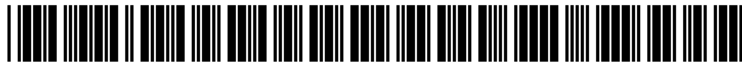

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(54) **SUBSTRATE PROCESSING SYSTEM AND SUBSTRATE PROCESSING METHOD**

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(57) **ABSTRACT**

A substrate processing system includes a stage on which a substrate is placed, a heater configured to heat the substrate by being supplied with power, a power supply part configured to supply power to the heater, a sensor configured to measure a resistance value of the heater, and a controller. The controller is configured to: store a conversion table in which a plurality of resistance values are associated with a plurality of temperatures; and acquire a reference resistance value measured by the sensor when a heater temperature is equal to a reference temperature. The controller is further configured to: acquire a temperature adjustment resistance value measured by the sensor after the substrate is heated by the heater; and control the power supply part based on the conversion table, the reference temperature, the reference resistance value, and the temperature adjustment resistance value.

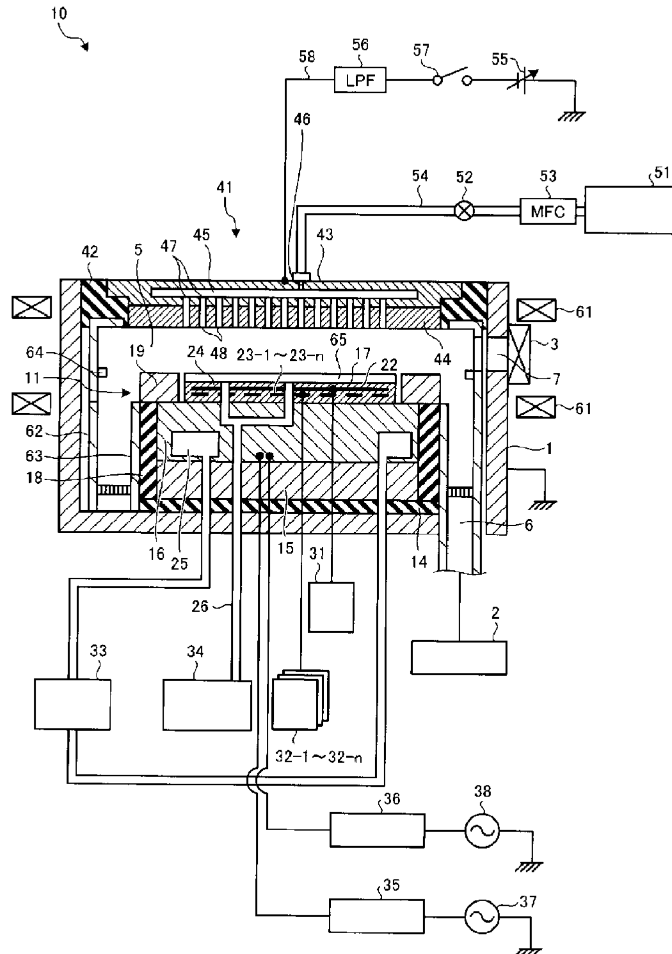


FIG. 1

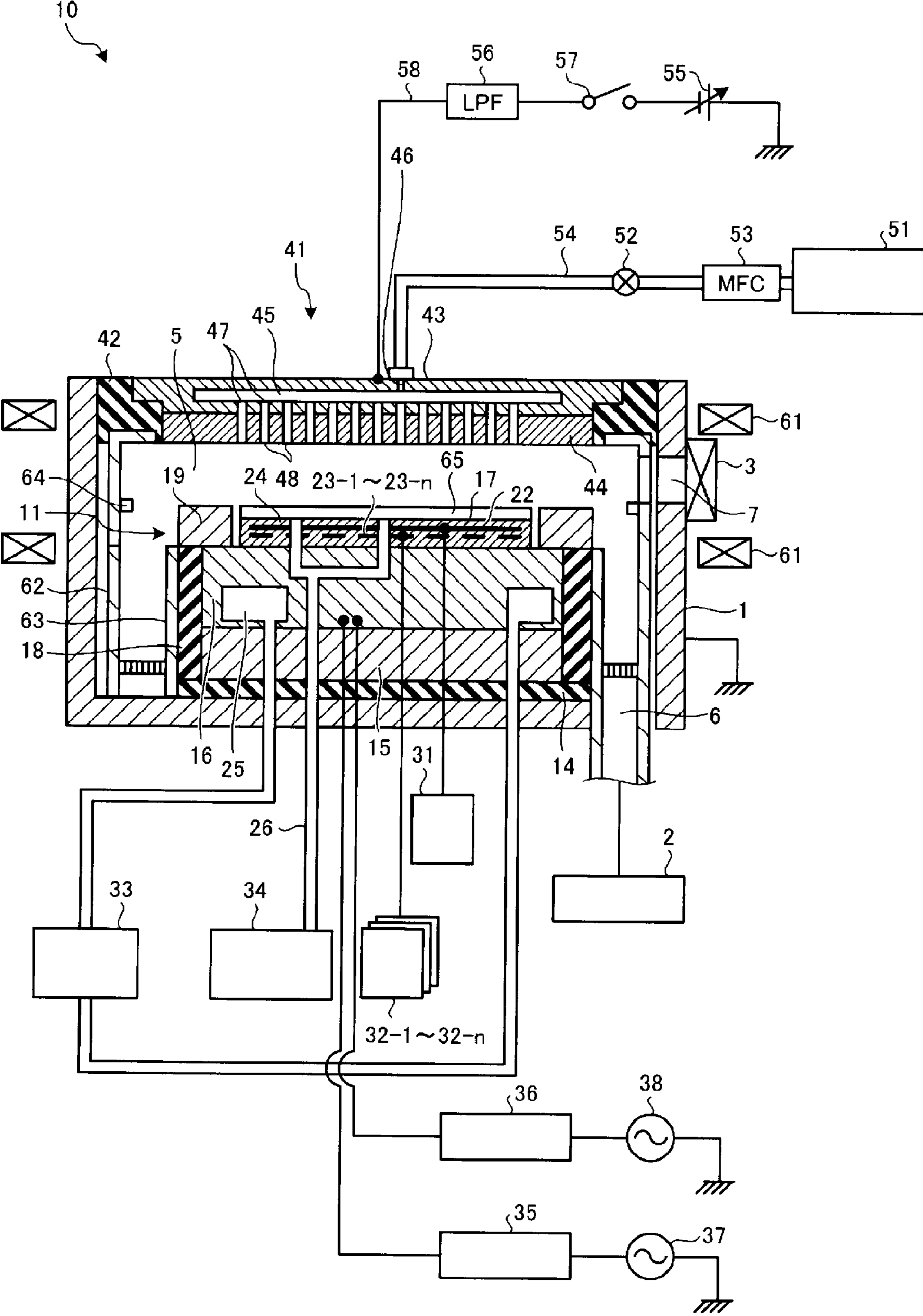


FIG. 2

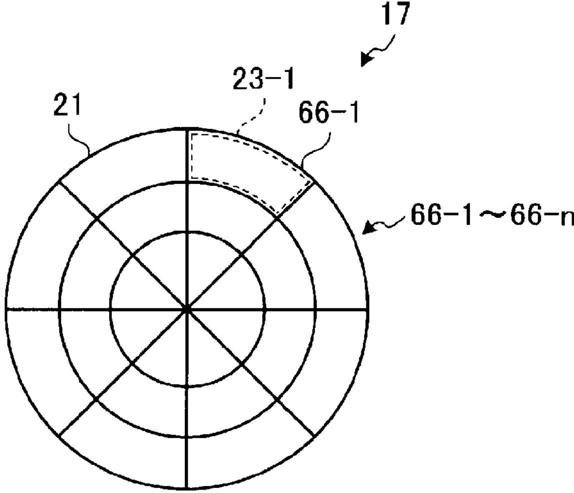


FIG. 3

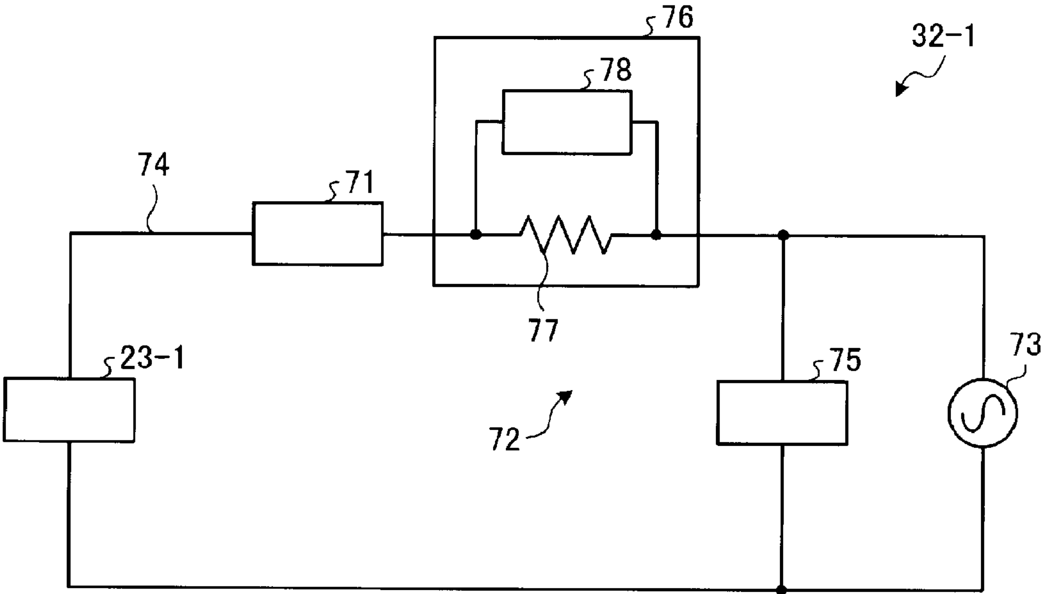


FIG. 4

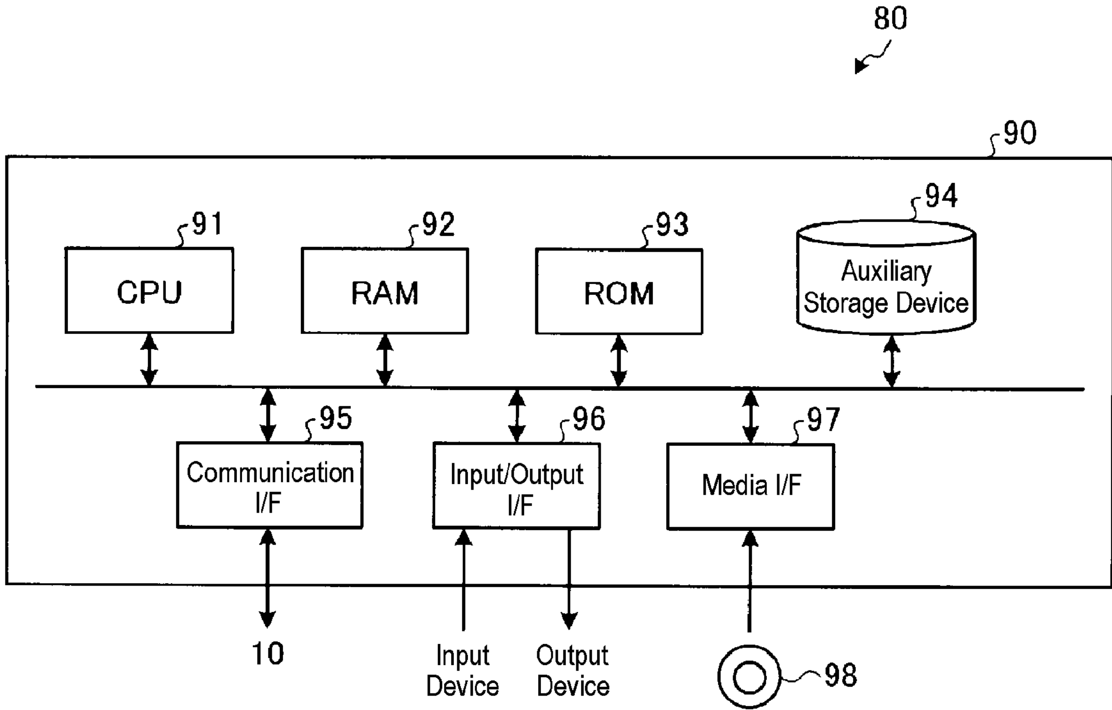


FIG. 5

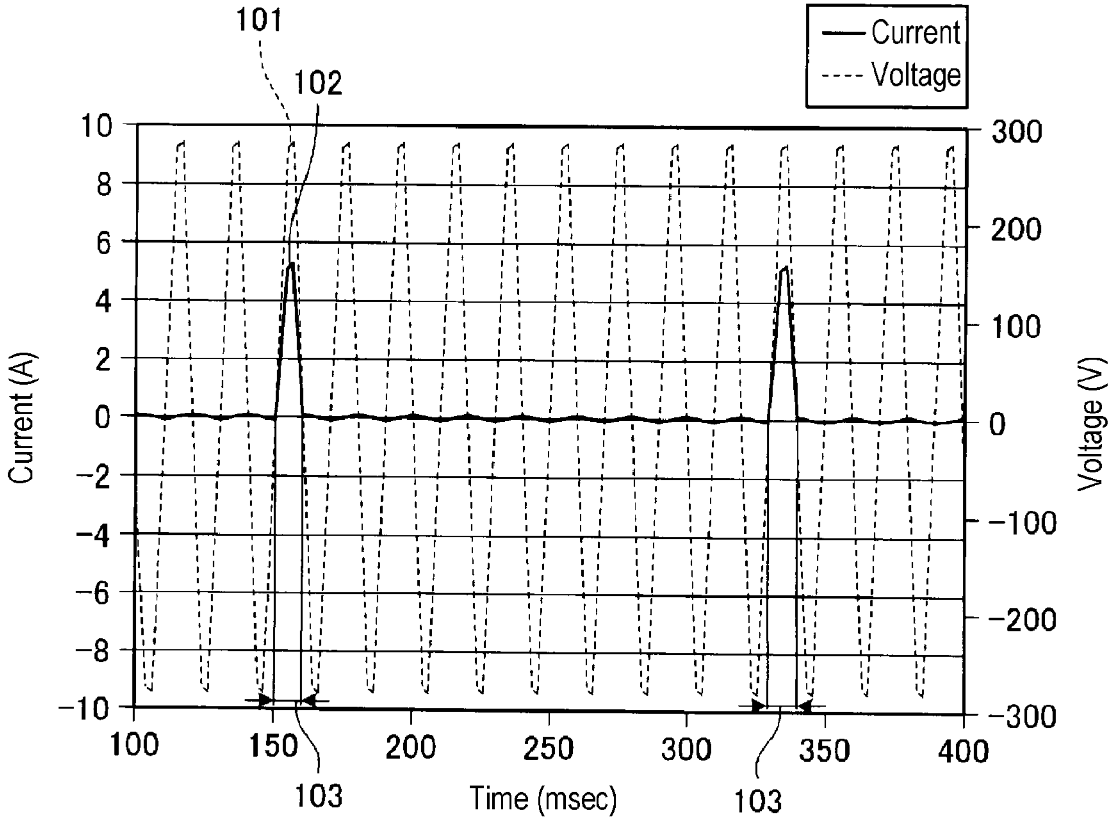


FIG. 6

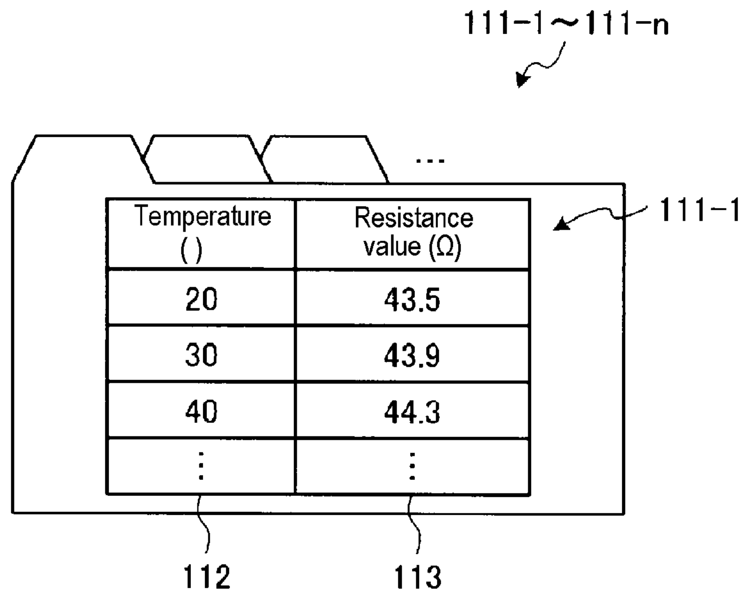


FIG. 7

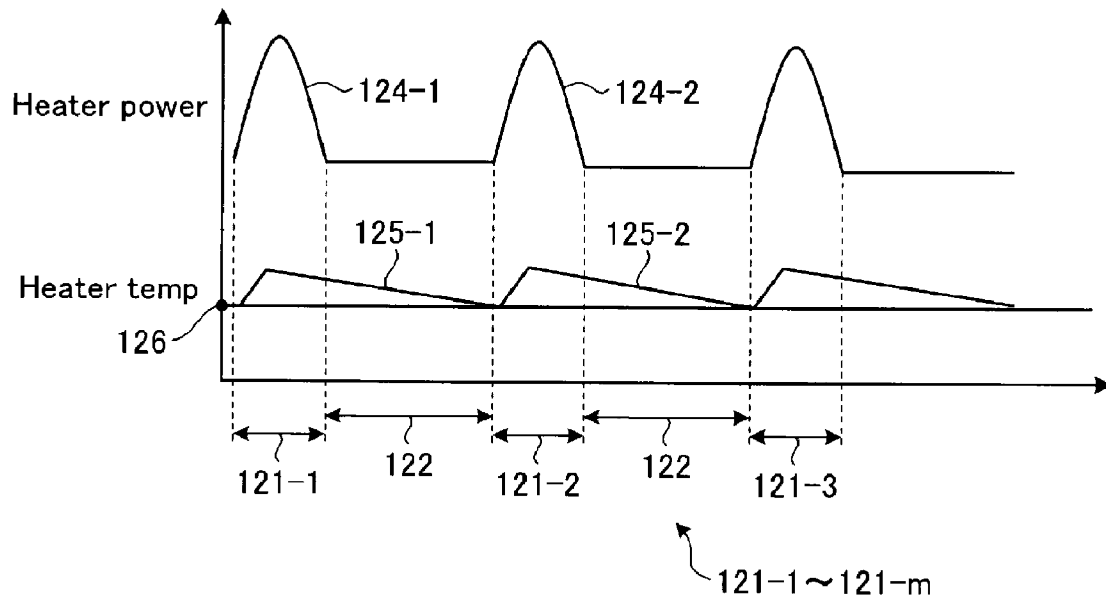


FIG. 8

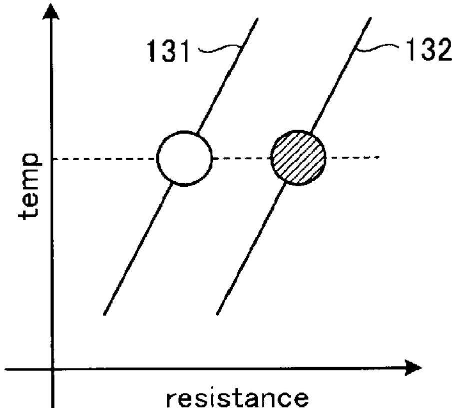
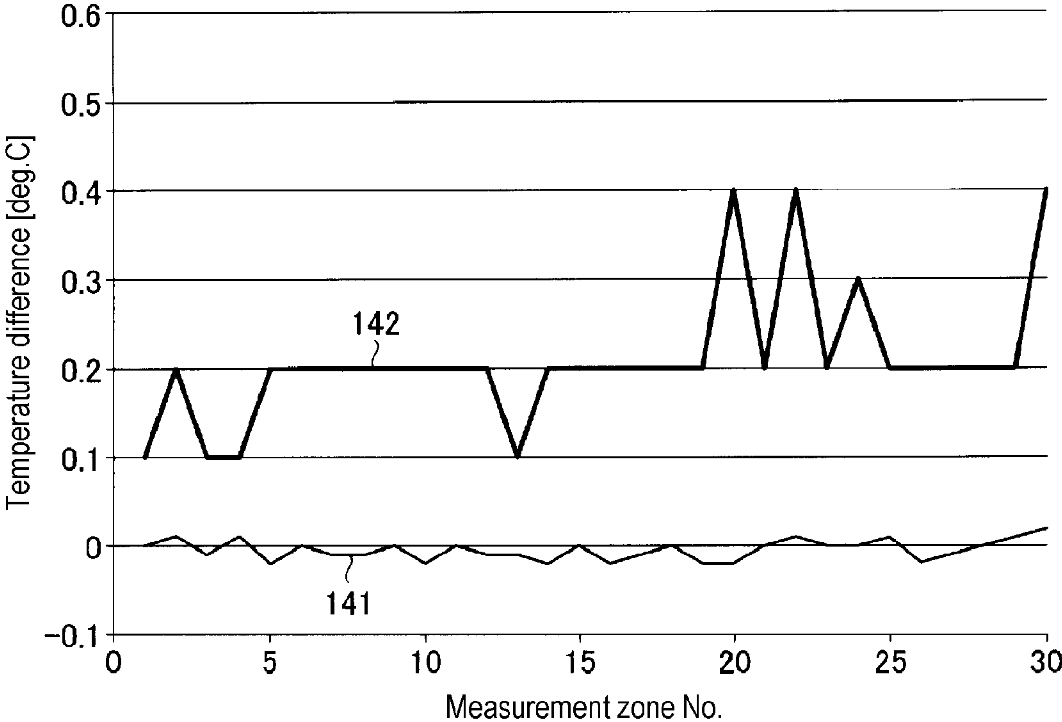


FIG. 9



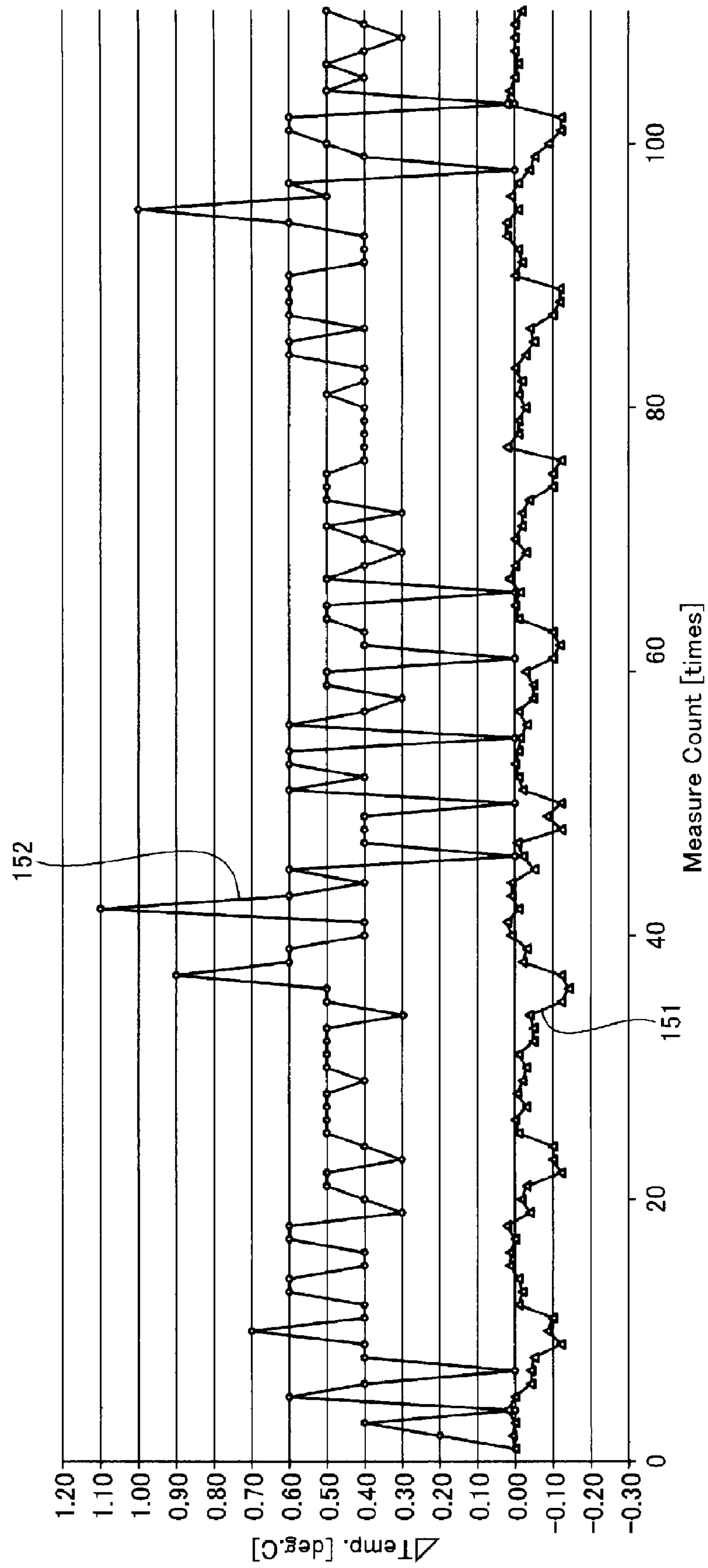


FIG. 10

SUBSTRATE PROCESSING SYSTEM AND SUBSTRATE PROCESSING METHOD

TECHNICAL FIELD

[0001] The present disclosure relates to a substrate processing system and a substrate processing method.

BACKGROUND

[0002] A substrate processing apparatus is known in which a plurality of heaters is provided to independently adjust temperatures of a plurality of regions of a stage on which a semiconductor wafer, which is a substrate to be processed, is placed (see Patent Document 1). In a semiconductor manufacturing process using such a substrate processing apparatus, since the temperature of the semiconductor wafer is controlled with high accuracy, it is possible to appropriately process the semiconductor.

PRIOR ART DOCUMENT

[0003] [Patent Document]

[0004] Patent Document 1: Japanese Laid-Open Patent Publication No. 2017-228230

SUMMARY

[0005] The present disclosure provides a substrate processing system and a substrate processing method for adjusting a temperature of a substrate with high accuracy.

[0006] A substrate processing system according to an aspect of the present disclosure includes a stage on which a substrate is placed, a heater configured to heat the substrate by being supplied with power, a power supply part configured to supply power to the heater, a sensor configured to measure a resistance value of the heater, and a controller. The controller is configured to: store a conversion table in which a plurality of resistance values are associated with a plurality of temperatures; and acquire a reference resistance value measured by the sensor when a heater temperature is equal to a reference temperature. The controller is further configured to: acquire a temperature adjustment resistance value measured by the sensor when the substrate is heated by the heater; and control the power supply part based on the conversion table, the reference temperature, the reference resistance value, and the temperature adjustment resistance value.

[0007] According to the present disclosure, it is possible to adjust a temperature of a substrate with high accuracy.

BRIEF DESCRIPTION OF DRAWINGS

[0008] FIG. **1** is a vertical cross-sectional view illustrating an exemplary substrate processing apparatus provided in a substrate processing system according to an embodiment.

[0009] FIG. **2** is a top plan view illustrating an exemplary electrostatic chuck provided in the substrate processing apparatus according to the embodiment.

[0010] FIG. **3** is a circuit diagram illustrating one exemplary power supply part corresponding to one heater among a plurality of power supply parts included in the substrate processing apparatus of the embodiment.

[0011] FIG. **4** is a view illustrating an exemplary controller included in the substrate processing system according to the embodiment.

[0012] FIG. **5** is a view illustrating an exemplary waveform of an AC voltage output from an AC power source that supplies power to the substrate processing apparatus of the embodiment, and an exemplary waveform of a current flowing through a heater.

[0013] FIG. **6** is a view illustrating a plurality of exemplary conversion tables stored in the controller included in the substrate processing system of the embodiment.

[0014] FIG. **7** is a view illustrating a plurality of exemplary measurement periods in which AC power is supplied from an AC power source to any of a plurality of heaters in an offset adjustment by a substrate processing method of an embodiment, and exemplary changes in AC power and temperature.

[0015] FIG. **8** is a graph showing a relationship between the resistance value and the temperature of a heater included in the substrate processing apparatus of the embodiment.

[0016] FIG. **9** is a graph showing a plurality of temperature differences in a comparative example and a plurality of temperature differences in an example in a first resistance value measurement test.

[0017] FIG. **10** is a graph showing a plurality of temperatures in the comparative example and a plurality of temperatures in the example in a second resistance value measurement test.

DETAILED DESCRIPTION

[0018] Examples of a disclosed substrate processing system and substrate processing method will be described in detail below with reference to the drawings. The technology disclosed herein is not limited by the following examples. Respective examples may be appropriately combined within a range in which the processing contents thereof do not contradict each other.

[Configuration of Substrate Processing Apparatus **10**]

[0019] FIG. **1** is a vertical cross-sectional view illustrating an exemplary substrate processing apparatus provided in a substrate processing system according to an embodiment. As shown in FIG. **1**, the substrate processing apparatus **10** includes a chamber **1**, an exhaust apparatus **2**, and a gate valve **3**. The chamber **1** is made of aluminum and has a substantially cylindrical shape. The surface of the chamber **1** is coated with an anodic oxide film. A processing space **5** is formed inside the chamber **1**. The chamber **1** isolates the processing space **5** from the external atmosphere. An exhaust port **6** and an opening **7** are formed in the chamber **1**. The exhaust port **6** is formed at the bottom of the chamber **1**. The opening **7** is formed in the side wall of the chamber **1**. The exhaust apparatus **2** is connected to the processing space **5** of the chamber **1** via the exhaust port **6**. The exhaust apparatus **2** exhausts gas from the processing space **5** through the exhaust port **6** so as to depressurize the processing space **5** to a predetermined degree of vacuum. The gate valve **3** opens or closes the opening **7**.

[Configuration of Stage **11**]

[0020] The substrate processing apparatus **10** further includes a stage **11**. The stage **11** is disposed in a lower part of the processing space **5**. The stage **11** includes an insulating plate **14**, a support **15**, a base material **16**, an electrostatic chuck **17**, an inner wall member **18**, a focus ring **19**, an electrode **22**, a plurality of heaters **23-1** to **23-*n*** (n=2, 3, 4,

. . .), and a temperature sensor **24**. The insulating plate **14** is made of an insulating material, and is supported on the bottom of the chamber **1**. The support **15** is made of a conductor. The support **15** is disposed on the insulating plate **14**, and is supported on the bottom of the chamber **1** via the insulating plate **14** such that the support **15** and the chamber **1** are electrically insulated.

[0021] The base material **16** is formed of a conductor such as aluminum. The base material **16** is disposed on the support **15**, and is supported on the bottom of the chamber **1** via the support **15**. The electrostatic chuck **17** is disposed on the base material **16** and is supported on the bottom of the chamber **1** via the base material **16**. The electrostatic chuck **17** is made of an insulator. The electrode **22** and the plurality of heaters **23-1** to **23-*n*** are embedded inside the electrostatic chuck **17**. The temperature sensor **24** indirectly measures the plurality of heaters **23-1** to **23-*n*** by measuring a temperature of the electrostatic chuck **17**.

[0022] The inner wall member **18** is formed of an insulator such as quartz, and has a cylindrical shape. The inner wall member **18** is disposed around the base material **16** and the support **15** such that the base material **16** and the support **15** are disposed inside the inner wall member **18**, and surrounds the base material **16** and the support **15**. The focus ring **19** is made of single-crystal silicon, and has a ring shape. The focus ring **19** is disposed on the outer circumference of the electrostatic chuck **17** such that the electrostatic chuck **17** is disposed inside the focus ring **19**, and surrounds the electrostatic chuck **17**. The stage **11** is further provided with a coolant circulation channel **25** and a heat transfer gas supply channel **26**. The coolant circulation channel **25** is formed inside the base material **16**. The heat transfer gas supply channel **26** is formed to penetrate the electrostatic chuck **17**, and one end of the heat transfer gas supply channel **26** is formed on a top surface of the electrostatic chuck **17**.

[0023] The substrate processing apparatus **10** further includes a DC power source **31**, a plurality of power supply parts **32-1** to **32-*n***, a chiller unit **33**, and a heat transfer gas supply part **34**. The DC power source **31** is electrically connected to the electrode **22** of the electrostatic chuck **17**. The DC power source **31** applies a DC voltage to the electrode **22**. The plurality of power supply parts **32-1** to **32-*n*** correspond to the plurality of heaters **23-1** to **23-*n***, respectively. The chiller unit **33** is connected to the coolant circulation channel **25**. The chiller unit **33** cools a coolant to a predetermined temperature, and circulates the cooled coolant in the coolant circulation channel **25** inside the base material **16**. The heat transfer gas supply part **34** is connected to the heat transfer gas supply channel **26**. The heat transfer gas supply part **34** supplies a heat transfer gas, such as He gas, to the heat transfer gas supply channel **26**.

[0024] The substrate processing apparatus **10** further includes a first high-frequency power source **37** and a second high-frequency power source **38**. The first high-frequency power source **37** is connected to the base material **16** via a first matcher **35**. The second high-frequency power source **38** is connected to the base material **16** via a second matcher **36**. The first high-frequency power source **37** supplies high-frequency power having a predetermined frequency (e.g., 100 MHz) to the base material **16**. The second high-frequency power source **38** supplies the base material **16** with high-frequency power having a frequency (e.g., 13 MHz) lower than the frequency of the high-frequency power supplied to the base material **16** by the first high-frequency power source **37**.

[Configuration of Shower Head **41**]

[0025] The substrate processing apparatus **10** further includes a shower head **41**. The shower head **41** is disposed above the stage **11** in the processing space **5** such that a bottom surface of the shower head **41** faces the stage **11** and the plane of the bottom surface of the shower head **41** is substantially parallel to the plane of the top surface of the stage **11**. The shower head **41** includes an insulating member **42**, a body **43**, and an upper ceiling plate **44**. The insulating member **42** is made of an insulating material, and is supported in an upper portion of the chamber **1**. The body **43** is made of, for example, a conductor, such as aluminum having an anodized surface. The body **43** is supported in the chamber **1** via the insulating member **42** such that the body **43** and the chamber **1** are electrically insulated. The body **43** and the base material **16** are used as a pair of upper and lower electrodes. The upper ceiling plate **44** is formed of a silicon-containing material, such as quartz. The upper ceiling plate **44** is disposed in a lower portion of the body **43**, and is supported on the body **43** to be detachable from the body **43**.

[0026] A gas diffusion chamber **45**, a gas inlet **46**, and a plurality of gas outlets **47** are formed in the body **43**. The gas diffusion chamber **45** is formed inside the body **43**. The gas inlet **46** is formed above the gas diffusion chamber **45** in the body **43** and communicates with the gas diffusion chamber **45**. The plurality of gas outlets **47** is formed on the upper ceiling plate **44** side of the gas diffusion chamber **45** in the body **43** and communicates with the gas diffusion chamber **45**. A plurality of gas inlets **48** is formed in the upper ceiling plate **44**. The plurality of gas inlets **48** is formed so as to penetrate the top surface and the bottom surface of the upper ceiling plate **44**, and to communicate with the plurality of gas outlets **47**, respectively.

[0027] The substrate processing apparatus **10** further includes a processing gas supply source **51**, a valve **52**, and a mass flow controller (MFC) **53**. The processing gas supply source **51** is connected to the gas inlet **46** in the body **43** of the shower head **41** via a pipe **54**. The mass flow controller **53** is provided in the middle of the pipe **54**. The valve **52** is provided between the mass flow controller **53** and the gas inlet **46** in the pipe **54**. When the valve **52** is opened or closed, the processing gas is supplied from the processing gas supply source **51** to the gas inlet **46**, or the processing gas is blocked from being supplied from the processing gas supply source **51** to the gas inlet **46**.

[0028] The substrate processing apparatus **10** further includes a variable DC power source **55**, a low-pass filter (LPF) **56**, and a switch **57**. The variable DC power source **55** is electrically connected to the body **43** of the shower head **41** via an electric path **58**. The low-pass filter **56** and the switch **57** are provided in the middle of the electric path **58**. The switch **57** is opened and closed so as to apply a DC voltage to the shower head **41**, or to block the application of a DC voltage to the shower head **41**.

[0029] The substrate processing apparatus **10** further includes a ring magnet **61**. The ring magnet **61** is formed of a permanent magnet, and has a ring shape. The ring magnet **61** is arranged concentrically with the chamber **1** such that the chamber **1** is arranged inside the ring magnet **61**. The

ring magnet **61** is rotatably supported by the chamber **1** via a rotation mechanism (not illustrated). The ring magnet **61** forms a magnetic field in a region of the processing space **5** between the shower head **41** and the stage **11**.

[0030] The substrate processing apparatus **10** further includes a deposition shield **62**, a deposition shield **63**, and a conductive member **64**. The deposition shield **62** is disposed so as to cover the inner wall surface of the chamber **1**, and is supported by the chamber **1** to be detachable from the chamber **1**. The deposition shield **62** prevents an etching byproduct (deposit) from adhering to the inner wall surface of the chamber **1**. The deposition shield **63** is disposed to cover the outer peripheral surface of the inner wall member **18**. The deposition shield **63** prevents the etching byproduct from adhering to the outer peripheral surface of the inner wall member **18**. The conductive member **64** is arranged in the processing space **5** such that the height at which the conductive member **64** is arranged is substantially the same as the height at which a wafer **65** placed on the stage **11** is arranged, and is supported by the deposition shield **62**. The conductive member **64** is formed of a conductor, and is electrically connected to a ground. The conductive member **64** suppresses abnormal discharge in the chamber **1**.

[Electrostatic Chuck **17**]

[0031] FIG. **2** is a top plan view illustrating an exemplary electrostatic chuck **17** provided in the substrate processing apparatus **10** according to the embodiment. A placement surface of the electrostatic chuck **17** that faces the wafer **65** placed on the stage **11** is divided into a plurality of regions **66-1** to **66-*n***, as illustrated in FIG. **2**. The shape of each of the plurality of regions **66-1** to **66-*n*** is not limited to the example illustrated in FIG. **2**, and the placement surface may be divided into a plurality of regions having shapes that are different from the shapes of the plurality of regions **66-1** to **66-*n***. The plurality of regions **66-1** to **66-*n*** correspond to the plurality of heaters **23-1** to **23-*n***, respectively. Among the plurality of heaters **23-1** to **23-*n***, one heater **23-1** corresponding to one region **66-1** is embedded near the region **66-1** in the electrostatic chuck **17**. The heater **23-1** heats the electrostatic chuck **17** around the region **66-1** when AC power is supplied thereto. Among the plurality of heaters **23-1** to **23-*n***, similarly to the heater **23-1**, each of the heaters other than the heater **23-1** also heats the electrostatic chuck **17** around a region corresponding thereto among the plurality of regions **66-1** to **66-*n*** when AC power is supplied thereto.

[Configuration of Plurality of Power Supply Parts **32-1** to **32-*n***]

[0032] The plurality of power supply parts **32-1** to **32-*n*** correspond to the plurality of heaters **23-1** to **23-*n***, respectively. FIG. **3** is a circuit diagram illustrating one exemplary power supply part **32-1** corresponding to one heater **23-1** among the plurality of power supply parts **32-1** to **32-*n*** included in the substrate processing apparatus **10** of the embodiment. The power supply part **32-1** includes a switch **71** and a resistance value sensor **72**. The switch **71** is provided in the middle of a heater power supply electric path **74** that connects the AC power source **73** and the heater **23-1**. The AC power source **73** is provided in a factory in which the substrate processing apparatus **10** is installed so as to supply AC power to the substrate processing apparatus **10**, and also supplies AC power to apparatuses other than the substrate processing apparatus **10**. When the switch **71** is closed, power is supplied from the AC power source **73** to the heater **23-1**, and when the switch **71** is opened, power supply from the AC power source **73** to the heater **23-1** is interrupted.

[0033] The resistance value sensor **72** includes a voltmeter **75** and an ammeter **76**. The voltmeter **75** measures the voltage applied to the heater **23-1**. The ammeter **76** includes a shunt resistor **77** and a voltmeter **78**. The shunt resistor **77** is provided in the middle of the heater power supply electric path **74**. The resistance value of the shunt resistor **77** is, for example, 10 mΩ. The voltmeter **78** measures the voltage applied to the shunt resistor **77**. The ammeter **76** measures the current flowing through the heater **23-1** based on the voltage measured by the voltmeter **78**. The resistance value sensor **72** measures the resistance value of the heater **23-1** based on the voltage measured by the voltmeter **75** and the current value measured by the ammeter **76**. The resistance value of the heater **23-1** is equal to a value obtained by dividing the voltage measured by the voltmeter **75** by the current value measured by the ammeter **76**. Among the plurality of power supply parts **32-1** to **32-*n***, another power supply part different from the power supply part **32-1** also includes a switch and a resistance value sensor, like the power supply part **32-1**. That is, the substrate processing apparatus **10** includes a plurality of resistance value sensors corresponding to the plurality of heaters **23-1** to **23-*n***. Like the power supply part **32-1**, the power supply part supplies AC power from the AC power source **73** to a heater corresponding to the power supply part among the plurality of heaters **23-1** to **23-*n***, and measures the resistance value of the heater.

[Configuration of Controller **80**]

[0034] The substrate processing system further includes a controller **80** as illustrated in FIG. **4**. FIG. **4** is a view illustrating an exemplary controller **80** included in the substrate processing system according to the embodiment. The controller **80** is implemented by a computer **90**. The computer **90** includes a central processing unit (CPU) **91**, a random access memory (RAM) **92**, and a read-only memory (ROM) **93**. The CPU **91** operates based on a program installed in the computer **90**, controls each part of the computer **90**, and controls each part of the substrate processing apparatus **10**. The ROM **93** stores a boot program executed by the CPU **91** when the computer **90** is activated, and a program depending on the hardware of the computer **90**.

[0035] The computer **90** further includes an auxiliary storage device **94**, a communication I/F **95**, an input/output I/F **96**, and a media I/F **97**. The auxiliary storage device **94** stores a program executed by the CPU **91** and data used by the program. The auxiliary storage device **94** may be, for example, a hard disk drive (HDD) or a solid-state drive (SSD). The CPU **91** reads the program from the auxiliary storage device **94**, loads the program into the RAM **92**, and executes the loaded program.

[0036] The communication I/F **95** communicates with the substrate processing apparatus **10** via a communication line, such as a local area network (LAN). The communication I/F **95** sends information received from the substrate processing apparatus **10** via the communication line to the CPU **91**, and transmits data generated by the CPU **91** to the substrate processing apparatus **10** via the communication line.

[0037] The computer **90** further includes an input device such as a keyboard, and an output device such as a display. The CPU **91** controls the input device and the output device via the input/output I/F **96**. The input/output I/F **96** transmits a signal input via the input device to the CPU **91**, and outputs the data generated by the CPU **91** to the output device.

[0038] The media I/F **97** reads a program or data recorded in a non-transitory recording medium **98**. The recording medium **98** may be, for example, an optical recording medium, a magneto-optical recording medium, a tape medium, a magnetic recording medium, or a semiconductor memory. The optical recording medium may be, for example, a digital versatile disc (DVD) and a phase change rewritable disc (PD). The magneto-optical recording medium may be, for example, a magneto-optical disk (MO).

[0039] The CPU **91** stores a program read from the recording medium **98** via the media I/F **97** in the auxiliary storage device **94**. As another example, the program acquired from another device via a communication line may be stored in the auxiliary storage device **94**.

[0040] FIG. **5** shows an exemplary waveform **101** of an AC voltage output from the AC power source **73** that supplies power to the substrate processing apparatus **10** of the embodiment, and an exemplary waveform **102** of a current flowing through the heater **23-1**. The waveform **101** of the AC voltage indicates that the AC power source **73** outputs an AC voltage having a predetermined frequency (e.g., 50 Hz) along a sine curve. The waveform **102** of the current indicates that the power is not supplied from the AC power source **73** to the heater **23-1** in all the periods in which the AC voltage is negative. The current waveform **102** further indicates that power is supplied from the AC power source **73** to the heater **23-1** during a plurality of predetermined energization periods **103** among a plurality of periods in which the AC voltage is positive. That is, the length of each of the plurality of energization periods **103** is equal to half the cycle of the AC voltage output from the AC power source **73**.

[0041] That is, when the AC voltage output from the AC power source **73** is negative, the controller **80** opens the switch **71** of the power supply part **32-1** such that the AC voltage is not applied to the heater **23-1**. The controller **80** further sets a plurality of energization periods **103** such that the ratio of the plurality of energization periods **103** to the plurality of periods in which the AC voltage is positive is equal to a predetermined ratio. The controller **80** further closes the switch **71** of the power supply part **32-1** such that the AC voltage is applied to the heater **23-1** during the energization periods **103**.

[0042] As illustrated in FIG. **6**, the controller **80** stores a plurality of conversion tables **111-1** to **111-*n*** in the auxiliary storage device **94**. FIG. **6** is a view illustrating the plurality of exemplary conversion tables **111-1** to **111-*n*** stored in the controller **80** included in the substrate processing system of the embodiment. The plurality of conversion tables **111-1** to **111-*n*** correspond to the plurality of heaters **23-1** to **23-*n***, respectively. Among the plurality of conversion tables **111-1** to **111-*n***, in the conversion table **111-1** corresponding to the heater **23-1**, a plurality of temperatures **112** are associated with a plurality of resistance values **113**. As the plurality of temperatures **112**, **11** preset temperatures set in steps of 10 degrees C. from 20 degrees C. to 120 degrees C. are described by way of example. A resistance value corresponding to a certain temperature among the plurality of resistance values **113** is equal to the resistance value of the heater **23-1** when that temperature is equal to the temperature of the heater **23-1**.

[0043] The conversion table **111-1** is generated before the electrostatic chuck **17** is installed in the substrate processing apparatus **10**. For example, a user measures the distribution of radiation quantity of infrared rays radiated from the top surface of the electrostatic chuck **17** using an infrared camera, and acquires the temperature of each of the plurality of heaters **23-1** to **23-*n***. The user supplies a predetermined level of power to the heater **23-1** and measures the voltage applied to the heater **23-1** and the current flowing through the heater **23-1** during a predetermined period in which the temperature of the heater **23-1** is equal to a predetermined temperature, and the user calculates the resistance value of the heater **23-1** based on the voltage and the current. The user generates the conversion table **111-1** such that the acquired temperatures of the heater **23-1** are associated with the acquired resistance values of the heater **23-1**.

[0044] Among the plurality of conversion tables **111-1** to **111-*n***, the conversion tables other than the conversion table **111-1** are also formed similarly to the conversion table **111-1**. In a conversion table among the plurality of conversion tables **111-1** to **111-*n***, the temperatures of a heater corresponding to that conversion table among the plurality of heaters are associated to correspond to the resistance values of that heater.

[Substrate Processing Method]

[0045] A substrate processing method of an embodiment is executed using a substrate processing system, and includes an offset adjustment and a plasma-etching method.

[0046] The offset adjustment is executed, for example, when the substrate processing apparatus **10** is installed in a factory. The controller **80** controls the chiller unit **33** to circulate the coolant cooled to a predetermined chiller temperature in the coolant circulation channel **25** so as to cool the electrostatic chuck **17**. The controller **80** measures the temperatures of the plurality of heaters **23-1** to **23-*n*** by controlling the temperature sensor **24** while the electrostatic chuck **17** is being cooled. When the electrostatic chuck **17** is sufficiently cooled by the chiller unit **33**, for example, for 120 minutes or more, the temperature becomes constant and the temperature distribution becomes uniform. Further, the temperatures of the plurality of heaters **23-1** to **23-*n*** become equal to the temperature of the electrostatic chuck **17** when the electrostatic chuck **17** is sufficiently cooled, and the temperatures become equal to each other. After the electrostatic chuck **17** is sufficiently cooled, the controller **80** controls the auxiliary storage device **94** to store a reference temperature measured by the temperature sensor **24** in the auxiliary storage device **94**.

[0047] After the electrostatic chuck **17** is sufficiently cooled, the controller **80** opens/closes the switches **71** of the plurality of power supply parts **32-1** to **32-*n*** so as to supply AC power to the plurality of heaters **23-1** to **23-*n*** at a predetermined timing. FIG. **7** is a view illustrating a plurality of exemplary measurement periods in which AC power is supplied from the AC power source **73** to any of the plurality of heaters **23-1** to **23-*n*** in an offset adjustment by a substrate processing method of an embodiment, and exemplary changes in AC power and temperature. As illustrated in FIG. **7**, the lengths of the plurality of measurement periods **121-1** to **121-*m*** are equal to each other, and are equal

to half the cycle of the AC voltage output from the AC power source **73**. Further, the interval **122** between the plurality of measurement periods **121-1** to **121-*m*** is equal to a predetermined length (for example, 5 sec). That is, the plurality of measurement periods **121-1** to **121-*m*** are intermittently formed at an equal interval.

[0048] The controller **80** opens/closes the switches **71** of the plurality of power supply parts **32-1** to **32-*n*** in the measurement period **121-1** so as to supply the AC power **124-1** to a plurality of (for example, four) first heaters among the plurality of heaters **23-1** to **23-*n***. In this case, a plurality of first regions corresponding to the plurality of first heaters among the plurality of regions **66-1** to **66-*n*** are not adjacent to each other. That is, the contours of any two first regions selected from the plurality of first regions do not have overlapping portions. Further, the contours of the two first regions may share one point. The controller **80** respectively measures the resistance values of the plurality of first heaters by controlling the resistance value sensors **72** of the plurality of power supply parts **32-1** to **32-*n*** during the measurement period **121-1**.

[0049] A temperature change **125-1** indicates a change in the temperature of one first heater among the plurality of first heaters. The temperature change **125-1** indicates that the AC power **124-1** is supplied to the first heater during the measurement period **121-1**, and thus the temperature of the first heater increases during the measurement period **121-1**. The temperature change **125-1** also indicates that the AC power is not supplied to the first heater after the measurement period **121-1** ends, and thus the temperature of the first heater decreases. The temperature change **125-1** also indicates that the temperature of the first heater becomes substantially equal to a chiller temperature **126** in the measurement period **121-2** following the measurement period **121-1** among the plurality of measurement periods **121-1** to **121-*m***. That is, the length of the interval **122** is set such that, when one of the plurality of heaters **23-1** to **23-*n*** is supplied with power in the measurement period **121-1**, the temperature of the heater decreases until the temperature of the heater becomes substantially equal to the chiller temperature in the measurement period **121-2**.

[0050] The controller **80** opens/closes the switches **71** of the plurality of power supply parts **32-1** to **32-*n*** in the measurement period **121-2** so as to supply the AC power to a plurality of second heaters different from the plurality of first heaters among the plurality of heaters **23-1** to **23-*n***. In this case, a plurality of second regions corresponding to the plurality of second heaters among the plurality of regions **66-1** to **66-*n*** are not adjacent to each other. Further, the plurality of second regions are not adjacent to any of the plurality of first regions. The controller **80** respectively measures the resistance values of the second heaters by controlling the resistance value sensors **72** of the plurality of power supply parts **32-1** to **32-*n*** during the measurement period **121-2**.

[0051] A combination of a plurality of heaters for which resistance values are measured in each of a plurality of measurement periods **121-1** to **121-*m*** is set similarly to the plurality of second heaters. For example, a plurality of third heaters for which resistance values are measured in the measurement period **121-3** are set such that the plurality of third regions corresponding to the plurality of third heaters among the plurality of regions **66-1** to **66-*n*** are not adjacent to each other, and such that the plurality of third regions are not adjacent to the plurality of second regions. The combination is also set such that when all of the plurality of measurement periods **121-1** to **121-*m*** have passed, the resistance value of each of the plurality of heaters **23-1** to **23-*n*** is measured a predetermined number of times (e.g., 50 times).

[0052] The controller **80** controls the auxiliary storage device **94** after the resistance value of each of the plurality of heaters **23-1** to **23-*n*** has been measured the predetermined number of times, whereby a plurality of reference resistance values corresponding to the plurality of heaters **23-1** to **23-*n*** are stored in the auxiliary storage device **94**. Among the plurality of reference resistance values, the reference resistance value corresponding to the heater **23-1** indicates the average of a plurality of resistance values measured by the resistance value sensor **72** of the power supply part **32-1**. When the variation in the resistance values measured by the resistance value sensor **72** of any of the plurality of power supply parts **32-1** to **32-*n*** is larger than a predetermined value, the controller **80** executes the offset adjustment again from the beginning.

[0053] After the reference resistance values are acquired, the controller **80** generates a plurality of post-correction conversion tables corresponding to the plurality of heaters **23-1** to **23-*n*** based on the plurality of conversion tables **111-1** to **111-*n***, the reference temperature, and the plurality of reference resistance values. Among the plurality of post-correction conversion tables, the post-correction conversion table corresponding to the heater **23-1** is generated based on the conversion table **111-1**, the reference temperature, and the reference resistance value corresponding to the heater **23-1** among the plurality of reference resistance values. In the post-correction conversion table, a plurality of resistance values are associated with the plurality of temperatures **112** of the conversion table **111-1**. The plurality of resistance values are equal to a value obtained by adding a predetermined value to the plurality of resistance values **113** in the conversion table **111-1** so that, in the post-correction conversion table, the reference resistance values are associated to correspond to the reference temperatures. After a plurality of post-correction tables are generated, the controller **80** stores the plurality of post-correction conversion tables in the auxiliary storage device **94** by controlling the auxiliary storage device **94**.

[Plasma-Etching Method]

[0054] The plasma-etching method is performed after the offset adjustment is performed. In the plasma-etching method, first, the controller **80** controls the gate valve **3** to open the opening **7**. A wafer **65** to be processed is loaded into the processing space **5** in the chamber **1** through the opening **7** and is placed on the stage **11** when the opening **7** is opened. After the wafer **65** is placed on the stage **11**, the controller **80** controls the DC power source **31** to apply a DC voltage to the electrode **22** so as to hold the wafer **65** on the electrostatic chuck **17** by Coulomb force. The controller **80** closes the opening **7** by controlling the gate valve **3** after the wafer **65** is held on the stage **11**.

[0055] When the opening **7** is closed, the controller **80** controls the exhaust apparatus **2** to evacuate the atmosphere in the processing space **5** to a predetermined degree of vacuum. The controller **80** further controls the valve **52** to supply a predetermined amount of processing gas from the processing gas supply source **51** to the gas inlet **46**. The

processing gas supplied from the processing gas supply source **51** to the gas inlet **46** is supplied to the gas diffusion chamber **45**, and is then supplied to the processing space **5** in the chamber **1** via the plurality of gas outlets **47** and the plurality of gas inlets **48** in the form of a shower.

[0056] While the wafer **65** is held on the electrostatic chuck **17**, the controller **80** supplies a heat transfer gas to the space between the electrostatic chuck **17** and the wafer **65** by controlling the heat transfer gas supply part **34** to supply the heat transfer gas to the heat transfer gas supply channel **26**. The controller **80** further controls the chiller unit **33** to circulate the coolant cooled to a predetermined temperature in the coolant circulation channel **25** so as to cool the electrostatic chuck **17**.

[0057] While the wafer **65** is held on the electrostatic chuck **17**, the controller **80** opens/closes the switch **71** of the power supply part **32-1** such that AC power is supplied from the AC power source **73** to the heater **23-1** during a plurality of energization periods **103**. The controller **80** further controls the resistance value sensor **72** of the power supply part **32-1** to measure the resistance value of the heater **23-1** for each of the plurality of energization periods **103**. The controller **80** refers to the post-correction conversion table corresponding to the heater **23-1** among the plurality of post-correction conversion tables, and calculates the temperature of the heater **23-1** based on the measured resistance value. The calculated temperature is equal to the temperature associated with the measured resistance value by the post-correction conversion table. When the calculated temperature is lower than a target temperature, the controller **80** changes the plurality of energization periods **103** such that the ratio of the plurality of energization periods **103** to the plurality of periods in which the AC voltage output from the AC power source **73** is positive increases. When the calculated temperature is higher than the target temperature, the controller **80** changes the plurality of energization periods **103** such that the ratio of the plurality of energization periods **103** to the plurality of periods in which the AC voltage output is positive decreases. The controller **80** opens/closes the switch **71** of the power supply part **32-1** to supply AC power from the AC power source **73** to the heater **23-1** during the changed plurality of energization periods **103**.

[0058] By changing the ratio of the plurality of energization periods **103** as described above, the controller **80** is capable of adjusting the temperature of the heater **23-1** with high accuracy such that the temperature of the heater **23-1** becomes the target temperature. With respect to any heater other than the heater **23-1** among the plurality of heaters **23-1** to **23-*n***, the controller **80** also adjusts the temperature using the post-correction conversion table corresponding to the heater among the plurality of post-correction conversion tables, similarly to the heater **23-1**. In this case, the temperature of the wafer **65** is adjusted to reach the target temperature since heat is transferred from the electrostatic chuck **17** to the wafer **65** through the heat transfer gas supplied to the space between the electrostatic chuck **17** and the wafer **65**.

[0059] After the temperature of the wafer **65** is adjusted to the predetermined temperature, the controller **80** controls the first high-frequency power source **37** and the second high-frequency power source **38** to supply high-frequency power to the base material **16** of the stage **11**. Since the high-frequency power is supplied to the base material **16** of the stage **11**, plasma is generated in the region of the processing space **5** between the stage **11** and the shower head **41**. The controller **80** controls the variable DC power source **55** and the switch **57** to apply a DC voltage of a predetermined magnitude from the variable DC power source **55** to the shower head **41**. At this time, the wafer **65** is etched by the plasma generated in the processing space **5**.

[0060] After the wafer **65** is appropriately etched, the controller **80** controls the first high-frequency power source **37** and the second high-frequency power source **38** so as to stop the supply of high-frequency power to the base material **16** of the stage **11**. The controller **80** further controls the variable DC power source **55** and the switch **57** to prevent the DC voltage from being applied to the shower head **41**. The controller **80** further controls the gate valve **3** to open the opening **7**. The controller **80** further controls the DC power source **31** to release the wafer **65** held by the electrostatic chuck **17**. The wafer **65** is unloaded from the processing space **5** of the chamber **1** through the opening **7** when the wafer **65** is not held by the electrostatic chuck **17** and the opening **7** is opened. According to this plasma-etching method, the temperature of the wafer **65** can be appropriately adjusted to a predetermined temperature, and thus the wafer **65** can be appropriately etched.

[0061] FIG. **8** is a graph showing a relationship between the resistance value of the heater **23-1** and the temperature of the heater **23-1** included in the substrate processing apparatus **10** of the embodiment. A line **131** in the graph of FIG. **8** shows the relationship between the resistance value of the heater **23-1** and the temperature of the heater **23-1**. The line **131** indicates that the resistance value of the heater **23-1** increases as the temperature of the heater **23-1** increases. A line **132** in the graph of FIG. **8** shows a relationship between the resistance value measured by the resistance value sensor **72** of the power supply part **32-1** and the temperature of the heater **23-1**. The line **132** indicates that the resistance value measured by the resistance value sensor **72** of the power supply part **32-1** increases as the temperature of the heater **23-1** increases.

[0062] The resistance value measured by the resistance value sensor **72** of the power supply part **32-1** may be different from the resistance value of the heater **23-1** due to electrical elements provided in the electric circuit including the heater **23-1** and the resistance value sensor **72**. The electrical elements may include, for example, a wire, a terminal, and a filter. The graph of FIG. **8** shows that the line **131** and the line **132** have substantially the same shape, and indicates that the line **131** substantially overlaps the line **132** by translating the line **131** parallel to the horizontal axis. The graph of FIG. **8** indicates that, in the post-correction conversion table generated from the conversion table **111-1** by the offset adjustment, the resistance value measured by the resistance value sensor **72** of the power supply part **32-1** can be appropriately associated with the temperature of the heater **23-1**. The controller **80** is capable of calculating the temperature of the heater **23-1** with high accuracy by referring to the post-correction conversion table. Thus, it is possible to adjust the temperature of the heater **23-1** with high accuracy. The controller **80** is capable of calculating the temperatures of the plurality of heaters **23-1** to **23-*n*** with high accuracy by referring to the plurality of post-correction conversion tables similarly to this post-correction conversion table. Thus, it is possible to adjust the temperatures of the plurality of heaters **23-1** to **23-*n*** with high accuracy.

[0063] FIG. **9** is a graph showing a plurality of temperature differences in a comparative example and a plurality of temperature differences in an example in a first resistance value measurement test. In the first resistance value measurement test, the resistance values of the plurality of heaters **23-1** to **23**-*n* are measured a plurality of times using the resistance value sensor **72**, and the temperatures of the plurality of heaters **23-1** to **23**-*n* are respectively calculated based on the measured resistance values by referring to the plurality of post-correction conversion tables. A plurality of measurement zone numbers in the graph of FIG. **9** identify the plurality of regions **66-1** to **66**-*n*, respectively, that is, identify the plurality of heaters **23-1** to **23**-*n*, respectively, and the resistance value sensors **72** of the plurality of power supply parts **32-1** to **32**-*n*, respectively. A plurality of temperature differences correspond to the plurality of measurement zone numbers, that is, the plurality of heaters **23-1** to **23**-*n*, respectively. For example, among the plurality of temperature differences, the temperature difference corresponding to the heater **23-1** indicates a value obtained by subtracting the temperature of the heater **23-1** at the first time from the temperature of the heater **23-1** at the tenth time. The temperature of the heater **23-1** at the tenth time indicates the temperature calculated based on the resistance value measured at the tenth time by the resistance value sensor **72** of the power supply part **32-1**. The temperature of the heater **23-1** at the first time indicates the temperature calculated based on the resistance value measured by the resistance value sensor **72** of the power supply part **32-1** at the first time.

[0064] A bent line **142** in the graph of FIG. **9** indicates a plurality of temperature differences of the comparative example, and indicates a plurality of temperature differences when the length of the measurement interval of a plurality of resistance values is 1 sec, that is, when the measurement interval of the plurality of resistance values is shorter than the length of the interval **122**. The bent line **142** indicates that the plurality of temperature differences are relatively large, and that the variation of the temperature differences is 0.26 degrees C. A bent line **141** indicates a plurality of temperature differences of the example, and indicates a plurality of temperature differences when the length of the measurement interval of a plurality of resistance values is 5 sec, that is, when the measurement interval of the plurality of resistance values is equal to the length of the interval **122**. The bent line **141** indicates that the plurality of temperature differences in the example are smaller than the plurality of temperature differences in the comparative example. The bent line **141** further indicates that variation of the temperature differences in the example is 0.04 degrees C., and that the variation of the temperature differences in the example is smaller than the variation of the temperature differences in the comparative example.

[0065] The graph of FIG. **9** shows that when the resistance value measurement interval is sufficiently long, an increase in the temperatures of the plurality of heaters **23-1** to **23**-*n* caused by supplying power when measuring a resistance value is suppressed at the time of measuring the next resistance value so that the temperatures of the plurality of heaters **23-1** to **23**-*n* can be calculated with high accuracy. That is, the graph of FIG. **9** shows that the temperatures of the plurality of heaters **23-1** to **23**-*n* can be calculated with high accuracy through the offset adjustment of the substrate processing method described above. In the substrate processing system, since the temperatures of the plurality of heaters **23-1** to **23**-*n* are calculated with high accuracy, it is possible to adjust the temperature of the wafer **65** with high accuracy, and thus to appropriately process the wafer **65**.

[0066] FIG. **10** is a graph showing a plurality of temperatures in the comparative example and a plurality of temperatures of the example in a second resistance value measurement test. In the second resistance value measurement test, the resistance value of the heater **23-1** was measured a plurality of times using the resistance value sensor **72**, and the temperature of the heater **23-1** was calculated from a plurality of measured resistance values with reference to the post-correction conversion table. A bent line **152** indicates a plurality of temperatures in the comparative example. The plurality of temperatures in the comparative example indicate respective temperatures of the heater **23-1** when another heater different from and adjacent to the heater **23-1** among the plurality of heaters **23-1** to **23**-*n* is supplied with power in parallel with the heater **23-1**. Among the plurality of regions **66-1** to **66**-*n*, the region corresponding to the adjacent heater is adjacent to the region **66-1**. The bent line **152** indicates that the variation of the temperatures in the comparative example is 0.19 degrees C., and that the variation of the temperatures in the comparative example is relatively large.

[0067] A bent line **151** indicates a plurality of temperatures in the example. The plurality of temperatures in the example indicate respective temperatures of the heater **23-1** when another heater different from and not adjacent to the heater **23-1** among the plurality of heaters **23-1** to **23**-*n* is supplied with power in parallel with the heater **23-1**. Among the plurality of regions **66-1** to **66**-*n*, the region corresponding to the non-adjacent heater is not adjacent to the region **66-1**. The bent line **151** indicates that variation of the temperatures in the example is 0.04 degrees C., and that the variation of the temperatures in the example is smaller than the variation of the temperatures in the comparative example.

[0068] The graph of FIG. **10** shows that, by not measuring the resistance value of the heater that heats the region adjacent to the region **66-1** when the resistance value of the heater **23-1** is measured, the resistance value of the heater **23-1** is measured with higher accuracy. That is, the graph of FIG. **10** shows that the temperatures of the plurality of heaters **23-1** to **23**-*n* can be calculated with high accuracy through the offset adjustment of the substrate processing method described above. In the substrate processing system, since the temperatures of the plurality of heaters **23-1** to **23**-*n* are calculated with high accuracy through the offset adjustment, it is possible to appropriately generate a plurality of post-correction conversion tables. In the substrate processing system, since the plurality of post-correction conversion tables are appropriately generated, it is possible to calculate the temperatures of the plurality of heaters **23-1** to **23**-*n* with high accuracy. In the substrate processing system, since the temperatures of the plurality of heaters **23-1** to **23**-*n* are calculated with high accuracy, it is possible to adjust the temperature of the wafer **65** with high accuracy, and thus to appropriately process the wafer **65**.

[Effect of Substrate Processing System of Embodiment]

[0069] The substrate processing system of the embodiment includes the stage **11**, the heater **23-1**, the power supply part **32-1**, the resistance value sensor **72**, and the controller

80. The wafer **65** is mounted on the stage **11**. The heater **23-1** heats the wafer **65** when power is supplied thereto. The power supply part **32-1** supplies power to the heater **23-1**. The resistance value sensor **72** provided in the power supply part **32-1** measures the resistance value of the heater **23-1**. The controller **80** stores a conversion table **111-1** in which a plurality of resistance values are associated with a plurality of temperatures, respectively, and acquires a first reference resistance value measured by the resistance value sensor **72** of the power supply part **32-1** when the temperature of the heater **23-1** is the reference temperature. The controller **80** acquires a first temperature adjustment resistance value measured by the resistance value sensor **72** of the power supply part **32-1** after the wafer **65** is heated by the heater **23-1**. The controller **80** controls the power supply part **32-1** based on the conversion table **111-1**, the reference temperature, the first reference resistance value, and the first temperature adjustment resistance value.

[0070] In this substrate processing system, it is possible to calculate the temperature of the heater **23-1** with high accuracy from the measured resistance value, even if the correspondence relationship between the resistance value and the temperature according to the conversion table **111-1** is shifted relative to the correspondence relationship between the measured resistance value and the temperature of the heater **23-1**. In this substrate processing system, since the temperature of the heater **23-1** is calculated with high accuracy, it is possible to adjust the temperature of the heater **23-1** with high accuracy, and thus to appropriately process the wafer **65**.

[0071] Further, the substrate processing system of the embodiment further includes the plurality of heaters **23-1** to **23-*n***, the plurality of power supply parts **32-1** to **32-*n***, and the plurality of resistance value sensors. The controller **80** further stores the plurality of conversion tables **111-1** to **111-*n*** corresponding to the plurality of heaters **23-1** to **23-*n***. After the first reference resistance value is measured, the controller **80** acquires a second reference resistance value measured by the resistance value sensor **72** of the power supply part **32-2** corresponding to the heater **23-2** among the plurality of power supply parts **32-1** to **32-*n***. The controller **80** acquires a second temperature adjustment resistance value measured by the resistance value sensor **72** of the power supply part **32-2** after the wafer **65** is heated by the heater **23-2**. The controller **80** generates a post-correction conversion table by offset-adjusting the conversion table **111-2** corresponding to the heater **23-2** among the plurality of conversion tables **111-1** to **111-*n***, based on the reference temperature and the second reference resistance value. The controller **80** controls the power supply part **32-2**, which supplies power to the heater **23-2**, among the plurality of power supply parts **32-1** to **32-*n***, based on the temperature calculated based on the second temperature adjustment resistance value with reference to the post-correction conversion table.

[0072] In this substrate processing system, since the resistance values of the plurality of heaters **23-1** to **23-2** are measured in parallel, it is possible to measure the resistance values of all the plurality of heaters **23-1** to **23-*n*** in a short time. The substrate processing system can be set up in a short time since the resistance values of all the plurality of heaters **23-1** to **23-*n*** are measured in a short time.

[0073] In addition, the placement surface of the stage **11** of the substrate processing system of the embodiment facing the wafer **65** is divided into a plurality of regions **66-1** to **66-*n*** corresponding to the plurality of heaters **23-1** to **23-*n***. For example, the heater **23-1** heats the wafer **65** by heating the region **66-1** corresponding thereto among the plurality of regions **66-1** to **66-*n***. The heater **23-2** heats the wafer **65** by heating the region **66-2** corresponding thereto among the plurality of regions **66-1** to **66-*n***. In this case, the region **66-2** is arranged not to be adjacent to the region **66-1**.

[0074] In this substrate processing system, it is possible to suppress thermal interference of heating the heater **23-1** while the resistance value of the heater **23-2** is being measured, and thus to measure a plurality of reference resistance values corresponding to plurality of heaters **23-1** to **23-*n*** with high accuracy. In the substrate processing system, since the reference resistance values are measured with high accuracy, it is possible to generate a plurality of post-correction conversion tables with high accuracy, and thus to calculate the temperatures of the plurality of heaters **23-1** to **23-*n*** from the measured resistance values with high accuracy.

[0075] The resistance value sensors **72** of the plurality of power supply parts **32-1** to **32-*n*** of the substrate processing system according to the embodiment respectively measures a plurality of reference resistance values corresponding to the plurality of heaters **23-1** to **23-*n*** in any measurement period among a plurality of measurement periods **121-1** to **121-*m***. For example, a third reference resistance value corresponding to the heater **23-3** among the plurality of reference resistance values is measured in the measurement period **121-2** subsequent to the measurement period **121-1** in which the first and second reference resistance values are measured, among the plurality of measurement periods **121-1** to **121-*m***. In this case, among the plurality of regions **66-1** to **66-*n***, the region **66-3** corresponding to the heater **23-3** is arranged not to be adjacent to the region **66-1** and not to be adjacent to the region **66-2**.

[0076] In this substrate processing system, it is possible to suppress the thermal interference exerted from the heat of the heaters **23-1** and **23-2** on the measurement of the resistance value of the heater **23-3**, and thus to measure a plurality of reference resistance values corresponding to the plurality of heaters **23-1** to **23-*n*** with high accuracy. In the substrate processing system, since the reference resistance values are measured with high accuracy, it is possible to generate a plurality of post-correction conversion tables with high accuracy, and thus to calculate the temperatures of the plurality of heaters **23-1** to **23-*n*** from the measured resistance values with high accuracy.

[0077] In the offset adjustment of the substrate processing method described above, the plurality of second regions heated in the measurement period **121-2** are not adjacent to the plurality of first regions heated in the measurement period **121-1**, but may be adjacent to the plurality of first regions. Even in this case, in the substrate processing system, since the plurality of first regions are not adjacent to each other, it is possible to suppress thermal interference. Thus, it is possible to measure the reference resistance values of heaters corresponding to the plurality of first regions among the plurality of heaters **23-1** to **23-*n***, with high accuracy. In the substrate processing system, since the reference resistance values of the plurality of heaters are measured in the first measurement period **121-1**, it is possible to acquire a plurality of reference resistance values corresponding to the plurality of heaters **23-1** to **23-*n*** in a

short time. In the substrate processing system, it is possible to calculate the temperature of the heater **23-1** with high accuracy from the measured resistance value, even if the correspondence relationship between the resistance value and the temperature according to the conversion table **111-1** is shifted relative to the correspondence relationship between the measured resistance value and the temperature of the heater **23-1**.

[0078] In the offset adjustment of the substrate processing method described above, the plurality of first regions heated in the measurement period **121-1** are not adjacent to each other, but may be adjacent to each other. Even in this case, in the substrate processing system, since the reference resistance values of the plurality of heaters are measured during one measurement period **121-1**, it is possible to acquire a plurality of reference resistance values corresponding to the plurality of heaters **23-1** to **23-*n*** in a short time. In the substrate processing system, it is possible to calculate the temperature of the heater **23-1** with high accuracy from the measured resistance value, even if the correspondence relationship between the resistance value and the temperature according to the conversion table **111-1** is shifted with respect to the correspondence relationship between the measured resistance value and the temperature of the heater **23-1**.

[0079] In the offset adjustment of the substrate processing method described above, the resistance values of two or more heaters are measured among the plurality of heaters **23-1** to **23-*n*** in each of the plurality of measurement periods **121-1** to **121-*m***, but only the resistance value of one heater may be measured. Even in this case, in the substrate processing system, it is possible to calculate the temperature of the heater **23-1** with high accuracy from the measured resistance value, even if the correspondence relationship between the resistance value and the temperature according to the conversion table **111-1** is shifted relative to the correspondence relationship between the measured resistance value and the temperature of the heater **23-1**.

[0080] In the substrate processing apparatus **10** described above, plasma is used to etch the wafer **65**, in which various types of plasma may be used. The plasma may be, for example, capacitively coupled plasma (CCP), inductively coupled plasma (ICP), or radial line slot antenna plasma. Further, the plasma may be, for example, electron cyclotron resonance plasma (ECR) or helicon wave plasma (HWP).

EXPLANATION OF REFERENCE NUMERALS

[0081] **10**: substrate processing apparatus, **11**: stage, **23-1** to **23-*n***: plurality of heaters, **32-1** to **32-*n***: plurality of power supply parts, **33**: chiller unit, **65**: wafer, **66-1** to **66-*n***: plurality of regions, **71**: switch, **72**: resistance value sensor, **80**: controller, **111-1** to **111-*n***: plurality of conversion tables, **121-1** to **121-*m***: plurality of measurement periods

What is claimed is:

1. A substrate processing system comprising:

a stage on which a substrate is placed;

a plurality of heaters configured to heat the substrate by being supplied with power;

a plurality of power supply parts configured to supply power to the plurality of heaters, respectively;

a plurality of sensors corresponding to the plurality of heaters; and

a controller,

wherein the controller is configured to:

store a plurality of conversion tables corresponding to the plurality of heaters, in which a plurality of resistance values in the plurality of conversion tables llisll being associated with a plurality of temperatures;

acquire a plurality of reference resistance values corresponding to the plurality of heaters, the plurality of reference resistance values being measured by the plurality of sensors when a temperature of one heater among the plurality of heaters is a reference temperature;

acquire a plurality of temperature adjustment resistance values corresponding to the plurality of heaters, the plurality of temperature adjustment resistance values being measured by the plurality of sensors after the substrate is heated by the plurality of heaters; and

control the plurality of power supply parts based on the plurality of conversion tables, the reference temperature, the plurality of reference resistance values, and the plurality of temperature adjustment resistance values,

wherein the plurality of sensors respectively measure the plurality of reference resistance values in any of a plurality of measurement periods,

a first reference resistance value corresponding to a first heater among the plurality of reference resistance values is measured in a first measurement period among the plurality of measurement periods,

a second reference resistance value corresponding to a second heater among the plurality of reference resistance values is measured in a second measurement period among the plurality of measurement periods, subsequent to the first measurement period, and

a second region corresponding to the second heater among a plurality of regions is arranged not to be adjacent to a first region corresponding to the first heater among the plurality of regions, and

the controller is further configured to set a length of an interval between the plurality of measurement periods based on a time when a temperature of the first heater decreases and becomes equal to a chiller temperature after the first measurement period among the plurality of measurement periods in which power is supplied to the first heater corresponding to the first measurement period.

2. The substrate processing system of claim **1**,

wherein the controller is configured to:

acquire the first reference resistance value measured by a first sensor corresponding to a first heater among the plurality of sensors after a reference resistance value is measured;

acquire a first temperature adjustment resistance value measured by the first sensor after the substrate is heated by the first heater; and

control a first power supply part configured to supply power to the first heater among the plurality of power supply parts based on a first conversion table corresponding to the first heater among the plurality of conversion tables, the reference temperature, the first reference resistance value, and the first temperature adjustment resistance value.

3. The substrate processing system of claim **2**, wherein a placement surface of the stage facing the substrate is divided into the plurality of regions corresponding to the plurality of heaters including the one heater,

the one heater heats the substrate by heating one region corresponding thereto among the plurality of regions,

the first heater heats the substrate by heating the first region corresponding thereto among the plurality of regions, and

the first region is arranged not to be adjacent to the one region.

4. The substrate processing system of claim **3**, wherein during the first measurement period, a reference resistance value and the first reference resistance value are measured.

5. A substrate processing method executed using a substrate processing apparatus comprising a stage on which a substrate is placed, a plurality of heaters configured to heat the substrate by being supplied with power, a plurality of power supply parts configured to supply power to the plurality of heaters, respectively, and a plurality of sensors corresponding to the plurality of heaters, wherein the substrate processing method comprises:

storing a plurality of conversion tables corresponding to the plurality of heaters, a plurality of resistance values in the plurality of conversion tables being associated with a plurality of temperatures;

acquiring a plurality of reference resistance values corresponding to the plurality of heaters, the plurality of reference resistance values being measured by the plurality of sensors when a temperature of one heater among the plurality of heaters is a reference temperature;

acquiring a plurality of temperature adjustment resistance values corresponding to the plurality of heaters, the plurality of temperature adjustment resistance values being measured by the plurality of sensors after the substrate is heated by the plurality of heaters; and

controlling the plurality of power supply parts based on the plurality of conversion tables, the reference temperature, the plurality of reference resistance values, and the plurality of temperature adjustment resistance values,

wherein the plurality of sensors respectively measure the plurality of reference resistance values in any of a plurality of measurement periods,

a first reference resistance value corresponding to a first heater among the plurality of reference resistance values is measured in a first measurement period among the plurality of measurement periods,

a second reference resistance value corresponding to a second heater among the plurality of reference resistance values is measured in a second measurement period among the plurality of measurement periods, subsequent to the first measurement period, and

a second region corresponding to the second heater among a plurality of regions is arranged not to be adjacent to a first region corresponding to the first heater among the plurality of regions, and

the substrate processing method further comprises: setting a length of an interval between the plurality of measurement periods based on a time when a temperature of the first heater decreases and becomes equal to a chiller temperature after the first measurement period among the plurality of measurement periods in which power is supplied to the first heater corresponding to the first measurement period.

6. The substrate processing system of claim **1**, wherein the interval between the plurality of measurement periods is equal to a predetermined length.

7. The substrate processing system of claim **1**, wherein the plurality of sensors respectively measure a plurality of reference resistance values corresponding to the plurality of heaters in any of the plurality of measurement periods,

a third reference resistance value corresponding to a third heater among the plurality of reference resistance values is measured in a third measurement period among the plurality of measurement periods, subsequent to the first measurement period or the second measurement period, and

a third region corresponding to the third heater among the plurality of regions is arranged not to be adjacent to the first region and the second region.

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