electrode and the plasma is hindered. As a result, the state of the plasma is different from the design-time state. Thus, the process may become unstable, leading to an increased gap between the result of the process and the desired result.

[0011] To address this, the present disclosure provides a technique capable of achieving process stabilization while suppressing wear of components in a chamber.

[0012] (First embodiment)

[Configuration of plasma processing apparatus 1]

FIG. 1 is a schematic diagram illustrating an example of a plasma processing apparatus 1. In the present embodiment, the plasma processing apparatus 1 is, for example, a capacitively coupled plasma processing apparatus. A plasma processing apparatus 1 includes a plasma processing chamber 10, a gas supplier 20, a power supply 30, and an exhaust system 40. The plasma processing apparatus 1 includes a substrate support 11 and a gas introducer. The gas introducer is configured to introduce at least one gas into the plasma processing chamber 10. The gas introducer includes a showerhead 13. The substrate support 11 is disposed in the plasma processing chamber 10. The showerhead 13 is arranged above the substrate support 11. In an embodiment, the showerhead 13 forms at least a part of a ceiling of the plasma processing chamber 10. The plasma processing chamber 10 has a plasma processing space 10s defined by the showerhead 13, a lateral wall 10a of the plasma processing chamber 10, and the substrate support 11.

[0013] The plasma processing chamber 10 includes at least one gas supply port for supplying at least one gas to the plasma processing space 10s and at least one gas discharge port for discharging the gas from the plasma processing space. The plasma processing chamber 10 is

processing space 10s. The showerhead 13 includes at least one gas supply port 13a, at least one gas diffusion chamber 13b, and a plurality of gas introduction ports 13c. The gas supplied to the gas supply port 13a is introduced from a plurality of gas introduction ports 13c into the plasma processing space 10s through the gas diffusion chamber 13b. In addition, the showerhead 13 includes at least one upper electrode. The gas introducer may include, in addition to the showerhead 13, one or more side gas injectors (SGI) mounted in one or more openings formed in the lateral wall 10a.

[0020] The gas supplier 20 may include at least one gas source 21 and at least one flow control device 22. In an embodiment, the gas supplier 20 is configured to supply at least one gas from the corresponding gas source 21 through the corresponding flow control device 22 to the showerhead 13. Each flow control device 22 may include, for example, a mass flow controller or a flow controller of pressure control type. Further, the gas supplier 20 may include one or more flow modulation devices that modulate or pulse the flow of at least one gas.

[0021] The power supply 30 includes an RF power supply 31 coupled to the plasma processing chamber 10 through at least one impedance matching circuit. The RF power supply 31 is configured to supply at least one RF signal (RF power) to the at least one lower electrode and/or the at least one upper electrode. This forms plasma from at least one gas supplied to the plasma processing space 10s. Therefore, the RF power supply 31 can function as at least a part of a plasma generator configured to produce plasma from one or more gases in the plasma processing chamber 10. In addition, by supplying a bias RF signal to at least one lower electrode, a bias potential is generated in the

into the plasma processing chamber 10 through the showerhead 13. In the plasma processing chamber 10, the third gas is turned into plasma by the RF power for plasma production which is supplied from the power supply 30 into the plasma processing chamber 10. In addition, RF power for biasing and a DC signal are supplied from the power supply 30 into the plasma processing chamber 10 as necessary. Processing such as film formation and etching is performed on the substrate W by, for example, active species and ions contained in the plasma. In step S13, reaction by-products (so-called deposits) generated due to the processing of the substrate W attach to the surface of the protective film formed on the surfaces of components in the plasma processing chamber 10 in step S11.

[0037] In the present embodiment, when the substrate W is etched, a gas capable of etching a film to be etched, which the substrate W has, is used as the third gas. When the film to be etched is a silicon oxide film or a silicon nitride film, the third gas contains fluorocarbon gas or hydrofluorocarbon gas. When the film to be etched is a silicon film or a metal film, the third gas contains a halogen-containing gas. When the film to be etched is an organic film, the third gas contains an oxygen-containing gas and a hydrogen-containing gas.

[0038] Next, the substrate W is taken out from the inside of the plasma processing chamber 10 (step S14). In step S14, the controller 2 controls a lift pin driving mechanism so that the tip of a lift pin protrudes from the upper surface of the electrostatic chuck 1111. Accordingly, the processed substrate W is lifted from the electrostatic chuck 1111. The controller 2 controls the gate valve G so as to open the gate valve G. The processed substrate W is then taken out from the plasma processing

S41). Step S41 is an example of process d1). The target contains a first element that is at least one of carbon, silicon and germanium, and a second element that is at least one of boron, nitrogen, phosphorus and arsenic. In the present embodiment, a substrate W" on which the target is arranged is introduced into the plasma processing chamber 10, and placed on an electrostatic chuck 1111. As long as the target is arranged in the plasma processing chamber 10, it may be arranged in the plasma processing chamber 10 in a form other than the substrate W", for example, in the form of an edge ring in which the target is arranged.

[0080] Next, sputtering is performed in the plasma processing chamber 10 (step S42). Step S42 is an example of process d2). In step S42, a rare gas is supplied from the gas supplier 20 into the plasma processing chamber 10 through the showerhead 13. In the plasma processing chamber 10, the rare gas is turned into plasma by the RF power for plasma production which is supplied from the power supply 30 into the plasma processing chamber 10. In addition, RF power for biasing and a DC signal are supplied from the power supply 30 into the plasma processing chamber 10 as necessary. The first element and the second element contained in the target are driven out by ions contained in the plasma, and a conductive protective film is formed on the surfaces of components in the plasma processing chamber 10. The target is taken out from the inside of the plasma processing chamber 10 (step S43). Processing in and after step S24 is performed.

[0081] In sputtering in step S42, an additive gas may be supplied together with the rare gas. The additive gas contains at least one of boron, nitrogen, phosphorus and arsenic. Accordingly, a protective film having higher

plasma (ECP), and helicon wave-excited plasma (HWP).

[0087] In addition, it should be considered that the embodiments disclosed herein are illustrative in all respects, and are not restrictive. Indeed, the embodiments described above can be implemented in various forms. In addition, in the embodiments described above, omissions, replacements or changes may be made in various forms without departing from the appended claims and the spirit thereof.

[0088] In addition, in relation to the embodiments described above, the following supplements are further disclosed.

CLAIMS

Claim 1. A plasma processing method for processing a substrate using plasma, comprising:

a1) a process of coating a surfaces of a component in a chamber with a conductive film by turning a first gas and a second gas into plasma in the chamber;

a2) a process of introducing the substrate into the chamber; and

a3) a process of processing the substrate by turning a third gas into plasma in the chamber in a state where the surface of the component in the chamber is coated with the conductive film,

the first gas containing at least one of carbon, silicon and germanium,

the second gas containing at least one of boron, nitrogen, phosphorus and arsenic.

Claim 2. The plasma processing method according to claim 1, wherein

in the process a1),

the surface of the component in the chamber is coated with a conductive film by turning the first gas and the second gas into plasma in the chamber in a state where an inside of the chamber is supplied with both the first gas and the second gas.

Claim 3. The plasma processing method according to claim 1, wherein

in the process a1),

the surface of the component in the chamber is coated with a conductive film by turning the second gas into plasma after turning the first gas into plasma in the chamber.

Claim 4. The plasma processing method according to any one of claims 1 to 3, wherein the first gas contains at least one of hydrocarbon gas, hydrofluorocarbon gas, fluorocarbon gas and carbon tetrachloride gas.

Claim 5. The plasma processing method according to any one of claims 1 to 3, wherein the first gas contains at least one of aminosilane gas, monosilane gas, disilane gas, dichlorosilane gas, silicon tetrachloride gas and silicon tetrafluoride gas.

Claim 6. The plasma processing method according to any one of claims 1 to 3, wherein the first gas contains at least one of monogermane gas and germanium tetrachloride gas.

Claim 7. The plasma processing method according to any one of claims 1 to 3, wherein the second gas contains at least one of boron trifluoride gas, boron trichloride gas, monoborane gas, diborane gas and boron tribromide gas.

Claim 8. The plasma processing method according to any one of claims 1 to 3, wherein the second gas contains at least one of nitrogen gas, ammonia gas, nitrogen trifluoride gas, nitrogen trichloride gas, nitrogen monoxide gas, nitrous oxide gas, nitrogen dioxide gas and trimethylamine gas.

Claim 9. The plasma processing method according to any one of claims 1 to 3, wherein the second gas contains at least one of phosphorus trifluoride gas, phosphorus trichloride gas, phosphine gas, phosphorus pentafluoride gas, phosphorus pentachloride gas, phosphorus tribromide gas and phosphoryl chloride gas.

Claim 10. The plasma processing method according to any one of claims 1 to 3, wherein the second gas contains at least one of arsine gas, arsenic trifluoride gas, arsenic pentafluoride gas, arsenic trichloride gas and arsenic pentachloride gas.

Claim 11. A plasma processing method for processing a substrate using plasma, comprising:

b1) a process of arranging a target containing a predetermined element in a chamber;

b2) a process of coating a surfaces of a component in the chamber with a conductive film by turning a rare gas and an additive gas into plasma to sputter the target in the chamber;

b3) a process of introducing the substrate into the chamber; and

b4) a process of processing the substrate by turning a processing gas into plasma in the chamber in a state where the surface of the component in the chamber are coated with the conductive film,

the element being at least one of carbon, silicon and germanium,

the additive gas containing at least one of boron, nitrogen, phosphorus and arsenic.

Claim 12. A plasma processing method for processing a substrate using plasma, comprising:

c1) a process of arranging a target containing a predetermined element in a chamber;

c2) a process of coating a surface of a component in the chamber with a film containing the element by turning a rare gas into plasma to sputter the target in the chamber;

c3) a process of reforming the film applied to the surface of the component in the chamber and containing the element into a conductive film by turning a reforming gas into plasma in the chamber;

c4) a process of introducing the substrate into the chamber; and

c5) a process of processing the substrate by turning a processing gas into plasma in the chamber in a state where the surface of the component in the chamber is coated with the conductive film,

the element being at least one of carbon, silicon and germanium,

the reforming gas containing at least one of boron, nitrogen, phosphorus and arsenic.

Claim 13. A plasma processing method for processing a substrate using plasma, comprising:

d1) a process of arranging a target containing a predetermined first element and second element in a chamber;

d2) a process of coating a surface of a component in the chamber with a conductive film by turning a rare gas into plasma to sputter the target in the chamber;

d3) a process of introducing the substrate into the chamber; and

d4) a process of processing the substrate by turning a processing gas into plasma in the chamber in a state where the surface of the component in the chamber is coated with the conductive film,

the first element being at least one of carbon, silicon and germanium,

the second element being at least one of boron, nitrogen, phosphorus and arsenic.

Claim 14. A plasma processing apparatus comprising:

a chamber having a gas supply port and a gas discharge port;

a substrate support that is provided in the chamber, and supports a substrate;

a plasma generator that produces plasma from a gas supplied into the chamber; and

a controller, wherein

the controller executes:

a1) a process of coating a surface of a component in the chamber with a conductive film with a first gas and a second gas turned into plasma in the chamber by controlling the plasma generator;

a2) a process of placing the substrate introduced into the chamber on the substrate support; and

a3) a process of processing the substrate with a third gas turned into plasma in the chamber in a state where the surface of the component in the chamber is coated with the conductive film, by controlling the plasma generator,

the first gas contains at least one of carbon, silicon, and germanium, and

the second gas contains at least one of boron, nitrogen, phosphorus, and arsenic.

Claim 15. A plasma processing apparatus comprising:

a chamber having a gas supply port and a gas discharge port;

a substrate support that is provided in the chamber, and supports a substrate;

a plasma generator that produces plasma from a gas supplied into the chamber; and

a controller, wherein

the controller executes:

b1) a process of arranging a target containing a predetermined element in the chamber;

b2) a process of coating a surface of a component in the chamber with a conductive film with a rare gas and an additive gas turned into plasma to sputter the target in the chamber by controlling the plasma generator;

b3) a process of placing the substrate introduced into the chamber on the substrate support; and

b4) a process of processing the substrate with a processing gas turned into plasma in the chamber in a state where the surface of the component in the chamber is coated with the conductive film, by controlling the plasma generator,

the element contains at least one of carbon, silicon, and germanium, and

the additive gas contains at least one of boron, nitrogen, phosphorus, and arsenic.

Claim 16. A plasma processing apparatus comprising:

a chamber having a gas supply port and a gas discharge port;

a substrate support that is provided in the chamber, and supports a substrate;

a plasma generator that produces plasma from a gas supplied into the chamber; and

a controller, wherein

the controller executes:

c1) a process of arranging a target containing a predetermined element in the chamber;

c2) a process of coating a surface of a component in the chamber with a film containing the element with a rare gas turned into plasma to sputter the target in the chamber

by controlling the plasma generator;

c3) a process of reforming the film applied to the surface of the component in the chamber and containing the element into a conductive film with a reforming gas turned into plasma in the chamber by controlling the plasma generator;

c4) a process of placing the substrate introduced into the chamber on the substrate support; and

c5) a process of processing the substrate with a processing gas turned into plasma in the chamber in a state where the surface of the component in the chamber is coated with the conductive film, by controlling the plasma generator,

the predetermined element contains at least one of carbon, silicon, and germanium, and

the reforming gas contains at least one of boron, nitrogen, phosphorus, and arsenic.

Claim 17. A plasma processing apparatus comprising:

a chamber having a gas supply port and a gas discharge port;

a substrate support that is provided in the chamber, and supports a substrate;

a plasma generator that produces plasma from a gas supplied into the chamber; and

a controller, wherein

the controller executes:

d1) a process of arranging a target containing a predetermined first element and second element in the chamber;

d2) a process of coating a surface of a component in the chamber with a conductive film with a rare gas turned into plasma to sputter the target in the chamber by

controlling the plasma generator;

d3) a process of placing the substrate introduced into the chamber on the substrate support; and

d4) a process of processing the substrate with a processing gas turned into plasma in the chamber in a state where the surface of the component in the chamber is coated with the conductive film, by controlling the plasma generator,

the first element is at least one of carbon, silicon, and germanium, and

the second element is at least one of boron, nitrogen, phosphorus, and arsenic.