ELECTROSTATIC CHUCK AND PLASMA PROCESSING APPARATUS

FIELD

[0001] The disclosure relates to an electrostatic chuck (ESC) and a plasma processing apparatus.

BACKGROUND

[0002] An ESC has gas supply holes for supplying a heat transfer gas introduced from the back surface of the ESC to the upper surface of the ESC to cool a wafer. For example, Patent Literature 1 describes a substrate support including an ESC to support a wafer, an electrostatic electrode located in the ESC, and gas supply holes that are open in the upper surface of the ESC to connect with a heat transfer gas channel extending through the ESC from its upper surface to the lower surface.

CITATION LIST

PATENT LITERATURE

[0003] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2021-82788

BRIEF SUMMARY

TECHNICAL PROBLEM

[0004] One or more aspects of the disclosure are directed to a technique for preventing or reducing occurrence of abnormal discharge in gas supply holes for supplying a heat transfer gas.

SOLUTION TO PROBLEM

[0005] An electrostatic chuck according to a first aspect of the disclosure includes a substrate support to support at least one of a substrate or an edge ring, an electrostatic electrode inside the substrate support to electrostatically clamp at least one of the substrate or the edge ring, and an electrode inside the substrate support and located on a plane different from a plane on which the electrostatic electrode is located. The substrate support has a through-hole extending through the substrate support from an upper surface of the substrate support to a lower surface of the substrate support. The electrode is at least partially located between the electrostatic electrode and the through-hole, wherein the electrode includes a first electrode portion parallel to the electrostatic electrode and a second electrode portion electrically coupled to the first electrode portion, and the second electrode portion is located between the electrostatic electrode and the through-hole.

[0005a] According to a second aspect of the disclosure, there is provided a plasma processing apparatus, including: a plasma processing chamber; a base in the plasma processing chamber; an electrostatic chuck on the base; and a radio-frequency power supply electrically coupled to the base or an electrode inside the electrostatic chuck, wherein the electrostatic chuck includes a substrate support to support at least one of a substrate or an edge ring, an electrostatic electrode inside the substrate support, the electrostatic electrode being configured to electrostatically clamp at least one of the substrate or the edge ring, and an electrode inside the substrate support, the electrode being located on a plane different from a plane on which the electrostatic electrode is located, the substrate support has a through-hole extending through the substrate support from an upper surface of the substrate support to a lower surface of the substrate support, and the electrode is at least partially located between the electrostatic electrode and the through-hole, wherein the electrode includes a first electrode portion parallel to the electrostatic electrode and a second electrode portion electrically coupled to the first electrode portion, and the second electrode portion is located between the electrostatic electrode and the through-hole.

ADVANTAGEOUS EFFECTS

[0006] The technique according to the above aspects of the disclosure can prevent or reduce occurrence of abnormal discharge in gas supply holes for supplying a heat transfer gas.

BRIEF DESCRIPTION OF DRAWINGS

[0007] FIG. 1 is a diagram of a plasma processing system according to one embodiment.

FIG. 2 is a diagram of a plasma processing apparatus with an example structure according to one embodiment.

FIGs. 3A to 3C are diagrams of an electrostatic chuck (ESC) according to one embodiment, showing its electrode structure.

FIG. 4 is a sectional view taken along line B-B in FIG. 3B.

FIG. 5 is a longitudinal sectional view of an ESC according to one embodiment, showing its electrode structure.

FIG. 6A is a diagram of a second electrode portion in a first modification of one embodiment.

FIG. 6B is a diagram of a second electrode portion in a second modification of one embodiment.

FIG. 6C is a diagram of a second electrode portion in a third modification of one embodiment.

DETAILED DESCRIPTION

[0008] One or more embodiments of the disclosure will now be described with reference to the drawings. Like reference numerals denote like components in the drawings. Such components may not be described repeatedly.

CLAIMS

1. An electrostatic chuck, comprising:

a substrate support to support at least one of a substrate or an edge ring;

an electrostatic electrode inside the substrate support, the electrostatic electrode being configured to electrostatically clamp at least one of the substrate or the edge ring; and

an electrode inside the substrate support, the electrode being located on a plane different from a plane on which the electrostatic electrode is located,

wherein the substrate support has a through-hole extending through the substrate support from an upper surface of the substrate support to a lower surface of the substrate support, and the electrode is at least partially located between the electrostatic electrode and the through-hole, wherein

the electrode includes a first electrode portion parallel to the electrostatic electrode and a second electrode portion electrically coupled to the first electrode portion, and

the second electrode portion is located between the electrostatic electrode and the through-hole.

2. The electrostatic chuck according to claim 1, wherein

the second electrode portion surrounds the through-hole.

3. The electrostatic chuck according to claim 1, wherein

the first electrode portion is located below the electrostatic electrode.

4. The electrostatic chuck according to claim 1, wherein

the first electrode portion is located above the electrostatic electrode.

5. The electrostatic chuck according to claim 3, wherein

a distance t2 between an upper end of the second electrode portion and a lower surface of the electrostatic chuck is greater than or equal to a distance t1 between the electrostatic electrode and the lower surface of the electrostatic chuck.

6. The electrostatic chuck according to claim 4, wherein

a distance t4 between a lower end of the second electrode portion and a lower surface of the electrostatic chuck is less than or equal to a distance t3 between the electrostatic electrode and the lower surface of the electrostatic chuck.

7. The electrostatic chuck according to claim 1, wherein

the second electrode portion is perpendicular to the first electrode portion.

8. The electrostatic chuck according to claim 1, wherein

the second electrode portion cylindrically surrounds the through-hole.

9. The electrostatic chuck according to claim 8, wherein

the second electrode portion being cylindrical has a cutout.

10. The electrostatic chuck according to claim 8, wherein

a plurality of the second electrode portions cylindrically surround the through-hole.

11. The electrostatic chuck according to claim 10, wherein

the plurality of second electrode portions include an inner cylindrical portion and an outer cylindrical portion, and the inner cylindrical portion has a height greater than or equal to a height of the outer cylindrical portion.

12. A plasma processing apparatus, comprising:

a plasma processing chamber;

a base in the plasma processing chamber;

an electrostatic chuck on the base; and

a radio-frequency power supply electrically coupled to the base or an electrode inside the electrostatic chuck,

wherein the electrostatic chuck includes

a substrate support to support at least one of a substrate or an edge ring,

an electrostatic electrode inside the substrate support, the electrostatic electrode being configured to electrostatically clamp at least one of the substrate or the edge ring, and

an electrode inside the substrate support, the electrode being located on a plane different from a plane on which the electrostatic electrode is located,

the substrate support has a through-hole extending through the substrate support from an upper surface of the substrate support to a lower surface of the substrate support, and

the electrode is at least partially located between the electrostatic electrode and the through-hole, wherein

the electrode includes a first electrode portion parallel to the electrostatic electrode and a second electrode portion electrically connected to the first electrode portion, and

the second electrode portion is located between the electrostatic electrode and the through-hole.

13. The plasma processing apparatus according to claim 12, wherein

the second electrode portion surrounds the through-hole.

14. The plasma processing apparatus according to claim 12, wherein

the first electrode portion is located below the electrostatic electrode.

15. The plasma processing apparatus according to claim 12, wherein

the first electrode portion is located above the electrostatic electrode.

16. The plasma processing apparatus according to claim 14, wherein

a distance t2 between an upper end of the second electrode portion and a lower surface of the electrostatic chuck is greater than or equal to a distance t1 between the electrostatic electrode and the lower surface of the electrostatic chuck.

17. The plasma processing apparatus according to claim 15, wherein

a distance t4 between a lower end of the second electrode portion and a lower surface of the electrostatic chuck is less than or equal to a distance t3 between the electrostatic electrode and the lower surface of the electrostatic chuck.

18. The plasma processing apparatus according to claim 12, wherein

the second electrode portion is perpendicular to the first electrode portion.

19. The plasma processing apparatus according to claim 12, wherein

the second electrode portion cylindrically surrounds the through-hole.

20. The plasma processing apparatus according to claim 19, wherein

the second electrode portion being cylindrical has a cutout.

21. The plasma processing apparatus according to claim 19, wherein

a plurality of the second electrode portions cylindrically surround the through-hole.

22. The plasma processing apparatus according to claim 21, wherein

the plurality of second electrode portions include an inner cylindrical portion and an outer cylindrical portion, and the inner cylindrical portion has a height greater than or equal to a height of the outer cylindrical portion