

Claims:

1. A plasma processing apparatus comprising:
 - a chamber main body defining a chamber;
 - 5 a stage, provided in the chamber, including a lower electrode and an electrostatic chuck provided on the lower electrode, on which a focus ring is arranged to surround a substrate mounted on the electrostatic chuck;
 - a first high frequency power supply configured to
10 supply a first high frequency power for generating plasma of a gas in the chamber;
 - a second high frequency power supply configured to supply a second high frequency power for ion attraction to the lower electrode;
 - 15 a DC power supply configured to generate a negative DC voltage to be applied to the focus ring in order to correct inclination of an incident direction of ions to an edge region of the substrate mounted on the electrostatic chuck with respect to a vertical direction;
 - 20 a switching unit configured to stop the application of the DC voltage to the focus ring; and
 - a controller configured to control one or both of the high frequency power supply and the second high frequency power supply and control the switching unit,
 - 25 wherein the controller controls one or both of the first high frequency power supply and the second high

frequency power supply to periodically stop the supply of one or both of the first high frequency power and the second high frequency power, and

the controller also controls the switching unit to
5 apply the DC voltage to the focus ring from a first time after a predetermined period of time in which a self-bias voltage of the lower electrode is decreased from a start point of each period in which one or both of the first high frequency power and the second high frequency power are
10 supplied and to stop the application of the DC voltage to the focus ring during each period in which the supply of one or both of the first high frequency power and the second high frequency power is stopped.

15 2. The plasma processing apparatus of claim 1, wherein the controller controls the switching unit to stop the application of the DC voltage to the focus ring at a second time earlier than an end point of each period in which one or both of the first high frequency power and the second
20 high frequency power are supplied.

3. The plasma processing apparatus of claim 2, further comprising:

a main control unit; and
25 a measuring device configured to measure the self-bias voltage of the lower electrode;

wherein the DC power supply is configured to generate the DC voltage whose absolute value is a sum of an absolute value of the self-bias voltage measured by the measuring device and a set value designated by the main control unit,
5 and

the main control unit is configured to determine the set value from the self-bias voltage of the lower electrode specified from a processing condition and an amount of consumption of the focus ring by using a predetermined
10 function or table.

4. The plasma processing apparatus of claim 3, wherein the DC power supply is configured to obtain the self-bias voltage measured by the measuring device between the second
15 time and the end point in each period in which one or both of the first high frequency power and the second high frequency power are supplied and to generate the DC voltage whose absolute value is the sum of the set value and an absolute value of the measured self-bias voltage in a next
20 period in which one or both of the first high frequency power and the second high frequency power are supplied.

5. The plasma processing apparatus of claim 1, wherein the controller is configured to control a duration of
25 applying the DC voltage to the focus ring in each period in which one or both of the first high frequency power and the

second high frequency power are supplied in order to correct the inclination.

6. A plasma processing method performed by using a plasma processing apparatus comprising a chamber main body defining a chamber; a stage, provided in the chamber, including a lower electrode and an electrostatic chuck provided on the lower electrode, on which a focus ring is arranged to surround a substrate mounted on the electrostatic chuck; a first high frequency power supply configured to supply a first high frequency power for generating plasma of a gas in the chamber; a second high frequency power supply configured to supply a second high frequency power for ion attraction to the lower electrode; a DC power supply configured to generate a negative DC voltage to be applied to the focus ring in order to correct inclination of an incident direction of ions to an edge region of the substrate mounted on the electrostatic chuck with respect to a vertical direction; a switching unit configured to stop the application of the DC voltage to the focus ring; and a controller configured to control one or both of the high frequency power supply and the second high frequency power supply and control the switching unit, the method comprising:

supplying one or both of the first high frequency power and the second high frequency power; and

stopping the supply of one or both of the first high frequency power and the second high frequency power,

wherein said supplying one or both of the first high frequency power and the second high frequency power and said
5 stopping the supply of one or both of the first high frequency power and the second high frequency power are alternately executed,

the method further comprising:

applying the DC voltage to the focus ring from a first
10 time after a predetermined period of time in which a self-bias voltage of the lower electrode is decreased from a start point of each period in which one or both of the first high frequency power and the second high frequency power are supplied; and

15 stopping the application of the DC voltage to the focus ring during each period in which the supply of one or both of the first high frequency power and the second high frequency power is stopped.

20 7. The plasma processing method of claim 6, wherein said stopping the application of the DC voltage starts at a second time earlier than an end point of each period in which one or both of the first high frequency power and the second high frequency power are supplied.

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8. The plasma processing method of claim 7, wherein the

plasma processing apparatus further includes:

a main control unit; and

a measuring device configured to measure the self-bias voltage of the lower electrode,

5 wherein the main control unit is configured to determine a set value from the self-bias voltage of the lower electrode specified from a process condition and an amount of consumption of the focus ring by using a predetermined function or table, and

10 wherein in said applying the DC voltage, the DC voltage whose absolute value is a sum of the set value determined by the main control unit and an absolute value of the self-bias voltage measured by the measuring device is applied to the focus ring.

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9. The plasma processing method of claim 8, wherein the self-bias voltage measured by the measuring device between the second time and the end point in each period in which one or both of the first high frequency power and the second high frequency power are supplied is obtained, and the DC voltage whose absolute value is the sum of the set value and an absolute value of the measured self-bias voltage is applied to the focus ring in a next period in which one or both of the first high frequency power and the second high frequency power are supplied.

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10. A plasma processing method performed by using a plasma processing apparatus comprising a chamber main body defining a chamber; a stage, provided in the chamber, including a lower electrode and an electrostatic chuck provided on the lower electrode, on which a focus ring is arranged to surround a substrate mounted on the electrostatic chuck; a first high frequency power supply configured to supply a first high frequency power for generating plasma of a gas in the chamber; a second high frequency power supply configured to supply a second high frequency power for ion attraction to the lower electrode; a DC power supply configured to generate a negative DC voltage to be applied to the focus ring in order to correct inclination of an incident direction of ions to an edge region of the substrate mounted on the electrostatic chuck with respect to a vertical direction; a switching unit configured to stop the application of the DC voltage to the focus ring; and a controller configured to control one or both of the high frequency power supply and the second high frequency power supply and control the switching unit, the method comprising:

- supplying one or both of the first high frequency power and the second high frequency power, and
- applying the DC voltage to the focus ring from a first time after a predetermined period of time in which a self-bias voltage of the lower electrode is decreased from a start point of a period in which one or both of the first

high frequency power and the second high frequency power are supplied.

11. The plasma processing method of claim 10, wherein the
5 method further comprises stopping the application of the DC voltage to the focus ring.

12. The plasma processing method of claim 11, wherein the plasma processing apparatus further includes:

10 a main control unit; and
 a measuring device configured to measure the self-bias voltage of the lower electrode,

 wherein the main control unit is configured to determine a set value from the self-bias voltage of the
15 lower electrode specified from a process condition and an amount of consumption of the focus ring by using a predetermined function or table, and

 wherein in said applying the DC voltage, the DC voltage whose absolute value is a sum of the set value
20 determined by the main control unit and an absolute value of the self-bias voltage measured by the measuring device is applied to the focus ring.