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

Abstract

A technique includes: (a) a first process chamber in which processing of causing a temperature of a substrate to be a first temperature is performed; (b) a second process chamber whereby processing of causing a temperature of the substrate to be a second temperature higher than the first temperature is performed; (c) a transfer chamber formed in communication with the first process chamber and the second process chamber and including a transfer mechanism configured to transfer the substrate; (d) a temperature control mechanism configured to perform temperature control on a predetermined target in the transfer chamber; and (e) a controller capable of controlling the transfer mechanism and the temperature control mechanism to perform control with contents of transfer of the substrate between the first process chamber and the second process chamber and control with contents of the temperature control in accordance with the contents of transfer to be performed.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION
[0001] This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2024-020704, filed on Feb. 14, 2024, the entire contents of which are incorporated herein by reference.
FIELD OF THE INVENTION
[0002] The present disclosure relates to a substrate processing apparatus, a method of processing a substrate, a method of manufacturing a semiconductor device, and a recording medium.
DESCRIPTION OF THE RELATED ART
[0003] As one process among substrate processing processes (processes of manufacturing semiconductor devices), there may be a case where a substrate processing apparatus including a plurality of process chambers and a transfer chamber communicating with the process chambers is used to process a substrate.
SUMMARY OF THE INVENTION
[0004] Some embodiments of the present disclosure provide a technique capable of reducing energy excessively consumed by a substrate processing apparatus.
[0005] According to an aspect of the present disclosure, a technique is provided, including: [0006] a first process chamber in which processing of causing a temperature of a substrate to be a first temperature is performed; [0007] a second process chamber in which processing of causing a temperature of the substrate to be a second temperature higher than the first temperature is performed; [0008] a transfer chamber formed to be communicable with the first process chamber and the second process chamber and including a transfer mechanism configured to transfer the substrate; [0009] a temperature control mechanism configured to perform temperature control on a predetermined target in the transfer chamber; and [0010] a controller capable of controlling the transfer mechanism and the temperature control mechanism to perform control with contents of transfer of the substrate between the first process chamber and the second process chamber in the transfer chamber and control with contents of the temperature control in accordance with the contents of transfer to be performed.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0011] FIG. **1** is a transverse cross-sectional view illustrating a configuration example of a substrate processing apparatus according to an embodiment.
[0012] FIG. **2** is a vertical cross-sectional view taken along line α-α′ of the substrate processing apparatus illustrated in FIG. **1**.
[0013] FIG. **3** is a schematic configuration view of a chamber according to the embodiment.
[0014] FIG. **4** is a schematic configuration view of a gas supplier according to the embodiment.
[0015] FIG. **5** is a schematic configuration view of a controller illustrated in FIG. **1**.
[0016] FIG. **6** is a flowchart of a substrate processing process in the substrate processing apparatus

illustrated in FIG. **1**.

[0017] FIG. **7** is a view for describing an output of temperature control.

DETAILED DESCRIPTION

[0018] An aspect of the present disclosure will be described below mainly with reference to FIGS. **1** to **7**. Note that the drawings used in below description are all schematic and thus, for example, the dimensional relationship between each constituent element and the ratio between each constituent element illustrated in the drawings do not necessarily coincide with realities. In addition, dimensional relationships between elements, ratios between elements, and the like do not necessarily coincide with each other between a plurality of drawings.

(1) Configuration of Substrate Processing Apparatus

[0019] A schematic configuration of a substrate processing apparatus according to an embodiment will now be described herein with reference to FIGS. **1** and **2**.

[0020] A substrate processing apparatus **10** processes wafers **200**, and mainly includes an input-and-output (IO) stage **110**, an atmospheric transfer chamber **120**, a load lock chamber **130**, a transfer chamber (transfer module or TM) **140**, and process modules (PMs) **100**. Next, each configuration will be specifically described. In below description, in FIG. **1**, an X1 direction may be referred to as right, an X2 direction may be referred to as left, a Y1 direction may be referred to as front, and a Y2 direction may be referred to as back.

(Atmospheric Transfer Chamber and IO Stage)

[0021] As illustrated in FIG. **1**, the IO stage (load port) **110** is installed on a front side of the substrate processing apparatus **10**. A plurality of pods **111** are equipped on the IO stage **110**. The pods **111** are used as carriers for transferring the wafers **200** such as silicon (Si) substrates. In the pods **111**, a plurality of the wafers **200** that are not processed and the wafers **200** that are processed are stored each in a horizontal posture.

[0022] Each of the pods **111** is provided with a cap **112**, and is opened and closed by a pod opener **121**. The pod opener **121** opens and closes the cap **112** of each of the pods **111** mounted on the IO stage **110**, and opens and closes a substrate loading-and-unloading port of each of the pods **111**. Each of the pods **111** is supplied to and discharged from the IO stage **110** by a non-illustrated in-process transfer device (rail guided vehicle (RGV)).

[0023] The IO stage **110** is adjacent to the atmospheric transfer chamber **120**. The load lock chamber **130** described later is coupled to the atmospheric transfer chamber **120** on a surface different from a surface for the IO stage **110**.

[0024] An atmospheric transfer robot **122** serving as a first transfer robot configured to transfer each of the wafers **200** is installed in the atmospheric transfer chamber **120**. In addition, a device (hereinafter referred to as a pre-aligner) **126** configured to perform alignment of a notch or an orientation flat formed on each of the wafers **200** is installed on a left side of the atmospheric transfer chamber **120**.

[0025] Loading-and-unloading ports **128** and the pod openers **121** are installed on a front side of a housing **127** of the atmospheric transfer chamber **120**. The wafers **200** are transferred between the pods **111** and the atmospheric transfer chamber **120** via the loading-and-unloading ports **128**.

[0026] A loading-and-unloading port **129** for loading and unloading the wafers **200** into and from the load lock chamber **130** is provided on a rear side of the housing **127** of the atmospheric transfer chamber **120**. The loading-and-unloading port **129** is opened and closed by a gate valve (GV) **133**. The wafers **200** are transferred between the atmospheric transfer chamber **120** and the load lock chamber **130** via the loading-and-unloading port **129**.

(Load Lock Chamber)

[0027] The load lock chamber **130** is adjacent to the atmospheric transfer chamber **120**. As described later, the transfer chamber **140** is disposed on a surface different from a surface for the atmospheric transfer chamber **120** among surfaces of a housing **131** forming the load lock chamber **130**.

[0028] A loading-and-unloading port **134** is provided on a side, which is adjacent to the transfer chamber **140**, of the housing **131**. The loading-and-unloading port **134** is opened and closed by a GV **135**. The wafers **200** are transferred between the atmospheric transfer chamber **120** and the transfer chamber **140** via the loading-and-unloading port **134**.

[0029] Furthermore, supports **131***a*, **131***b* on which the wafers **200** are to be placed are installed in the load lock chamber **130**.

[0030] In addition, an inert gas supplier that supplies an inert gas serving as a cooling gas into the load lock chamber **130** and exhaust system **601**, **602** configured to exhaust atmosphere air in the load lock chamber **130** are provided. The inert gas supplier includes gas supply pipes **501***a*, **502***a*, valves **501***b*, **502***b*, and mass flow controllers (MFCs) **501***c*, **502***c* serving as flow rate control devices (flow rate controllers), and is configured to be able to adjust a flow rate of the cooling gas to be supplied into the load lock chamber **130**. The load lock chamber **130** also serves as a process chamber for performing processing of performing temperature control (cooling) of the wafers **200** to a predetermined temperature.

(Transfer Chamber)

[0031] The substrate processing apparatus **10** includes the transfer chamber **140** serving as a transfer space in which each of the wafers **200** is to be transferred. A depressurized state or a vacuum state may be maintained inside the transfer chamber **140**. A housing **141** forming the transfer chamber **140** is formed into a pentagonal shape in plan view, and the load lock chamber **130** and PMs **100***a* to **100***d* in which each of the wafers **200** is to be processed are coupled to respective sides of the pentagonal shape. As illustrated in FIG. **2**, a transfer robot **170** serving as a transfer mechanism configured to transfer (convey) each of the wafers **200** is installed at a substantially center of the transfer chamber **140** via a flange **143** serving as a base. Note that, although an example in which the transfer chamber **140** has a pentagonal shape is illustrated in here, the transfer chamber may have a polygonal shape such as a quadrangle shape or a hexagonal shape. The transfer chamber **140** is provided with a heat transfer gas supplier **150**, a gas exhaust system **160**, and a heat medium supplier, which serve as an example of a temperature control mechanism **310** configured to perform temperature control on a predetermined target in the transfer chamber **140**.

[0032] As illustrated in FIG. **2**, the transfer robot **170** installed in the transfer chamber **140** is configured to be lifted and lowered while maintaining airtightness of the TM **140** by an elevator **145** and the flange **143**. The elevator **145** is configured to independently lift and lower two arms **180** and **190** that the transfer robot **170** includes. In addition, each of the two arms **180** and **190** is provided with each of tweezers **181**, **182**, **191**, **192**, and is configured to be able to simultaneously transfer two of the wafers **200** by one arm.

[0033] The housing **141** is provided with a heat transfer gas supply hole **146** for supplying a heat transfer gas into the housing **141**. The heat transfer gas supply hole **146** is provided with a heat transfer gas supply pipe **151**. The heat transfer gas supply pipe **151** is provided with, in order from upstream, a heat transfer gas source **152**, a mass flow controller (MFC) **153**, and a valve **154** for controlling a supply amount of the heat transfer gas to be supplied into the housing **141**.

[0034] The heat transfer gas supplier **150** in the transfer chamber **140** mainly includes the heat transfer gas supply pipe **151**, the MFC **153**, and the valve **154**. Note that the heat transfer gas supplier **150** may include the heat transfer gas source **152** and the heat transfer gas supply hole **146**.

[0035] The housing **141** is provided with an exhaust hole **147** for exhausting atmosphere air in the housing **141**. The exhaust hole **147** is provided with an exhaust pipe **161**. The exhaust pipe **161** is provided with, in order from upstream, a pressure sensor **164** serving as a pressure detector configured to detect pressure in the transfer chamber **140**, an auto-pressure controller (APC) **162** serving as a pressure control device, and a vacuum pump **163**.

[0036] The exhaust pipe **161** and the APC **162** mainly form the gas exhaust system **160** in the transfer chamber **140**. Note that the exhaust system **160** may include the pressure sensor **164**, the vacuum pump **163**, and the exhaust hole **147**.

[0037] At least one of the heat transfer gas supplier **150** and the gas exhaust system **160** controls the pressure in the transfer chamber **140**. Note that at least one of the heat transfer gas supplier **150** and the gas exhaust system **160** may control the pressure in the transfer chamber **140** based on measurement data by the pressure sensor **164**.

[0038] As illustrated in FIG. **1**, the PMs **100***a*, **100***b*, **100***c*, **100***d* configured to perform desired processing on the wafers **200** are coupled to sides where the load lock chamber **130** is not installed among five side walls of the housing **141**. One or more of the PMs **100***a*, **100***b*, **100***c*, **100***d* may be hereinafter referred to as the PMs **100**.

[0039] The PMs **100***a*, **100***b*, **100***c*, **100***d* are respectively provided with chambers **101** serving as a configuration of the substrate processing apparatus. Note herein that the chambers **101** are one or more of chambers **101***a* to **101***h*. Specifically, the PM **100***a* is provided with the chambers **101***a*, **101***b*. The PM **100***b* is provided with the chambers **101***c*, **101***d*. The PM **100***c* is provided with the chambers **101***e*, **101***f*. The PM **100***d* is provided with the chambers **101***g*, **101***h*.

[0040] Loading-and-unloading ports **148** are provided on the walls facing the chambers **101**, respectively, among the side walls of the housing **141**. Note herein that the loading-and-unloading ports **148** are one or more of loading-and-unloading ports **148***a* to **148***h*. For example, as illustrated in FIG. **2**, the loading-and-unloading port **148***a* is provided on one of the side walls of the housing **141**, which faces the chamber **101***a*. Similarly, the loading-and-unloading ports **148***b* to **148***h* are provided on the side walls of the housing **141**, which face the chambers **101***b* to **101***h*, respectively.

[0041] GVs **149***a* to **149***h* are provided for the chambers **101**, respectively. Specifically, the GV **149***a* is provided between the chamber **101***a* and the TM **140**. Similarly, the GVs **149***b* to **149***h* are provided between the chambers **101***b* to **101***h* and the TM**140**, respectively. One or more of the GVs **149***a* to **149***h* may be referred to as the GVs **149**.

[0042] The loading-and-unloading ports **148***a* to **148***h* are opened and closed by the GVs **149**, respectively. The wafers **200** are transferred between the transfer chamber **140** and the chambers **101** through the loading-and-unloading ports **148**. That is, the transfer chamber **140** is formed to be communicable with the chambers **101***a* to **101***h*.

[0043] In addition, temperature sensors (temperature measurers) **701***a*, **701***b*, **701***c*, **701***d*, **701***e*, **701***f*, **701***g*, **701***h*, **701***i*, **701***j* configured to measure temperatures of the wafers **200** may be provided in the transfer chamber **140** and in front of the GVs **135**, **149**, respectively. The temperature sensors are, for example, radiation thermometers. As the temperature sensors are provided, it is possible to measure the temperatures of the wafers **200** being transferred. The temperature sensors **701***a* to **701***j* are, when not distinguished from each other, collectively referred to as the temperature sensors **701**.

[0044] Next, the chambers **101***a* to **101***h* will now be described herein with reference to FIGS. **3** and **4**. Since the chambers **101***a* to **101***h* have similar or identical configurations to each other, each of the chambers will be hereinafter described as one chamber **101**. Each of the chambers **101** is formed to be able to perform a plurality of types of processing. Details will be described below.

[0045] The chamber **101** includes a container **202**. The container **202** is configured as, for example, a hermetically sealed flat container having a circular transverse cross section. In addition, the container **202** includes, for example, a metal material such as aluminum (Al) or stainless steel (SUS). The container **202** is formed with a process chamber **201** forming a process space for processing the wafer **200** and a transfer chamber **206** including a transfer space through which the wafer **200** passes when the wafer **200** is to be transferred into the process chamber **201**. The container **202** includes an upper container **202***a* and a lower container **202***b*. A partition **208** is provided between the upper container **202***a* and the lower container **202***b*.

[0046] The loading-and-unloading port **148** adjacent to the GV **149** is provided on a side surface of the lower container **202***b*, and the wafer **200** moves between the container and the transfer chamber **140** via the loading-and-unloading port **148**. At a bottom of the lower container **202***b*, a plurality of

lift pins **207** are provided.
[0047] In the process chamber **201**, a substrate support **210** configured to support the wafer **200** is disposed. The substrate support **210** mainly includes a substrate mounting surface **211** on which the wafer **200** is to be mounted, a substrate mounting table **212** including the substrate mounting surface **211** on its surface, and a heater **213** provided in the substrate mounting table **212**. In the substrate mounting table **212**, through-holes **214** through which the lift pins **207** pass are provided at positions corresponding to the lift pins **207**, respectively. In addition, the substrate mounting table **212** may be provided with a bias electrode **276** configured to apply a bias to the wafer **200** and the process chamber **201**.
[0048] Wiring **222** for supplying electric power is coupled to the heater **213**. The wiring **222** is coupled to a heater controller **223**. The heater controller **223** is electrically coupled to a controller **280**. The controller **280** is configured to control the heater controller **223** to allow the heater **213** to operate. In addition, the bias electrode **276** is coupled to a bias adjuster **277**, and it is configured that the bias is adjustable by the bias adjuster **277**.
[0049] The substrate mounting table **212** is supported by a shaft **217**. The shaft **217** passes through a bottom of the container **202** and is further coupled to a lifter **218** outside the container **202**. As the lifter **218** is caused to operate to lift and lower the shaft **217** and the substrate mounting table **212**, the substrate mounting table **212** is able to lift and lower the wafer **200** mounted on the substrate mounting surface **211**.
[0050] The process chamber **201** includes, for example, a buffer structure **230** described later and the substrate mounting table **212**. Note that it is sufficient that the process chamber **201** be only able to secure the process space for processing the wafer **200**, and may be formed based on another structure.
[0051] When the wafer **200** is to be transferred, the substrate mounting surface **211** of the substrate mounting table **212** lowers to a transfer position P**0** facing the loading-and-unloading port **148**, and, when the wafer **200** is to be processed, the wafer **200** is lifted to a process position in the process chamber **201**, as illustrated in FIG. **3**.
[0052] The buffer structure **230** for allowing a gas to be diffused is provided to an upper portion (upstream side) of the process chamber **201**. The buffer structure **230** mainly includes a lid **231**. A first gas supplier **240**, a second gas supplier **250**, and a third gas supplier **260**, which will be described later, are coupled to a gas introduction hole **231***a* provided in the lid **231**. In accordance with processing performed in each of the process chambers **201**, coupling between a part of a gas supply system and the gas introduction hole **231***a* may be omitted, and an additional gas supplier may be further coupled to the gas introduction hole **231***a*. Although the gas introduction hole **231***a* illustrated in FIG. **3** is only one, a gas introduction hole may be provided for each of the gas suppliers.
[0053] Next, an exhaust system **291** will now be described herein. An exhaust pipe **292** communicates with the process chamber **201**. The exhaust pipe **292** is coupled to the upper container **202***a* to communicate with the process chamber **201**. The exhaust pipe **292** is provided with, in order from upstream, a pressure sensor **296** serving as a pressure detector configured to detect pressure in the process chamber **201** and an APC **293** serving as a pressure control device configured to control the pressure in the process chamber **201** to predetermined pressure based on data of the pressure sensor **296**. The APC **293** including a valve body (not illustrated) in which its degree of opening is adjustable regulates conductance of the exhaust pipe **292** in accordance with an instruction from the controller **280**. In addition, a valve **294** is provided on an upstream side of the APC **293** in the exhaust pipe **292**. The exhaust pipe **292**, the valve **294**, and the APC **293** are collectively referred to as the exhaust system.
[0054] Furthermore, a vacuum pump **295** is provided downstream of the exhaust pipe **292**. The vacuum pump **295** exhausts atmosphere air in the process chamber **201** via the exhaust pipe **292**.
[0055] A matcher **271** and a high frequency power source **272** are configured and coupled to an

electrode **275** serving as an activator (plasma generator), making it possible to supply an electromagnetic wave (high frequency electric power or a microwave). As a result, it is possible to activate a gas supplied into the process chamber **201**. In addition, the electrode **275** is configured to be able to generate capacitive coupling type plasma. Specifically, the electrode **275** is formed in a plate shape to have electric conductivity, and is configured to be supported by the upper container **202***a*. The activator includes at least the electrode **275**, the matcher **271**, and the high frequency power source **272**. Note that the activator may include an impedance meter **274**. Note that the impedance meter **274** may be provided between the electrode **275** and the high frequency power source **272**. Providing the impedance meter **274** makes it possible to perform feedback control for the matcher **271** and the high frequency power source **272** based on measured impedance.

[0056] Next, the gas supplier configured to supply a gas into the process chamber **201** will now be described herein with reference to FIG. **4**.

[0057] A first gas supply pipe **241** is provided with, in order in an upstream direction, a first gas source **242** configured to supply a first gas, an MFC **243**, and a valve **244** that is an opening-and-closing valve. The first gas is an example of a process gas in the present disclosure. The first gas supply pipe **241**, the MFC **243**, and the valve **244** mainly form the first gas supplier **240**. The first gas supplier **240** may include the first gas source **242** and the gas introduction hole **231***a*.

[0058] A second gas supply pipe **251** is provided with, in order in the upstream direction, a second gas source **252** configured to supply a second gas, an MFC **253**, and a valve **254** that is an opening-and-closing valve. The second gas is an example of a process gas in the present disclosure. The second gas supply pipe **251** may be provided with a remote plasma unit (RPU) **255**. The RPU **255** brings the second gas passing through the second gas supply pipe **251** into a plasma state. The second gas supply pipe **251**, the MFC **253**, and the valve **254** mainly form the second gas supplier **250**. The second gas supplier **250** may include the RPU **255**. In addition, the second gas supplier **250** may include the second gas source **252** and the gas introduction hole **231***a*.

[0059] A third gas supply pipe **261** is provided with, in order in the upstream direction, a third gas source **262** configured to supply a third gas, an MFC **263**, and a valve **264** that is an opening-and-closing valve. The third gas is, for example, an inert gas. The third gas may be a purge gas used to perform purging inside the process chamber **201**. The third gas supply pipe **261**, the MFC **263**, and the valve **264** mainly form the third gas supplier **260**. The third gas supplier **260** may include the third gas source **262** and the gas introduction hole **231***a*.

(Controller)

[0060] The substrate processing apparatus **10** illustrated in FIG. **1** includes the controller **280** configured to control operation of each component of the substrate processing apparatus **10**. Next, the controller **280** will be described herein with reference to FIG. **5**.

[0061] The controller **280** is configured to serve as a computer including a central processing unit (CPU) **280***a*, a random access memory (RAM) **280***b*, a memory **280***c*, and an input-and-output (I/O) port **280***d*. The RAM **280***b*, the memory **280***c*, and the I/O port **280***d* are configured to be able to exchange data with the CPU **280***a* via an internal bus **280***e*. An input-and-output device **282** formed as a touch panel and an external memory **281** are, for example, formed to be able to be coupled to the controller **280**.

[0062] The memory **280***c* includes, for example, a flash memory and a hard disk drive (HDD). The memory **280***c* stores, in a readable manner, for example, a control program for controlling operation of the substrate processing apparatus, a process recipe describing procedures and conditions for substrate processing described later, and calculation data and processing data generated until a process recipe used for performing processing on the wafer **200** is set. Note that a process recipe is a combination of those causing the controller **280** to execute each step in a substrate processing process described later to acquire a certain result, and functions as a program. Hereinafter, for example, the process recipe, the control program, and the like will also be collectively and simply referred to as a program. Note that, in the present specification, the term "program" may include only a process recipe alone, only a control program alone, or both of them. In addition, the RAM **280***b* is configured to serve as a memory region (work area) in which a program, calculation data, and processing data, for example, read by the CPU **280***a* are temporarily stored.

[0063] The I/O port **280***d* is coupled to, for example, the GVs **133**, **135**, **149**, the heater controller **223**, the APCs **162**, **293**, the vacuum pumps **163**, **295**, the pressure sensors **164**, **296**, the matcher **271**, the high frequency power source **272**, the MFCs **153**, **243**, **253**, **263**, **501***c*, **502***c*, the valves **154**, **244**, **254**, **264**, **294**, **501***b*, **502***b*, the RPU **255**, the bias adjuster **277**, the transfer robot **170**, and a chiller **803**. In addition, for example, it may also be coupled to the impedance meter **274**.

[0064] The CPU **280***a* serving as a calculator is configured to read and execute a control program from the memory **280***c*, and to read a process recipe from the memory **280***c* in response to input of an operation command from the input-and-output device **282**, for example. Then, the CPU **280***a* is configured to control, in accordance with contents of the read process recipe, for example, opening-and-closing operation of the GVs **149**, operation of the heater controller **223**, pressure adjustment operation of the APCs **162**, **293** based on the pressure sensors **164**, **296**, on-and-off control of the vacuum pumps **163**, **295**, gas flow rate control operation using the MFCs **153**, **243**, **253**, **263**, **501***c*, **502***c*, gas activation operation of the RPU **255**, gas on-and-off control using the valves **154**, **244**, **254**, **264**, **294**, **501***b*, **502***b*, matching operation of electric power of the matcher **271**, electric power control of the high frequency power source **272**, control operation of the bias adjuster **277**, matching operation of the matcher **271** based on measurement data measured by the impedance meter **274**, electric power control operation of the high frequency power source **272**, and transfer operation of the transfer robot **170**. When each component is to be controlled, the CPU **280***a* performs control by transmitting and receiving control information in accordance with the contents of the process recipe.

[0065] Note that the controller **280** is not limited to be configured as a dedicated computer, and may be configured as a general-purpose computer. For example, preparing the external memory (e.g., a magnetic tape, a magnetic disk, such as a flexible disk or hard disk, an optical disc, such as a compact disc (CD) or digital versatile disc (DVD), a magneto-optical disc called MO, or a semiconductor memory, such as a universal serial bus (USB) memory or memory card) **281** storing the program described above and then using the external memory **281** to install the program on a general-purpose computer make it possible to achieve the controller **280** according to the present embodiment. Note that the memory **280***c* and the external memory **281** are configured to each serve as a computer-readable recording medium. Hereinafter, these will also be collectively and simply referred to as a recording medium. Note that, in the present specification, the term "recording medium" may include only the memory **280***c* alone, only the external memory **281** alone, or both of the memories.

(2) Process of Manufacturing Semiconductor Device

[0066] Next, as one process among processes of manufacturing semiconductor devices, an example of processing of the wafer **200** using a plurality of chambers in which processing temperatures differ from each other will be described herein with reference to FIG. **6**. Note that one process among the manufacturing processes is performed in the substrate processing apparatus **10** described above. Note that, the controller **280** controls operation of each component to perform processes in below description.

[0067] The term "wafer" used in the present specification may mean the wafer itself, or a laminate of the wafer and a predetermined layer or film formed on the surface the wafer. The term "surface of the wafer" used in the present specification may mean the surface of the wafer itself or the surface of a predetermined layer and the like formed on the wafer. The term "forming a predetermined layer on the wafer" in the present specification may mean that a predetermined layer is directly formed on the surface of the wafer itself or that a predetermined layer is formed on a layer and the like formed on the wafer. In a case where the term "substrate" is used in this

specification, this is a synonym of the term “wafer”.
[0068] In the present disclosure, “causing a substrate in a certain process chamber A to move to another process chamber B” means “causing a substrate to be transferred from the process chamber A to the process chamber B”. In addition, when the process chamber A and the process chamber B are not specified, “transferring of a substrate from the process chamber A to the process chamber B” may be simply referred to as “transferring of the substrate” or “transferring”. In below description, a point in time at which the transfer mechanism supports a substrate in the process chamber A is referred to as “start of transfer” and a point in time at which the transfer mechanism places the substrate in the process chamber B is referred to as “end of transfer”. Note that a period of time during transfer (that is, a period of time from the start of transfer to the end of transfer) may include a period of time during which the substrate is not moved. In addition, a period of time during transfer may include a period of time during which the transfer mechanism does not support a substrate. In addition, a substrate may be transferred by a plurality of transfer mechanisms.
[0069] An example of the substrate processing process using the PM **100***a* and the PM **100***b* will now be described herein. Note herein that an example will now be described herein, in which processing of causing a temperature of the wafer **200** to be a first temperature is performed in each of the process chambers **201** in the chambers **101***a*, **101***b* of the PM **100***a* serving as a first process chamber and processing of causing a temperature of the wafer **200** to be a second temperature higher than the first temperature is performed in each of the process chambers **201** in the chambers **101***c*, **101***d* of the PM **100***b* serving as a second process chamber.
(Transfer Step S**301**)
[0070] In transfer step S**301**, the atmospheric transfer robot **122** picks up and loads the wafer **200** in the pod **111** on the IO stage **110** into the load lock chamber **130**, and places the wafer **200** on the support **131***a*, **131***b*. After that, purging in the load lock chamber **130** is performed using the inert gas supplier and the exhaust system **601**, **602** to allow pressure in the load lock chamber **130** to reach substantially identical pressure to pressure in the transfer chamber **140**. Next, the transfer robot **170** uses the arm **180** or **190** to load the wafer **200** from the load lock chamber **130** into the transfer chamber **140**. Next, the transfer robot **170** loads (transfers) the wafer **200** held by the arm **180** or **190** from the transfer chamber **140** into the process chamber **201** of the PM **100***a*.
(Processing Step (Step A) S**302**)
[0071] In processing step S**302**, processing involving at least one of a chemical reaction, supply of a gas activated by plasma, and adsorption (chemical adsorption and/or physical adsorption) of a process gas other than an inert gas is performed on at least a part of the wafer **200**.
[0072] For example, in step A in processing step S**303**, in a state where the wafer **200** is heated to the first temperature (the temperature of wafer **200** is caused to the first temperature) in accordance with a process recipe, the first gas supplier **240** and the third gas supplier **260** in the PM **100***a* are controlled to supply the first gas and the third gas to the process chamber **201**. In addition, the exhaust system **291** is controlled to allow air in the process chamber **201** to be exhausted. Thus, the processing is performed on the wafer **200**.
(Transfer Step (First Transfer) S**303**)
[0073] After the wafer **200** has undergone the predetermined processing, the transfer robot **170** uses the arm **180** or **190** to bring out the wafer **200** from the process chamber **201** of the PM **100***a* into the transfer chamber **140**. Next, the transfer robot **170** loads (transfers) the wafer **200** held by the arm **180** or **190** from the transfer chamber **140** into the process chamber **201** of the PM **100***b*. Note herein that transferring of the wafer **200** from the process chamber **201** of the PM **100***a* into the process chamber **201** of the PM **100***b* is referred to as first transfer.
[0074] During the transfer, the temperature control mechanism **310** performs temperature control (referred in here as first temperature control **311**) on a predetermined target in accordance with contents of the transfer (referred in here as contents of the first transfer). The first temperature control **311** will be described later. The predetermined target is, for example, at least one of the

wafer **200**, a gas in the transfer chamber **140**, and an object (for example, the arms **180**, **190** of the transfer robot **170**) in the transfer chamber **140**.

(Processing Step (Step B) S**304**)

[0075] In processing step S**304**, processing involving at least one of a chemical reaction, supply of a gas activated by plasma, and adsorption (chemical adsorption and/or physical adsorption) of a process gas other than an inert gas is performed on at least a part of the wafer **200**.

[0076] For example, in step B in processing step S**304**, in a state where the wafer **200** is heated to the second temperature (the temperature of wafer **200** is caused to the second temperature) in accordance with a process recipe, the second gas supplier **250** and the third gas supplier **260** in the PM **100***b* are controlled to supply the second gas and the third gas to the process chamber **201**. In addition, the exhaust system **291** is controlled to allow air in the process chamber **201** to be exhausted. In addition, the RPU **255** may be used or high frequency electric power may be supplied to the bias electrode **276** to supply a gas in a plasma state into the process chamber **201**. Thus, the processing is performed on the wafer **200**.

(Determination S**305**)

[0077] In here, it is determined whether or not the processing of step A and step B has been performed on the wafer **200** a predetermined number of times. When it is determined that the processing has not yet been performed the predetermined number of times, transfer step S**306** is performed. When it is determined that the processing has been performed the predetermined number of times, transfer step S**307** is performed.

(Transfer Step (Second Transfer) S**306**)

[0078] After the wafer **200** has undergone the predetermined processing in the process chamber **201** of the PM **100***b*, the transfer robot **170** uses the arm **180** or **190** to bring out the wafer **200** from the process chamber **201** of the PM **100***b* into the transfer chamber **140**. Next, the transfer robot **170** loads (transfers) the wafer **200** held by the arm **180** or **190** from the transfer chamber **140** into the process chamber **201** of the PM **100***a*. Note herein that transferring of the wafer **200** from the process chamber **201** of the PM **100***b* to the process chamber **201** of the PM **100***a* is referred to as second transfer.

[0079] During the transfer, the temperature control mechanism **310** performs temperature control (referred in here as second temperature control **312**) on a predetermined target in accordance with contents of the transfer (referred in here as contents of the second transfer). The second temperature control **312** will be described later.

(Transfer Step S**307**)

[0080] As the processing in the plurality of chambers ends, the transfer robot **170** uses the arm **180** or **190** to transfer the processed wafer **200** unloaded from the PM **100***b* into the load lock chamber **130**, allowing the wafer **200** to be transferred to the support **131***a*, **131***b* in the load lock chamber **130**. After that, the inert gas supplier and the exhaust system **601**, **602** allow pressure in the load lock chamber **130** to reach substantially identical pressure to atmospheric pressure. At this time, an inert gas supplied into the load lock chamber **130** may cool the wafer **200**. Next, the atmospheric transfer robot **122** picks up the wafer **200** from the support **131***a*, **131***b* in the load lock chamber **130**, unloads the wafer into the atmospheric transfer chamber **120**, and, further, stores the wafer in the pod **111**.

[0081] Next, a relationship between temperature control and transfer will now be described herein with reference to FIG. **7**. FIG. **7** schematically illustrates transition of an output of temperature control when periods of time during which there is transfer in progress and periods of time during which there is no transfer in progress alternately appear. Note herein that contents of transfer in the present disclosure include presence or absence of transfer in progress. In addition, in the present disclosure, energy required for operation of the temperature control mechanism **310** in controlling of the temperature of a predetermined target may be referred to as an output of temperature control. That is, as an output of temperature control increases, energy to be consumed by the temperature control mechanism **310** increases, allowing the temperature of the predetermined target to easily change. In addition, an increase in energy to be consumed refers to, for example, an increase in consumption of electric power by the temperature control mechanism **310** and an increase in an amount of a substance to be consumed in accordance with each temperature control.

[0082] A period of time during which there is transfer in progress refers to a period of time P**1** during which at least one of the arms **180** and **190** holds the wafer **200**, and a period of time P**0** during which there is no transfer in progress refers to a period of time during which neither of the arms **180** and **190** holds the wafer **200**. In addition to the period of time P**1** of the first transfer and a period of time P**2** of the second transfer, the periods of time during which there is transfer in progress may include a period of time during which the arm **180**, **190** loads the wafer **200** from the load lock chamber **130** into the transfer chamber **140** and a period of time during which the arm **180**, **190** unloads the wafer **200** from the transfer chamber **140** into the load lock chamber **130**.

[0083] The contents of temperature control performed by the temperature control mechanism **310** are controlled in accordance with the contents of transfer. The contents of temperature control include, for example, at least one of the first temperature control **311**, the second temperature control **312**, third temperature control **313**, fourth temperature control **314**, fifth temperature control **315**, sixth temperature control **316**, and seventh temperature control **317**, as described below.

[0084] The first temperature control **311** is performed during the first transfer. The second temperature control **312** is performed during the second transfer at an output different from an output of the first temperature control **311**. Note that the first temperature control may be performed in at least a part of the first transfer in progress. In addition, the second temperature control may be performed in at least a part of the second transfer in progress.

[0085] Processing of causing a temperature of the wafer **200** to the second temperature is performed before the second transfer, and processing of causing a temperature of the wafer **200** to the first temperature lower than the second temperature is performed after the second transfer. That is, after the second transfer, the wafer **200** is cooled. Note herein that, when the temperature control mechanism **310** cools a predetermined target, performing the second temperature control **312** at an output higher than an output of the first temperature control **311** makes it possible to shorten a period of time required for the processing of causing a temperature of the wafer **200** to the first temperature in the process chamber **201**. Therefore, it is possible to achieve an improvement in a number of the wafers **200** that are able to be processed per unit time (to improve a throughput). In addition, performing the second temperature control **312** at an output higher than an output of the first temperature control **311** makes it possible to suppress damage on a part of the transfer robot **170** due to heat from the wafer **200**.

[0086] On the other hand, processing of causing a temperature of the wafer **200** to the first temperature is performed after the first transfer, and processing of causing a temperature of the wafer **200** to be the second temperature higher than the first temperature is performed after the first transfer. That is, after the first transfer, the wafer **200** is heated. Note herein that performing control at an output lower than an output of the second temperature control **312** makes it possible to shorten a period of time required for the processing of causing a temperature of the wafer **200** to be the second temperature in the process chamber **201**, and to reduce energy to be consumed excessively by the temperature control mechanism **310**. In addition, the temperature of the wafer **200** that is subject to transfer during the first transfer is lower than the temperature of the wafer **200** during the second transfer, and a risk of damage to the transfer robot **170** due to heat from the wafer **200** is relatively low. Therefore, it is possible to perform the second temperature control **312** at an output lower than an output of the first temperature control **311**, making it possible to reduce energy to be consumed by the temperature control mechanism **310** for cooling the transfer robot **170**.

[0087] Similarly, when the temperature control mechanism **310** heats a predetermined target, the second temperature control **312** may be performed at an output lower than an output of the first temperature control **311**. In addition, the first temperature control **311** may be performed at an output higher than an output of the second temperature control **312**. As a result, it is possible to acquire at least one effect among reducing energy to be consumed by the temperature control mechanism **310** and improving a throughput.

[0088] As a result, performing the first temperature control **311** and the second temperature control **312** at outputs different from each other makes it possible to acquire at least one effect among reducing energy to be consumed by the temperature control mechanism **310** and improving a throughput.

[0089] The third temperature control **313** is performed during the period of time P**0** during which there is no transfer in progress at an output lower than an output of the first temperature control **311**. Note that the third temperature control may be performed in at least a part of the period of time P**0** during which there is no transfer in progress. As a result, it is possible to reduce energy to be consumed by the temperature control mechanism **310**.

[0090] The fourth temperature control **314** is performed after the first transfer and during a period of time P**01** during which there is no transfer in progress. The fifth temperature control **315** is performed during a period of time P**02** after the second transfer and during which there is no transfer in progress, and is performed at an output higher than an output of the fourth temperature control **314**. Note that the fourth temperature control **314** and the fifth temperature control **315** may be performed respectively in at least a part of each of the periods of time P**01** and P**02**.

[0091] The temperature of the wafer **200** that is subject to transfer during the first transfer is lower than the temperature of the wafer **200** that is subject to transfer during the second transfer. Therefore, during the period of time P**02**, the risk of damage to the transfer robot **170** due to heat from the wafer **200** is lower than the risk of damage during the period of time P**01**. Therefore, performing the fifth temperature control **315** at an output lower than an output of the fourth temperature control **314** makes it possible to reduce energy to be consumed by the temperature control mechanism **310**. In addition, the fifth temperature control **315** is performed at an output higher than an output of the fourth temperature control **314**. As a result, it is possible to efficiently lower the temperature of an object in the transfer chamber **140**, making it possible to suppress malfunction of various mechanisms due to an increase in temperature. Note herein that it is preferable that the fifth temperature control **315** be performed longer than the fourth temperature control **314**. As a result, effects of reducing energy to be consumed by the temperature control mechanism **310** and suppressing malfunction of various mechanisms are further easily acquired.

[0092] The sixth temperature control **316** is performed after the fourth temperature control **314** in at least a part of a period of time P**03** during which there is no transfer in progress, and is performed at an output higher than an output of the fourth temperature control **314**. The seventh temperature control **317** is performed after the fifth temperature control **315** in at least a part of a period of time P**04** during which there is no transfer in progress, and is performed at an output lower than an output of the fifth temperature control **315**. As a result, it is possible to reduce energy to be consumed by the temperature control mechanism **310** after the temperature of a target is lowered through the fourth temperature control **314** and the fifth temperature control **315**.

[0093] The contents of transfer may include at least one of a path along which the wafer **200** moves in the transfer chamber **140** during transfer and a period of time required for the transfer. For example, there are differences in path and period of time required for transfer between a case of transfer from the PM **100***a* to the PM **100***b* and a case of transfer from the PM **100***a* to the PM **100***c*. When a purpose of temperature control is cooling, for example, and when there are or is a longer path of transfer and/or a longer period of time required for the transfer, an output of the temperature control mechanism **310** may be further increased. As a result, it is possible to suppress malfunction of various mechanisms due to an increase in temperature. In addition, when there are or is a shorter path of transfer and/or a shorter period of time required for the transfer, the output of the temperature control mechanism **310** may be further reduced. As a result, it is possible to reduce energy to be consumed by the temperature control mechanism **310**. In addition, when there are or is a shorter path of transfer and/or a shorter period of time required for the transfer, the output of the temperature control mechanism **310** may be further increased. As a result, it is possible to efficiently cool the wafer **200** in the transfer chamber **140**.

[0094] The temperature control mechanism **310** may control the contents of temperature control in accordance with the temperature of a predetermined target (for example, the wafer **200**). For example, temperature data is acquired while the processed wafer **200** is transferred from the process chamber **201** of the PM **100***a* or the PM **100***b* to the process chamber **201** of the PM **100***b* or the PM **100***a* via the transfer chamber **140**. To acquire temperature data, it is acquired, for example, by measuring the temperature of the wafer **200** with at least one of the temperature sensors **701***a*, **701***b*, **701***c*, **701***d*, **701***e*, **701***f*, **701***g*, **701***h*, **701***i*, **701***j* provided in the transfer chamber **140**.

[0095] For example, an amount of a heat transfer gas to be supplied to the transfer chamber **140** by the heat transfer gas supplier **150** is controlled based on the acquired temperature data of the wafer **200** to allow the wafer **200** to undergo temperature control (for example, for cooling). As a result, it is possible to reduce energy to be consumed by the temperature control mechanism **310** while efficiently performing temperature control on a predetermined target. In addition, it is possible to suppress consumption of the heat transfer gas.

[0096] A specific example of the temperature control mechanism **310** will now be described herein.

[0097] The temperature control mechanism **310** may include the heat transfer gas supplier **150** that controls supply of the heat transfer gas into the transfer chamber **140**. The heat transfer gas supplier **150** controls, as the contents of temperature control, at least one of the temperature of the heat transfer gas to be supplied into the transfer chamber **140**, presence or absence of supply of the heat transfer gas into the transfer chamber **140**, and a flow rate of the heat transfer gas to be supplied into the transfer chamber **140**. For example, increasing the temperature of the heat transfer gas to be supplied into the transfer chamber **140**, starting supply of the heat transfer gas into the transfer chamber **140**, and increasing the flow rate of the heat transfer gas to be supplied into the transfer chamber **140** make it possible to increase an output of temperature control. The heat transfer gas supplier **150** may supply the heat transfer gas toward a predetermined target in the transfer chamber **140** in at least a part of transfer in progress. As a result, it is possible to more efficiently control the temperature of the predetermined target. As the heat transfer gas, for example, it is possible to use an inert gas of nitrogen (N2), helium (He), neon (Ne), argon (Ar), or krypton (Kr), or hydrogen (H).

[0098] The temperature control mechanism **310** may include the gas exhaust system **160** configured to control exhaust of a gas in the transfer chamber **140**. The gas exhaust system **160** is configured to control, as the contents of temperature control, at least one of presence or absence of exhaust and a flow rate of a gas to be exhausted from the transfer chamber **140**. For example, starting exhaust of a gas in the transfer chamber **140** and increasing a flow rate of the heat transfer gas to be supplied into the transfer chamber **140** make it possible to increase an output of temperature control.

[0099] The temperature control mechanism **310** may include a heat medium supplier configured to control supply of a heat medium to an object that is subject to temperature control, which is provided in the transfer chamber **140**. The heat medium supplier is at least one of a regulator for the temperature of the heat medium, an opening-and-closing valve provided in piping coupling the object and a supplier of the heat medium to the object, and a flow rate controller. The heat medium supplier controls, as the contents of temperature control, at least one of the temperature of the heat medium, presence or absence of supply of the heat medium, and the flow rate of the heat medium to be supplied to the object. For example, increasing a difference in temperature between a predetermined target and the heat medium, starting supply of the heat medium to the object, and increasing the flow rate of the heat medium to the object make it possible to increase an output of temperature control. An object to which the heat medium is to be supplied is an object that takes energy from an object serving as a predetermined target in the transfer chamber **140** or gives energy to an object serving as a predetermined target in the transfer chamber **140** through at least one of heat transfer and heat radiation. An object to which the heat medium is to be supplied is, for example, an object having a surface that easily absorbs electromagnetic waves, compared with other substances in a cooler, a lamp, and the transfer chamber **140** (a heat reflection suppressing body).

[0100] A configuration example of an object to which the heat medium is to be supplied and the heat medium supplier will now be described herein with reference to FIG. **2**.

[0101] A cooler **801** serving as an object to which the heat medium is to be supplied is provided under a ceiling or on a bottom wall of the housing **141**. In addition, the cooler **801** includes a refrigerant flow path **802** serving as piping, and is configured to allow a refrigerant serving as the heat medium to be supplied from the chiller **803** serving as a regulator of the temperature of the heat medium. Note herein that, as the refrigerant, for example, water (H2O) or perfluoropolyether (PFPE) is used. The chiller **803** may further include an opening-and-closing valve and an MFC serving as a flow rate controller. In addition, the refrigerant flow path **802** may be provided with an opening-and-closing valve and an MFC serving as a flow rate controller.

[0102] According to the present aspect, it is possible to acquire one or more effects as described below, in addition to the effects described above.

[0103] (a) Since it is possible to control the temperature of the wafer **200** during transfer, it is possible to shorten the period of time required for temperature control in the process chamber **201** serving as a destination of transfer. Therefore, it is possible to achieve an improvement in a number of the wafers **200** that are able to be processed per unit time (to improve a throughput).

[0104] (b) Since it is possible to control the contents of temperature control for a predetermined target in accordance with the contents of transfer, it is possible to reduce energy to be excessively consumed by the temperature control mechanism **310**.

[0105] The embodiment of the present disclosure has been described above in detail, but the present disclosure is not limited to the embodiment described above, and various modified examples can be made without departing from the gist of the present disclosure.

[0106] In the above description, the example where cooling of a predetermined target is performed as temperature control has been described. However, the present disclosure is not limited to the example. Even when heating of a predetermined target is performed as temperature control, it is possible to acquire at least a part of the effects described above.

[0107] The foregoing embodiment has described an exemplary case where a film is formed using a single-type substrate processing apparatus configured to process one or several substrates at a time. However, the present disclosure is not limited to the foregoing embodiment. For example, the present disclosure is suitably applicable to a case where a film is formed using a batch-type substrate processing apparatus configured to process a plurality of substrates at a time. The foregoing embodiment has also described an exemplary case where a film is formed using a substrate processing apparatus including a cold wall-type processing furnace. However, the present disclosure is not limited to the foregoing embodiment. For example, the present disclosure is suitably applicable to a case where a film is formed using a substrate processing apparatus including a hot wall-type processing furnace.

[0108] Even in a case where such substrate processing apparatuses are each used, the corresponding processing can be performed in accordance with a processing procedure and processing conditions similar to those in the above-described embodiment, leading to obtainment of an effect similar to that in the above-described embodiment.

[0109] According to the present disclosure, it is possible to provide a technique capable of reducing energy excessively consumed by a substrate processing apparatus.

Claims

1. A substrate processing apparatus comprising: a first process chamber in which processing of causing a temperature of a substrate to be a first temperature is performed; a second process chamber in which processing of causing a temperature of the substrate to be a second temperature higher than the first temperature is performed; a transfer chamber formed in communication with the first process chamber and the second process chamber and including a transfer mechanism configured to transfer the substrate; a temperature control mechanism configured to perform temperature control on a predetermined target in the transfer chamber; and a controller capable of controlling the transfer mechanism and the temperature control mechanism to perform: control with contents of transfer of the substrate between the first process chamber and the second process chamber, and control with contents of the temperature control in accordance with the contents of transfer to be performed.

2. The substrate processing apparatus according to claim 1, wherein: the controller is further configured to control the transfer mechanism to perform the transfer so that the contents of the transfer include: first transfer in which the substrate is transferred from the first process chamber to the second process chamber, and second transfer in which the substrate is transferred from the second process chamber to the first process chamber, and the controller is further configured to control the temperature control mechanism to perform the temperature control so that the contents of the temperature control include: first temperature control that is to be performed in at least a part of the first transfer in progress, and second temperature control that is to be performed in at least a part of the second transfer in progress and that is to be performed at an output different from an output of the first temperature control.

3. The substrate processing apparatus according to claim 2, wherein: the temperature control mechanism cools the predetermined target, and the controller is further configured to control the temperature control mechanism so that the second temperature control is performed at the output higher than the output of the first temperature control.

4. The substrate processing apparatus according to claim 3, wherein: the controller is further configured to control the transfer mechanism so that the contents of the transfer further include presence or absence of the transfer in progress, and the controller is further configured to control the temperature control mechanism so that the contents of the temperature control further include third temperature control that is to be performed in at least a part of a period of time in which the transfer in progress is not present and that is to be performed at an output lower than the output of the first temperature control.

5. The substrate processing apparatus according to claim 3, wherein: the controller is further configured to control the transfer mechanism so that the contents of the transfer further include presence or absence of the transfer in progress, and the controller is further configured to control the temperature control mechanism so that the contents of the temperature control further include: fourth temperature control that is performed after the first transfer is ended and in at least a part of a period of time in which the transfer in progress is not present, and fifth temperature control that is performed after the second transfer is ended and in at least a part of a period of time in which the transfer in progress is not present, and that is performed at an output higher than an output of the fourth temperature control.

6. The substrate processing apparatus according to claim 5, wherein: the controller is further configured to control the temperature control mechanism so that the contents of the temperature control further include at least one selected from a group of: sixth temperature control that is performed after the fourth temperature control is ended and in at least a part of a period of time in which the transfer in progress is not present, and that is performed at an output lower than the output of the fourth temperature control, or seventh temperature control that is performed after the

fifth temperature control is ended and in at least a part of a period of time in which the transfer in progress is not present, and that is to be performed at an output lower than the output of the fifth temperature control.
7. The substrate processing apparatus according to claim 1, wherein the controller is further configured to control the transfer mechanism so that the contents of the transfer include at least one selected from a group of a path along which the substrate moves in the transfer chamber in the transfer or a period of time taken for the transfer.
8. The substrate processing apparatus according to claim 1, wherein the temperature control mechanism performs temperature control on at least one selected from a group of the substrate, a gas in the transfer chamber, or an object in the transfer chamber as the predetermined target.
9. The substrate processing apparatus according to claim 1, further comprising a temperature measurer configured to measure a temperature of the predetermined target, wherein the temperature control mechanism controls the contents of the temperature control in accordance with the temperature measured by the temperature measurer.
10. The substrate processing apparatus according to claim 1, wherein the first process chamber and the second process chamber are each configured to internally perform processing involving at least one selected from a group of a chemical reaction, supply of a gas in a plasma state, or adsorption of a process gas other than an inert gas on at least a part of the substrate.
11. The substrate processing apparatus according to claim 1, wherein the temperature control mechanism includes a heat transfer gas supplier configured to control supply of a heat transfer gas into the transfer chamber.
12. The substrate processing apparatus according to claim 11, wherein the heat transfer gas supplier controls, as the contents of the temperature control, at least one selected from a group of a temperature of the heat transfer gas, presence or absence of supply of the heat transfer gas into the transfer chamber, or a flow rate of the heat transfer gas to be supplied into the transfer chamber.
13. The substrate processing apparatus according to claim 11, wherein the heat transfer gas supplier supplies the heat transfer gas toward the predetermined target in the transfer chamber in at least a part of the transfer in progress.
14. The substrate processing apparatus according to claim 1, wherein the temperature control mechanism includes an exhaust system configured to control exhaust of a gas in the transfer chamber.
15. The substrate processing apparatus according to claim 14, wherein the exhaust system controls, as the contents of the temperature control, at least one selected from a group of presence or absence of the exhaust or a flow rate of a gas to be exhausted from the transfer chamber.
16. The substrate processing apparatus according to claim 1, wherein the temperature control mechanism includes a heat medium supplier configured to control supply of a heat medium to an object in the transfer chamber.
17. The substrate processing apparatus according to claim 16, wherein the heat medium supplier controls, as the contents of the temperature control, at least one selected from a group of a temperature of the heat medium, presence or absence of supply of the heat medium to the object, or a flow rate of the heat medium to be supplied to the object.
18. A method of processing a substrate, comprising: (a) causing a temperature of the substrate in a first process chamber to be a first temperature; (b) causing a temperature of the substrate in a second process chamber to be a second temperature higher than the first temperature; (c) transferring the substrate between the first process chamber and the second process chamber via a transfer chamber; and (d) performing temperature control on a predetermined target in the transfer chamber, wherein contents of the temperature control are controlled in accordance with contents of the transfer.
19. The method of claim 18, further comprising manufacturing a semiconductor device.
20. A non-transitory computer-readable recording medium storing a program that causes, by a

computer, a substrate processing apparatus to perform: (a) causing a temperature of a substrate in a first process chamber to be a first temperature; (b) causing a temperature of the substrate in a second process chamber to be a second temperature higher than the first temperature; (c) transferring the substrate between the first process chamber and the second process chamber via a transfer chamber; and (d) performing temperature control on a predetermined target in the transfer chamber, wherein contents of the temperature control are controlled in accordance with contents of the transfer.