CLAIMS

1. A plasma processing apparatus comprising:

a chamber;

a substrate support in the chamber, the substrate support including

a base, and

an electrostatic chuck on the base;

a plasma generator including a radio-frequency power supply and configured to generate plasma in the chamber;

a bias power supply configured to generate an electrical bias to draw ions from the plasma into a substrate on the substrate support, the bias power supply and/or the radio-frequency power supply being electrically coupled to the base;

an edge ring placed to surround the substrate on the substrate support, the edge ring being conductive;

a lifter configured to raise and lower the edge ring, the lifter including

a conductive ring configured to be electrically coupled to the edge ring while supporting the edge ring placed on the conductive ring,

a rod extending in a vertical direction below the conductive ring,

an actuator configured to raise and lower the edge ring with the rod and the conductive ring, and a connector configured to electrically couple the conductive ring and the base;

a switch configured to switch between a first state in which the edge ring and the base are electrically coupled to each other and a second state in which the edge ring and the base are electrically disconnected from each other; and

a controller configured to control the switch to switch between the first state and the second state.

2. The plasma processing apparatus according to claim 1, wherein

the lifter is the switch configured to establish the second state by lowering the conductive ring with the actuator to separate the conductive ring from the edge ring.

3. The plasma processing apparatus according to claim 1, wherein

the switch includes a switching element coupled between the connector and the conductive ring or between the connector and the base.

4. The plasma processing apparatus according to claim 1, wherein

the switch includes another lifter configured to raise the edge ring from the conductive ring to establish the second state.

5. The plasma processing apparatus according to any one of claims 1 to 4, wherein

the controller

controls the switch to establish the first state when plasma processing specified in a recipe is plasma processing to be performed on the substrate on the substrate support, and

controls the switch to establish the second state when the plasma processing specified in the recipe is plasma cleaning of the chamber.

6. The plasma processing apparatus according to claim 3, wherein

the controller

controls the switch to establish the first state when plasma processing specified in a recipe is plasma processing to be performed on the substrate on the substrate support,

controls the switch to establish the second state when the plasma processing specified in the recipe is plasma cleaning of the chamber, and

controls the lifter to position the edge ring higher when the plasma cleaning is performed than when the plasma processing is performed on the substrate.

7. The plasma processing apparatus according to claim 6, wherein

the edge ring includes an inner circumferential portion and an outer circumferential portion, the outer circumferential portion being located on the conductive ring while the edge ring is being supported on the conductive ring, and

the outer circumferential portion has a vertical length to cover the conductive ring from a space above the substrate support during the plasma cleaning.

8. The plasma processing apparatus according to claim 6, wherein

the lifter further includes a film covering a surface of the conductive ring to protect the conductive ring from the plasma.

9. The plasma processing apparatus according to any one of claims 6 to 8, wherein

the electrostatic chuck includes, below the edge ring, an electrode incorporated therein,

the plasma processing apparatus further comprises another switching element electrically coupled between the base and the electrode, and

the controller

controls the switching element included in the switch to electrically disconnect the conductive ring from the base during the plasma cleaning to couple the conductive ring to a ground, and

controls the other switching element to electrically couple the electrode and the base to each other during the plasma cleaning.

10. The plasma processing apparatus according to claim 4, wherein

the lifter is conductive and further includes a protective member on the conductive ring, and

the controller

controls the switch to establish the first state when plasma processing specified in a recipe is plasma processing to be performed on the substrate on the substrate support,

controls the switch to establish the second state when the plasma processing specified in the recipe is plasma cleaning of the chamber, and

controls the other lifter to position the edge ring higher when the plasma cleaning is performed than when the plasma processing is performed on the substrate and position the edge ring above and spaced from the conductive ring and the protective member.

11. The plasma processing apparatus according to claim 10, wherein

the protective member is formed of a material same as a material of the edge ring.

12. The plasma processing apparatus according to any one of claims 1 to 4, wherein

the controller

causes the switch to establish the first state to perform plasma etching specified in a recipe to form a recess on the substrate on the substrate support,

causes the switch to establish the second state to perform ashing specified in the recipe to remove a deposit on the substrate, and

causes the switch to establish the first state after the ashing to perform plasma etching specified in the recipe to increase a depth of the recess.

13. The plasma processing apparatus according to any one of claims 1 to 4, wherein

the controller causes the switch to establish, with the edge ring placed on the substrate support, the second state to perform first plasma cleaning of the chamber specified in a recipe,

causes the switch to establish, with the edge ring placed on the substrate support, the first state to perform second plasma cleaning of the chamber specified in the recipe, and

causes the switch to establish, after the edge ring on the substrate support is replaced, the second state to perform seasoning of the chamber specified in the recipe.

14. The plasma processing apparatus according to any one of claims 1 to 4, further comprising:

a sensor configured to measure an amount of a deposit on the edge ring, wherein

the controller

controls the switch to establish the first state to perform plasma cleaning of the chamber specified in a recipe to remove the deposit, and

controls the switch to establish the second state when the amount of the deposit measured by the sensor during the plasma cleaning reaches or falls below a threshold.

15. A plasma processing method implementable using the plasma processing apparatus according to any one of claims 1 to 4, the method comprising:

reading, with the controller, a recipe;

controlling the switch based on the recipe; and performing plasma processing based on the recipe.

16. The plasma processing method according to claim 15, wherein

controlling the switch includes

controlling the switch to establish the first state when the plasma processing specified in the recipe is plasma processing to be performed on the substrate on the substrate support, and

controlling the switch to establish the second state when the plasma processing specified in the recipe is plasma cleaning of the chamber.

17. The plasma processing method according to claim 16, wherein

the edge ring is positioned higher when the plasma cleaning is performed than when the plasma processing is performed on the substrate.

18. The plasma processing method according to claim 17, wherein

the conductive ring is electrically disconnected from the base during the plasma cleaning and is coupled to a ground, and

during the plasma cleaning, an electrode incorporated in the electrostatic chuck below the edge ring and the base are electrically coupled to each other with a switching element.

19. The plasma processing method according to claim 15, wherein

controlling the switch includes causing the switch to establish the first state to form a recess on the substrate on the substrate support, and performing the plasma processing includes performing plasma etching specified in the recipe,

controlling the switch includes causing the switch to establish the second state to remove a deposit on the substrate, and performing the plasma processing includes performing

ashing specified in the recipe, and

controlling the switch includes causing the switch to establish the first state after the ashing to increase a depth of the recess, and performing the plasma processing includes performing plasma etching specified in the recipe.

20. The plasma processing method according to claim 15, wherein

controlling the switch includes causing the switch to establish the second state with the edge ring placed on the substrate support, and performing the plasma processing includes performing first plasma cleaning of the chamber specified in the recipe,

controlling the switch includes causing the switch to establish the first state with the edge ring placed on the substrate support, and performing the plasma processing includes performing second plasma cleaning of the chamber specified in the recipe, and

controlling the switch includes causing the switch to establish the second state after the edge ring on the substrate support is replaced, and performing the plasma processing includes performing seasoning of the chamber specified in the recipe.

21. The plasma processing method according to claim 15, wherein

the plasma processing apparatus further includes a sensor configured to measure an amount of a deposit on the edge ring,

controlling the switch includes causing the switch to establish the first state to remove the deposit, and

performing the plasma processing includes performing plasma cleaning of the chamber specified in the recipe, and

controlling the switch includes controlling the switch to establish the second state when the amount of the deposit measured by the sensor during the plasma cleaning reaches or falls below a threshold.