

Claims

1. An apparatus for etching a substrate, comprising:

a chamber;

a substrate support disposed in the chamber, the substrate support having an electrode, an electrostatic chuck disposed on the electrode, and a conductive edge ring disposed to surround the substrate placed on the electrostatic chuck;

a radio frequency (RF) power supply configured to supply RF power to generate plasma from a gas inside the chamber; and

a RF filter whose impedance is variable,

wherein the edge ring and the RF filter are electrically directly connected through a connecting unit, the connecting unit including a conductor member, and

a gap is located directly between the electrode and the edge ring, the conductor member is located in the gap and spanning the gap between the electrode and the edge ring, and the conductor member is directly in contact with the electrode and the edge ring.

2. The apparatus of claim 1, further comprising:

a controller,

wherein the controller is configured to execute a process of changing a voltage generated in the edge ring by varying the impedance.

3. The apparatus of claim 1 or 2, further comprising:

an additional RF power supply configured to supply RF bias power for drawing ions into the substrate,

wherein a frequency of the RF bias power is in a range from 5 MHz or less.

4. The apparatus of any one of claims 1 to 3, wherein the connecting unit includes a conductor structure that connects the edge ring and the RF filter.

5. The apparatus of claim 4, wherein the conductor member is provided between the edge ring and the conductor structure.

6. The apparatus of claim 5, wherein the conductor member is an elastic body and a contact pressure acting between the edge ring and the conductor structure is adjusted by an elastic force of the conductor member.

7. The apparatus of claim 5 or 6, wherein the connecting unit includes a plurality of conductor members, and

the conductor members are disposed at equal intervals on a concentric circle with the edge ring.

8. The apparatus of claim 5 or 6, wherein the conductor member has an annular shape and is disposed concentrically with the edge ring.

9. The apparatus of claim 4, wherein the connecting unit further includes a clamp member that fittedly encloses the edge ring therein on a side of the conductor structure and connects the edge ring and the conductor structure.

10. The apparatus of any one of claims 4 to 9, wherein the connecting

unit further includes a relay member that has an annular shape and is disposed concentrically with the edge ring in the conductor structure.

11. The apparatus of any one of claims 4 to 10, wherein the edge ring is attracted to and held on a peripheral portion of the electrostatic chuck by an electrostatic force, and a contact pressure acting between the edge ring and the conductor structure is adjusted by the electrostatic force.

12. The apparatus of claim 11, further comprising:

a supply unit configured to supply a gas to a gap between a bottom surface of the edge ring and an edge ring support surface of the electrostatic chuck;

an exhaust unit configured to evacuate the gap between the bottom surface of the edge ring and the edge ring support surface of the electrostatic chuck; and

a controller,

wherein the controller controls the supply unit and the exhaust unit, so that a desired pressure acts on the bottom surface of the edge ring when the edge ring is attracted to and held on the electrostatic chuck.

13. The apparatus of any one of claims 1 to 12, wherein the RF filter whose impedance is variable includes a first RF filter and a second RF filter.

14. The apparatus of any one of claims 1 to 13, wherein the conductive edge ring is made of Si or SiC.

15. The apparatus of any one of claims 1 to 14, wherein the RF filter includes one or more variable elements, each of which is capable of varying the impedance.

16. The apparatus of any one of claims 1 to 15, wherein the RF filter includes a plurality of elements and a switching circuit configured to vary the impedance by changing a combination of the plurality of elements.

17. A method of etching a substrate using an etching apparatus including a chamber; a substrate support disposed in the chamber, the substrate support having an electrode, an electrostatic chuck disposed on the electrode, and a conductive edge ring disposed to surround the substrate placed on the electrostatic chuck; a radio frequency (RF) power supply configured to supply RF power to generate plasma from a gas inside the chamber; and a RF filter whose impedance is variable, the edge ring and the RF filter being electrically directly connected through a connecting unit, the connecting unit including a conductor member,

wherein a gap is located directly between the electrode and the edge ring, the conductor member is located in the gap and spanning the gap between the electrode and the edge ring, and the conductor member is directly in contact with the electrode and the edge ring,

wherein the method comprises:

changing a voltage generated in the edge ring by varying the impedance;

and

correcting a tilting angle in an edge region of the substrate placed on the electrostatic chuck to a desired value.