

What is claimed is:

Claims

1. A plasma processing chamber configured to generate a plasma, comprising:
a bottom electrode assembly with an inner bottom electrode and an outer bottom electrode disposed outside of the inner bottom electrode, wherein the inner bottom electrode is configured to receive a substrate, and wherein the inner bottom electrode and the outer bottom electrode are insulated by a dielectric ring, the inner bottom electrode and the outer bottom electrode being inside the plasma processing chamber; and
a top electrode assembly with a top electrode, wherein the top electrode is disposed directly above the inner and outer bottom electrodes.
2. The plasma processing chamber of claim 1, wherein the inner bottom electrode and the top electrode are configured to convert a first gas into a first plasma.
3. The plasma processing chamber of claim 1, wherein the outer bottom electrode and the top electrode are configured to convert a second gas into a second plasma, which is away from the inner bottom electrode and is mainly disposed in the peripheral region between the outer bottom electrode and the top electrode to clean peripheral chamber hardware of the plasma processing chamber.
4. The plasma processing chamber of claim 3, wherein the outer bottom electrode is made of an inductive coil and the second plasma is an inductively coupled plasma.
5. The plasma processing chamber of claim 4, further comprising:
a Faraday shield disposed above the inductive coil.
6. The plasma processing chamber of claim 1, further comprising:
a plurality of confinement rings surrounding the top electrode assembly and the bottom electrode assembly, the plurality of confinement rings suspended parallel to the bottom electrode within the plasma processing chamber.

7. The plasma processing chamber of claim 1, wherein a first RF power source is coupled to the inner bottom electrode to create a first plasma with the top electrode by supplying a RF power with single frequency or multiple frequencies in the range between about 400 kHz to about 60 MHz.

8. The plasma processing chamber of claim 7, wherein an RF power source is coupled to the outer bottom electrode to create a second plasma by supplying RF power with single frequency or multiple frequencies in the range between about 400 kHz to about 27 MHz.

9. The plasma processing chamber of claim 1, wherein both the inner bottom electrode and the outer bottom electrode are coupled to a RF power source and a power switch is configured to control a supply of RF power from the RF power source to alternate between the inner and the outer bottom electrodes.

10. The plasma processing chamber of claim 1, wherein the outer bottom electrode is coupled to a switch, which can switch between a ground and a RF tuning block kit, wherein the RF tuning block kit can selectively ground single RF frequency or multiple RF frequencies.

11. The plasma processing chamber of claim 1, wherein the outer bottom electrode is a capacitive electrode.

12. The plasma processing chamber of claim 2, wherein the outer bottom electrode is also powered when the inner bottom electrode and the top electrode is converting the first gas into the first plasma to increase the density of the first plasma near an edge of the substrate.

13. The plasma processing chamber of claim 12, wherein the first plasma is an etching plasma used to etch the substrate.

14. The plasma processing chamber of claim 3, wherein the second plasma is a chamber cleaning plasma and is substantially disposed outside a surface of the inner bottom electrode.

15. A plasma processing chamber configured to generate a plasma, comprising:

a bottom electrode assembly including an inner bottom electrode and an outer bottom electrode surrounding the inner bottom electrode, wherein the inner bottom electrode is configured to receive a substrate, and wherein the inner bottom electrode and the outer bottom electrode are insulated by a dielectric ring, the inner bottom electrode and the outer bottom electrode being inside the plasma processing chamber; and

a top electrode assembly including a top electrode at a distance above the inner and outer bottom electrodes, the top electrode defines an area associated with the inner bottom electrode and at least a portion of the outer bottom electrode, wherein the inner bottom electrode and the top electrode are configured to convert a first gas into a first capacitively coupled plasma within a first region of a cavity defined between the bottom electrode assembly and the top electrode assembly, and the outer bottom electrode and the top electrode are configured to convert a second gas into a second capacitively coupled plasma within a second region of the cavity.

16. The plasma processing chamber of claim 15, further comprising:

a plurality of confinement rings surrounding a volume within which the first plasma or the second plasma is substantially disposed, wherein the plurality of confinement rings are suspended parallel to the inner bottom electrode within the plasma processing chamber.

17. The plasma processing chamber of claim 15, wherein the outer bottom electrode is coupled to a switch, which can switch between a ground and a RF tuning block kit, wherein the RF tuning block kit can selectively ground single RF frequency or multiple RF frequencies.

18. The plasma processing chamber of claim 15, wherein the outer bottom electrode is also powered when the inner bottom electrode and the top electrode are converting the first gas into the first capacitively coupled plasma to increase the density of the first capacitively coupled plasma near an edge of the substrate.

19. A method of generating a plasma in a plasma processing chamber, comprising method operations of:

supplying a process gas into the plasma processing chamber; and

creating a plasma by powering an outer bottom electrode which is part of a bottom electrode assembly and surrounds a periphery of an inner bottom electrode of the bottom electrode assembly in the plasma processing chamber, wherein the inner bottom electrode is configured to receive a substrate, the inner bottom electrode and the outer bottom electrode being insulated by a dielectric ring, the inner bottom electrode and the outer bottom electrode being inside the plasma processing chamber, and wherein the plasma processing chamber has a top electrode assembly with a top electrode, the top electrode being disposed directly above the inner and outer bottom electrodes.

20. The method of claim 19, wherein the plasma, created during the method operation of creating a plasma, is a chamber cleaning plasma and is substantially disposed outside a surface of the inner bottom electrode.

21. The method of claim 19, wherein during the method operation of creating a plasma, the inner bottom electrode is kept floating.

22. The method of claim 19, wherein the method operation of creating a plasma by powering an outer bottom electrode includes preventing power from reaching the inner bottom electrode.

23. The method of claim 19, wherein during the method operation of creating a plasma, the top electrode is grounded during the plasma creation operation.

What is claimed is:

1. A plasma processing chamber having a plasma processing region and a plasma cleaning region, the plasma processing chamber comprising:
 - (a) a bottom electrode assembly defined by,
 - (i) an inner bottom electrode defining the plasma processing region, and
 - (ii) an outer bottom electrode disposed outside of the inner bottom electrode, the outer bottom electrode defining the plasma cleaning region, wherein the inner bottom electrode is configured to support a substrate and the outer bottom electrode is placed under a conductive ring;
 - (iii) a dielectric disposed between the inner bottom electrode and the outer bottom electrode, the dielectric electrically isolating the inner bottom electrode from the outer bottom electrode;
 - (iv) a switch connecting radio frequency (RF) power to either the inner bottom electrode or the outer bottom electrode; and
 - (b) a top electrode assembly with a top electrode, the top electrode is disposed above both the inner and outer bottom electrodes, wherein the conductive ring is exposed to and faces toward the top electrode.
2. The plasma processing chamber of claim 1, wherein the inner bottom electrode and the top electrode are configured to convert a first gas into a first plasma.
3. The plasma processing chamber of claim 1, wherein the outer bottom electrode and the top electrode are configured to convert a second gas into a second plasma, which is concentrated away from the inner bottom electrode and is disposed in the peripheral region between the outer bottom electrode and the top electrode to clean peripheral chamber hardware of the plasma processing chamber.
4. The plasma processing chamber of claim 1, further comprising:
a plurality of confinement rings surrounding the top electrode assembly and the bottom electrode assembly, the plurality of confinement rings suspended parallel to the bottom electrode within the plasma processing chamber.
5. The plasma processing chamber of claim 1, wherein the outer bottom electrode is a capacitive electrode.

6. A plasma processing chamber configured to generate a plasma, the plasma processing chamber comprising:
- (a) a bottom electrode assembly defined by,
 - (i) an inner bottom electrode, and
 - (ii) an outer bottom electrode disposed outside of the inner bottom electrode, wherein the inner bottom electrode is configured to receive a substrate and the outer bottom electrode is placed below a conductive ring;
 - (iii) a dielectric ring disposed between the inner bottom electrode and the outer bottom electrode, the dielectric ring electrically isolating the inner bottom electrode from the outer bottom electrode;
 - (iv) a switch connecting radio frequency (RF) power to either the inner bottom electrode or the outer bottom electrode; and (v) a ground switch coupled to the outer bottom electrode, such that the outer bottom electrode provides an additional grounding path for plasma during substrate processing when the switch connects RF power to the inner bottom electrode; and
 - (b) a top electrode assembly with a top electrode, wherein the top electrode is disposed directly above the inner and outer bottom electrodes, wherein the conductive ring disposed above the outer bottom electrode faces the top electrode.
7. The plasma processing chamber of claim 6, wherein the inner bottom electrode and the top electrode are configured to convert a first gas into a first plasma.
8. The plasma processing chamber of claim 6, wherein the outer bottom electrode and the top electrode are configured to convert a second gas into a second plasma, which is concentrated away from the inner bottom electrode and is disposed in the peripheral region between the outer bottom electrode and the top electrode to clean peripheral chamber hardware of the plasma processing chamber.
9. The plasma processing chamber of claim 6, further comprising:
a plurality of confinement rings surrounding the top electrode assembly and the bottom electrode assembly, the plurality of confinement rings suspended parallel to the bottom electrode within the plasma processing chamber.
10. The plasma processing chamber of claim 6, wherein the outer bottom electrode is a capacitive electrode.