CLAIMS

1. An electrostatic chuck, the chuck comprising:

a top surface, wherein:

the top surface defines a recessed portion of the chuck configured to support a substrate in the recessed portion; and

the recessed portion of the chuck is characterized by a first diameter;

a first bipolar chucking electrode and a second bipolar chucking electrode disposed in the chuck, wherein the first bipolar chucking electrode and the second bipolar chucking electrode are substantially coplanar semicircles that are separated by a straight gap along straight edges of the coplanar semicircles; and

a third chucking electrode disposed in the chuck, wherein:

the third chucking electrode comprises a circular ring characterized by an inner diameter that defines an inner-most edge of the third chucking electrode;

the inner diameter is greater than the first diameter;

a top-most portion of the third chucking electrode is disposed below the first bipolar chucking electrode and the second bipolar chucking electrode and partially overlaps with the first bipolar chucking electrode and the second bipolar chucking electrode beneath the first bipolar chucking electrode and the second bipolar chucking electrode; and

the third chucking electrode is substantially parallel to the first bipolar chucking electrode and the second bipolar chucking electrode.

2. The chuck of claim 1,

wherein the first bipolar chucking electrode and the second bipolar chucking electrode have substantially the same surface area; and

wherein the third chucking electrode does not separate the first bipolar chucking electrode from the second bipolar chucking electrode.

3. The chuck of claim 1, wherein:

the first bipolar chucking electrode comprises a mesh; and

the second bipolar chucking electrode comprises a mesh.

4. The chuck of claim 1, wherein:

the third chucking electrode comprises a mesh.

5. The chuck of claim 1, wherein the third chucking electrode does not extend vertically above the recessed portion of the chuck and does not extend horizontally beneath the recessed portion of the chuck.

6. The chuck of claim 1, wherein the top-most portion of the third chucking electrode is disposed between 6.35 millimetre and 7.62 millimetre from the top surface outside of the recessed portion.

7. The chuck of claim 1, wherein:

the first bipolar chucking electrode and the second bipolar chucking electrode are characterized by a second diameter; and

the second diameter is greater than the inner diameter and less than the inner diameter.

8. The chuck of claim 7, wherein:

the third chucking electrode also is characterized by an outer diameter, and

the outer diameter is greater than the second diameter.

9. The chuck of claim 1, wherein the third chucking electrode comprises a confinement ring that reduces leakage current from the first bipolar chucking electrode and the second bipolar chucking electrode when chucking the substrate.

10. The chuck of claim 1, wherein:

the first bipolar chucking electrode is configured such that when the substrate is disposed in the recessed portion and a first voltage is applied to the first bipolar chucking electrode, a first electrostatic force holds the substrate to the chuck;

the second bipolar chucking electrode is configured such that when the substrate is disposed in the recessed portion and a second voltage is applied to the second bipolar chucking electrode, a second electrostatic force holds the substrate to the chuck, the second voltage having an opposite polarity as the first voltage;

the first bipolar chucking electrode, the second bipolar chucking electrode, and the third chucking electrode are configured to function as DC chucking electrodes, and as RF electrodes for modulating a plasma; and

the first bipolar chucking electrode and the second bipolar chucking electrode are also configured to function as heaters for the recessed portion of the chuck.

11. The chuck of claim 1, further comprising:

a first tuning circuit in electrical communication with the first bipolar chucking electrode and the second bipolar chucking electrode; and

a second tuning circuit in electrical communication with the third chucking electrode, wherein the first tuning circuit and the second tuning circuit are configured to modulate RF power between the first bipolar chucking electrode, the second bipolar chucking electrode, and the third chucking electrode.

12. The chuck of claim 1, further comprising:

a connection for the first bipolar chucking electrode to a positive output of a first DC electrostatic chucking source;

a connection for the second bipolar chucking electrode to a negative output of the first DC electrostatic chucking source; and

a connection for the third chucking electrode to a second DC electrostatic chucking source.

13. The chuck of claim 12,

wherein a maximum chucking voltage is set at -300 V for the first DC electrostatic chucking source; and

a maximum chucking voltage is set at +300 V for the second DC electrostatic chucking source.

14. The chuck of claim 13, wherein a minimum chucking voltage decreases more than 50% from a chucking voltage without the third chucking electrode.

15. The chuck of claim 1, wherein the first bipolar chucking electrode and the second bipolar chucking electrode are symmetric relative to the straight gap separating the first bipolar chucking electrode and the second bipolar chucking electrode.

16. The chuck of claim 1, wherein a distance between an edge of the substrate and an edge of the recessed portion is between 0.254 millimetres to 6.35 millimetres.

17. The chuck of claim 1, wherein an angle from an edge of the recessed portion to a top-most portion of the top surface is 90 degrees.

18. The chuck of claim 1, wherein the straight gap is uniform along the straight edges of the coplanar semicircles.

19. The chuck of claim 1, wherein an outer edge of the first bipolar chucking electrode, an outer edge of the second bipolar chucking electrode trace a circumference of a circle.

20. The chuck of claim 1, wherein a combined surface area of the first bipolar chucking electrode and the second bipolar chucking electrode has a greater surface area than the third chucking electrode.

21. The chuck of claim 1, wherein the first bipolar chucking electrode, the second bipolar chucking electrode, and the third chucking electrode are configured to function as DC chucking electrodes, and as RF electrodes for modulating a plasma.

22. A plasma processing system, the system comprising:

an electrostatic chuck of any one of claims 1 to 21; and

a first power source in electrical communication with the first bipolar chucking electrode and the second bipolar chucking electrode, wherein:

the first bipolar chucking electrode and the second bipolar chucking electrode are connected to the first power source such that the first bipolar chucking electrode and the second bipolar chucking electrode have opposite voltages when the first power source delivers voltage to the first bipolar chucking electrode; and

a second power source in electrical communication with the third chucking electrode.

23. The system of claim 22, wherein:
the first power source is a DC power source.

24. The system of claim 22, wherein:
the second power source is an RF power source.