO_2), silicon carbide (SiC) or the like, and has a cylindrical shape with its upper end closed and its lower end opened. A manifold (inlet flange) 209 is disposed below the outer tube 203 in a concentric relationship with the outer tube 203. The manifold 209 is made of metal such as, e.g., stainless steel (SUS), and has a cylindrical shape with its

process unit included in the substrate processing apparatus 10, and FIG. 5 is a top cross-sectional view of the process furnace 202b. The process furnace 202b according to the present embodiment is different from the aforementioned process furnace 202a in configuration in the process chamber 201a. In the process furnace 202b, only parts different from the aforementioned process furnace 202a will be described below and explanation of the same parts will be omitted. The process furnace 202b includes a process chamber 201b as a second process chamber.

[0039] Nozzles 420 and 430 are installed in the process chamber 201b to penetrate a sidewall of the manifold 209 and the inner tube 204. Gas supply pipes 320 and 330 are respectively connected to the nozzles 420 and 430. However, the process furnace 202b of the present embodiment is not limited to the aforementioned configurations.

[0040] MFCs 322 and 332 are installed at the gas supply pipes 320 and 330 sequentially from the corresponding upstream sides, respectively. In addition, valves 324 and 334 are installed in the gas supply pipes 320 and 330, respectively. Gas supply pipes 520 and 530, which supply an inert gas, are respectively connected to the gas supply pipes 320 and 330 at the downstream side of the valves 324 and 334. MFCs 522 and 532 and valves 524 and 534 are installed at the gas supply pipes 520 and 530 sequentially from the corresponding upstream sides, respectively.

[0041] The nozzles 420 and 430 are respectively connected to front end portions of the gas supply pipes 320 and 330. The nozzles 420 and 430 are each configured as an L-shaped nozzle. Horizontal portions of the nozzles 420 and 430 are formed to penetrate the sidewall of the manifold 209 and the inner tube 204. Vertical portions of the nozzles 420 and 430 are formed in a channel-shaped (groove-shaped) spare chamber 205b formed to protrude outward of the inner tube 204 in a radial direction and extend along the vertical direction, and is also formed to extend upward along the inner wall of the inner tube 204 in the spare chamber 205b (upward in the arrangement direction of the wafers 200).

[0042] The nozzles 420 and 430 are installed to extend from a lower region of the process chamber 201b to an upper region of the process chamber 201b, and a plurality of gas supply

pipe 320, a precursor gas supply system mainly includes the gas supply pipe 320, the MFC 322, and the valve 324, but the nozzle 420 may be regarded as being included in the precursor gas supply system. Further, when the reaction gas is allowed to flow from the gas supply pipe 330, a reaction gas supply system mainly includes the gas supply pipe 330, the MFC 332, and the valve 334, but the nozzle 430 may be regarded as being included in the reaction gas supply system. When a nitrogen-containing gas is supplied as the reaction gas from the gas supply pipe 330, the reaction gas supply system may also be referred to as a nitrogen-containing gas supply system. In addition, an inert gas supply system mainly includes the gas supply pipes 520 and 530, the MFCs 522 and 532, and the valves 524 and 534.

(Configuration of the Control Part)

[0048] As illustrated in FIG. 6, a controller 121, which is a control part (control means), may be configured as a computer including a central processing unit (CPU) 121a, a random access memory (RAM) 121b, a memory device 121c, and an I/O port 121d. The RAM 121b, the memory device 121c and the I/O port 121d are configured to exchange data with the CPU 121a via an internal bus. An input/output device 120 formed of, e.g., a touch panel or the like, is connected to the controller 121.

[0049] The memory device 121c includes, for example, a flash memory, a hard disk drive (HDD), or the like. A control program that controls operations of a substrate processing apparatus, a process recipe in which sequences and conditions of a method of manufacturing a semiconductor device as described hereinbelow and the like are specified, or the like is readably stored in the memory device 121c. The process recipe functions as a program combined to cause the controller 121 to execute each process (each step) in the method of manufacturing a semiconductor device, as described hereinbelow, to obtain a predetermined result. Hereinafter, the process recipe, the control program, and the like will be generally and simply referred to as a "program." When the term "program" is used herein, it may indicate a case of including only the process recipe, a case of including only the control program, or a case of including

combination of the process recipe and the control program. The RAM 121b is configured as a memory area (work area) in which a program, data or the like read by the CPU 121a is temporarily stored.

[0050] The I/O port 121d is connected to the MFCs 312, 322, 332, 512, 522 and 532, the valves 314, 324, 334, 514, 524 and 534, the pressure sensor 245, the APC valve 243, the vacuum pump 246, the heater 207, the temperature sensor 263, the rotation mechanism 267, the boat elevator 115 and the gate valves 70a to 70d respectively included in the process furnaces 202a and 202b described above, the first substrate transfer device 112, and the like.

[0051] The CPU 121a is configured to read the control program from the memory device 121c and execute the same. The CPU 121a is also configured to read the recipe and the like from the memory device 121c according to an input of an operation command from the input/output device 120. In addition, the CPU 121a is configured to control, according to the contents of the recipe thus read, the flow rate adjusting operation of various kinds of gases by the MFCs 312, 322, 332, 512, 522 and 532, the opening/closing operation of the valves 314, 324, 334, 514, 524 and 534, the opening/closing operation of the APC valve 243, the pressure regulating operation performed by the APC valve 243 based on the pressure sensor 245, the temperature adjusting operation performed by the heater 207 based on the temperature sensor 263, the driving and stopping of the vacuum pump 246, the operation of rotating the boat 217 with the rotation mechanism 267 and adjusting the rotation speed of the boat 217, the operation of moving the boat 217 up or down with the boat elevator 115, the operation of accommodating the wafers 200 in the boat 217, and the like.

[0052] The controller 121 may be configured by installing, on the computer, the aforementioned program stored in an external memory device 130 (for example, a magnetic tape, a magnetic disc such as a flexible disc or a hard disc, an optical disc such as a CD or DVD, a magneto-optical disc such as a MO, or a semiconductor memory such as a USB memory or a memory card). The memory device 121c or the external memory device 130 is configured as a computer-readable recording medium. Hereinafter, the memory device 121c and the external memory

device 130 will be generally and simply referred to as a "recording medium." In the present disclosure, the term "recording medium" may indicate a case of including only the memory device 121c, a case of including only the external memory device 130, or a case of including both the memory device 121c and the external memory device 130. Furthermore, the program may be supplied to the computer by using a communication means such as the Internet or a dedicated line, instead of using the external memory device 130.

(2) Substrate Processing

[0053] An example of a process of forming a titanium nitride (TiN) film on a SiN layer on a wafer 200 including a silicon oxide (SiO_2) layer as a first surface and the silicon nitride (SiN) layer as a second surface different from the first surface, which is a process for manufacturing a semiconductor device, will be described with reference to FIG. 7A. In this process, after a step of modifying the surface of the SiO_2 layer on the wafer 200 is performed in the process furnace 202a, a step of selectively growing the TiN film on the SiN layer on the wafer 200 is performed in the process furnace 202b. In FIG. 7A, the loading/unloading operation between the process furnace 202a and the process furnace 202b is omitted. In the following descriptions, the operations of the respective parts constituting the substrate processing apparatus 10 are controlled by the controller 121.

[0054] The substrate processing (a process of manufacturing a semiconductor device) according to the present embodiment includes: a step of supplying a tungsten hexafluoride (WF_6) gas as a modifying gas containing an inorganic ligand to a wafer 200 including a SiO_2 layer as a first surface and a SiN layer as a second surface to modify the surface of the SiO_2 layer; and a step of supplying a $TiCl_4$ gas as a precursor gas and a NH_3 gas as a reaction gas, as deposition gases, to the wafer 200 to selectively grow a TiN film on the surface of the SiN layer.

[0055] Further, the step of modifying the surface of the SiO_2 layer on the surface of the wafer 200 may be performed multiple times. The step of modifying the surface of the SiO_2 layer on the surface of the wafer 200 may be referred to as a surface modification process or simply a

modification process. In addition, the step of selectively growing the TiN film on the surface of the SiN layer on the surface of the wafer 200 may be referred to as a film-forming process.

[0056] When the term "wafer" is used herein, it may refer to "a wafer itself" or "a laminated body of a wafer and a predetermined layer or film formed on the surface of the wafer". In addition, when the phrase "a surface of a wafer" is used herein, it may refer to "a surface of a wafer itself" or "a surface of a predetermined layer or film formed on a wafer". Further, when the term "substrate" is used herein, it may be synonymous with the term "wafer."

A. Modification Process (Modification Processing Step)

[0057] First, a wafer 200 having a SiO_2 layer and a SiN layer on its surface is loaded into the process furnace 202a as the first process unit, in which a modification process is performed to form F termination on a surface of the SiO_2 layer on the wafer 200.

(Wafer Loading)

[0058] In a case where a plurality of wafers 200 is charged on the boat 217 (wafer charging), as illustrated in FIG. 2, the boat 217 supporting the plurality of wafers 200 is lifted up by the boat elevator 115 and is loaded into the process chamber 201a (boat loading). In this state, the seal cap 219 seals the lower end opening of the outer tube 203 via the O-ring 220.

(Pressure Regulation and Temperature Adjustment)

[0059] The interior of the process chamber 201a is vacuum-exhausted by the vacuum pump 246 to reach a desired pressure (degree of vacuum). In this operation, the internal pressure of the process chamber 201a is measured by the pressure sensor 245. The APC valve 243 is feedback-controlled based on the measured pressure information (pressure regulation). The vacuum pump 246 may be continuously activated at least until the processing of the wafers 200 is completed. Further, the interior of the process chamber 201a is heated by the heater 207 to a desired temperature. In this operation, the amount of electric power supplied to the heater 207

[0069] Next, the seal cap 219 is moved down by the boat elevator 115 to open the lower end of the outer tube 203. Then, the modified wafers 200 supported on the boat 217 are unloaded from the lower end of the outer tube 203 to the outside of the outer tube 203 (boat unloading). Thereafter, the modified wafers 200 are discharged from the boat 217 (wafer discharging).

B. Film-Forming Process (Selective Growth Step)

[0070] Next, the wafer 200 modified in the process furnace 202a is loaded into the process furnace 202b as the second process unit. Then, the interior of the process chamber 201b is adjusted in pressure and temperature to have a desired pressure and a desired temperature distribution, and the film-forming process is performed. This process differs from the process in the process furnace 202a described above only in the gas supply step. Therefore, only parts different from the process in the process furnace 202a described above will be described below, and the same parts will be omitted.

B-1: [First Step]

($TiCl_4$ Gas Supply)

[0071] The valve 324 is opened to allow a $TiCl_4$ gas, which is a precursor gas, to flow through the gas supply pipe 320. The flow rate of the $TiCl_4$ gas is adjusted by the MFC 322. The $TiCl_4$ gas is supplied from the gas supply hole 420a of the nozzle 420 into the process chamber 201b and is exhausted from the exhaust pipe 231. At this time, the $TiCl_4$ gas is supplied to the wafer 200. In parallel with this, the valve 524 is opened to allow an inert gas such as a N_2 gas to flow through the gas supply pipe 520. The flow rate of the N_2 gas flowing through the gas supply pipe 520 is adjusted by the MFC 522. The N_2 gas is supplied into the process chamber 201b together with the $TiCl_4$ gas and is exhausted from the exhaust pipe 231. At this time, the valve 534 is opened to allow a N_2 gas flows through the gas supply pipe 530, thus preventing the $TiCl_4$ gas from entering the nozzle 430,. The N_2 gas is supplied into the process chamber 201b

the N_2 gas controlled by the MFCs 522 and 532 may be set at a flow rate which falls within a range of, for example, 1 to 10 slm. The time, during which the NH_3 gas is supplied to the wafer 200, may be set at a time which falls within a range of, for example, 1 to 300 seconds. At this time, the temperature of the heater 207 may be set at the same temperature as that used at the $TiCl_4$ gas supply step.

[0082] The gases flowing through the process chamber 201b at this time are only the NH_3 gas and the N_2 gas. The NH_3 gas is substitution-reacted with at least a portion of the Ti-containing layer formed on the SiN layer of the wafer 200 at the first step described above. During the substitution reaction, Ti contained in the Ti-containing layer and N contained in the NH_3 gas are combined to form a TiN film containing Ti and N on the SiN layer on the wafer 200. That is, no TiN film is formed on the SiO_2 layer on the wafer 200.

B-4: [Fourth Step]

(Residual Gas Removal)

[0083] After the TiN film is formed, the valve 334 is closed to stop the supply of the NH_3 gas. Then, the unreacted NH_3 gas, the NH_3 gas contributed to the formation of the TiN film, or the reaction byproduct, which remains within the process chamber 201b, is removed from the interior of the process chamber 201b according to the same process procedures as those of the first step described above.

[0084] FIGS. 9A to 9C and FIG. 10A show a state in which halogen termination is formed on the SiO_2 layer and halogen termination is not formed on the SiN layer to form a TiN film. FIG. 9A is a model diagram showing a state of a surface of a wafer immediately after a $TiCl_4$ gas is supplied, FIG. 9B is a model diagram showing a state of the surface of the wafer after exposure with the $TiCl_4$ gas, and FIG. 9C is a model diagram showing a state of the surface of the wafer immediately after a NH_3 gas is supplied. FIG. 10A is a model diagram showing a state of the surface of the wafer after exposure with the NH_3 gas.

[0085] Referring to FIG. 10A, it can be seen that the surface of the SiO_2 layer on the wafer 200

incubation time by the modifying gas described above for the SiN film, the Si film, the metal film, and the metal oxide film is shorter than that for the SiO_2 film. By using this difference in the incubation time, a film is difficult to be formed on the SiO_2 film and can be selectively formed on other films.

[0096] That is, according to the present embodiment, it is possible to provide a technique capable of selectively forming a film on a substrate.

(4) Other Embodiments

[0097] In the aforementioned embodiments, there have been described the configurations in which the modification process and the film-forming process are performed in separate process chambers by using the cluster-type substrate processing apparatus 10 including the process chamber 201a in which the modification process is performed and the process chamber 201b in which the film-forming process is performed, but may be similarly applied to a configuration in which the modification process and the film-forming process are performed in the same process chamber 201 by using a substrate processing apparatus 300 including a modifying gas supply system and a deposition gas supply system in one process chamber 301, as illustrated in FIGS. 11 and 12. That is, the present disclosure may be similarly applied to a configuration in which substrate processing is performed in situ. In this case, the modification process and the film-forming process may be continuously performed. That is, the film-forming process may be continuously performed without unloading the wafer 200 to the outside of the process chamber after the modification process. Thus, the film-forming process can be further performed while maintaining the F termination formed on the surface of the SiO_2 layer, compared with the aforementioned embodiments.

[0098] As specific substrate processing, as the modification process, the wafer loading, and the pressure regulation and temperature adjustment are performed, the modifying gas supply step and the purge step are performed a predetermined number of times, and then the after-purge is performed. Thereafter, consecutively, as the film-forming process, the pressure regulation and

purge step during the exposure to the WF_6 gas and therefore the surface is modified, such that the incubation time became lengthened even at the same exposure amount.

(Example 4)

[0115] Next, a WF_6 gas is pulse-supplied (60 cycles) to a SiO_2 layer, a zirconium oxide (ZrO) layer, and a hafnium oxide (HfO) layer to form TiN films in the substrate processing described above by using the substrate processing apparatus 10 described above, and then a difference in film thicknesses of the formed TiN films will be described with reference to FIG. 15B.

[0116] As shown in FIG. 15B, it is confirmed that the incubation times of the TiN films formed on the ZrO layer and the HfO layer are shorter than the incubation time of the TiN film formed on the SiO_2 layer, even when the layers are exposed to the WF_6 gas. That is, it is confirmed that the incubation times on the ZrO layer and the HfO layer are shorter than the incubation time on the SiO_2 layer, and the TiN film can be preferentially formed on the ZrO layer and the HfO layer, as compared with the SiO_2 layer.

(Example 5)

[0117] Next, an effect of the modification process on a selectivity when a modification process is performed at 250 degrees C by using a ClF_3 gas as the modifying gas, and a film-forming process in which a SiN film is selectively grown on a SiN layer of a wafer having the SiN layer and a SiO_2 layer formed thereon at 500 degrees C is performed in the substrate processing described above by using the substrate processing apparatus 10 described above will be explained with reference to FIGS. 16A to 16C. FIG. 16A is a comparative example and is a diagram showing a film thickness of the SiN film selectively grown on each of the SiN layer and the SiO_2 layer when the film-forming process is performed without performing the modification process. In Fig. 16A, a case where the film-forming process is performed for 150 cycles and a case where the film-forming process is performed for 300 cycles are plotted. FIG. 16B is a diagram showing a film thickness of the SiN film selectively grown on each of the SiN layer and

WHAT IS CLAIMED IS:

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

modifying a first surface of a substrate by supplying a modifying gas containing an inorganic ligand to the substrate including the first surface and a second surface different from the first surface; and

selectively growing a film on the second surface by supplying a deposition gas to the substrate.

2. The method according to Claim 1, wherein the modifying gas is a first halide.

3. The method according to Claim 2, wherein the first halide is a fluorine-containing gas.

4. The method according to Claim 1, wherein the deposition gas includes a precursor gas and a reaction gas reacting with the precursor gas, and

wherein, in the act of selectively growing the film on the second surface, the precursor gas and the reaction gas are alternately supplied so that the precursor gas and the reaction gas are not mixed with each other.

5. The method according to Claim 2, wherein the deposition gas includes a precursor gas and a reaction gas reacting with the precursor gas, and

wherein, in the act of selectively growing the film on the second surface, the precursor gas and the reaction gas are alternately supplied so that the precursor gas and the reaction gas are not mixed with each other.

6. The method according to Claim 3, wherein the deposition gas includes a precursor gas and a reaction gas reacting with the precursor gas, and

wherein, in the act of selectively growing the film on the second surface, the precursor gas and the reaction gas are alternately supplied so that the precursor gas and the reaction gas are not mixed with each other.

7. The method according to Claim 4, wherein the precursor gas is a second halide.

8. The method according to Claim 5, wherein the precursor gas is a second halide.

9. The method according to Claim 6, wherein the precursor gas is a second halide.

10. The method according to Claim 7, wherein the second halide is a chlorine-containing gas.

11. The method according to Claim 4, wherein the modifying gas and the precursor gas each have a ligand which is electrically negative.

12. The method according to Claim 1, wherein the act of selectively growing the film on the second surface is performed while heating the substrate at 500 degrees C or higher.

13. The method according to Claim 1, wherein the act of modifying the first surface is performed while heating the substrate at 300 degrees C or lower.

14. The method according to Claim 12, wherein the act of modifying the first surface is performed while heating the substrate at 300 degrees C or lower.

15. The method according to Claim 1, wherein the first surface is a silicon oxide layer.

16. A substrate processing apparatus, comprising:

a first process chamber configured to accommodate a substrate including a first surface and a second surface different from the first surface;

a first gas supply system configured to supply a modifying gas containing an inorganic ligand to the first process chamber;

a second process chamber configured to accommodate the substrate;

a second gas supply system configured to supply a deposition gas to the second process chamber;

a transfer system configured to load and unload the substrate into and from the first process chamber and the second process chamber; and

a controller configured to control the first gas supply system, the second gas supply system, and the transfer system to perform a process, the process comprising:

loading the substrate into the first process chamber;

modifying the first surface by supplying the modifying gas to the first process chamber;

unloading the substrate from the first process chamber;

loading the substrate into the second process chamber;

selectively growing a film on the second surface by supplying the deposition gas to the second process chamber; and

unloading the substrate from the second process chamber.

17. A substrate processing apparatus, comprising:

a process chamber configured to accommodate a substrate;

a first gas supply system configured to supply a modifying gas containing an inorganic ligand to the process chamber;

a second gas supply system configured to supply a deposition gas to the process chamber; and

a controller configured to be capable of controlling the first gas supply system and the second gas supply system to perform a process comprising:

modifying a first surface of the substrate by supplying the modifying gas to the process chamber accommodating the substrate including the first surface and a second surface different from the first surface; and

selectively growing a film on the second surface by supplying the deposition gas to the process chamber.

18. A computer-readable recording medium recording a program that causes, by a computer, a substrate processing apparatus to perform a process comprising:

loading a substrate including a first surface and a second surface different from the first surface into a first process chamber of the substrate processing apparatus;

modifying the first surface by supplying a modifying gas containing an inorganic ligand to the substrate;

unloading the substrate from the first process chamber;

loading the substrate into a second process chamber of the substrate processing apparatus; and

selectively growing a film on the second surface by supplying a deposition gas to the substrate.

19. A computer-readable recording medium recording a program that causes, by a computer, a substrate processing apparatus to perform a process, the process comprising:

modifying a first surface of a substrate by supplying a modifying gas containing an inorganic ligand to the substrate accommodated in a process chamber of the substrate processing apparatus, the substrate including the first surface and a second surface different from the first surface; and

selectively growing a film on the second surface by supplying a deposition gas to the

substrate.