

CLAIMS

1. A confinement ring, including,
 - a lower horizontal section extending between an inner lower radius and an outer radius of the confinement ring, the lower horizontal section includes an extension section that extends vertically downward at the inner lower radius, and the lower horizontal section further includes a plurality of slots, wherein each slot extends radially from an inner diameter to an outer diameter along the lower horizontal section, an inner slot radius of each slot at the inner diameter is less than an outer slot radius of each slot at the outer diameter;
 - an upper horizontal section extending between an inner upper radius and the outer radius of the confinement ring; and
 - a vertical section that integrally continues the lower horizontal section to the upper horizontal section at the outer radius of the confinement ring.
2. The confinement ring of claim 1, wherein a difference in the inner slot radius and the outer slot radius of each slot defines a slot taper, such that each slot tapers down from the outer diameter to the inner diameter, wherein the inner slot radius and the outer slot radius influencing the slot taper are sized to be an inverse of a wear rate at the corresponding inner diameter and the outer diameter of the slot.
3. The confinement ring of claim 1, wherein the inner upper radius is greater than the inner lower radius.
4. The confinement ring of claim 1, wherein a step is defined on a top surface of the upper horizontal extension proximal to the inner upper radius, the step extending down from the top surface and out toward the inner upper radius of the confinement ring.
5. The confinement ring of claim 1, wherein the inner diameter is greater than an inner ring diameter defined by the inner lower radius and the outer diameter is less than an outer ring diameter defined by the outer radius of the confinement ring.
6. The confinement ring of claim 1, wherein a length of each slot is defined to be between about 1.85 inches and about 4.35 inches.
7. The confinement ring of claim 1, wherein a top surface of the upper horizontal section includes a plurality of holes, each hole of the plurality of holes is configured to receive a portion of a fastener means for securing the confinement ring to an upper electrode of a plasma processing chamber.

8. The confinement ring of claim 1, wherein the extension section of the lower horizontal section is configured to rest on a radio frequency gasket defined on a top surface of a lower electrode of a plasma processing chamber.
9. The confinement ring of claim 1, wherein the lower horizontal section, the vertical section and the upper horizontal section define a C-shaped structure for confining plasma generated in a plasma processing chamber.
10. The confinement ring of claim 1, wherein a ratio of the inner slot radius to the outer slot radius is between about 1 : 1.1 and 1 : 1.5.
11. An apparatus for confining plasma within a plasma processing chamber, the plasma processing chamber includes a lower electrode for supporting a substrate and an upper electrode disposed over the lower electrode, the apparatus comprising,
a confinement ring, including,
a lower horizontal section extending between an inner lower radius and an outer radius of the confinement ring, the lower horizontal section includes an extension section that extends vertically downward at the inner lower radius, the lower horizontal section includes a plurality of slots, wherein each slot extends radially from an inner diameter to an outer diameter along the lower horizontal section, an inner slot radius of each slot at the inner diameter is less than an outer slot radius of each slot at the outer diameter;
an upper horizontal section extending between an inner upper radius and the outer radius of the confinement ring; and
a vertical section that integrally continues the lower horizontal section to the upper horizontal section at the outer radius of the confinement ring,
wherein the extension section of the lower horizontal section is configured to surround a ground ring defined in the lower electrode.
12. The apparatus of claim 11, wherein the lower horizontal section, the vertical section and the upper horizontal section of the confinement ring define a C-shaped structure to confine plasma generated in the plasma processing chamber to a plasma region defined between the upper electrode and the lower electrode of the plasma processing chamber.
13. The apparatus of claim 11, wherein the inner upper radius is greater than the inner lower radius of the confinement ring.

14. The apparatus of claim 11, wherein a step is defined on a top surface proximate to the inner upper radius of the upper horizontal section, the step extending from the top surface down and outward toward the inner upper radius of the confinement ring.
15. The apparatus of claim 11, wherein a top surface of the upper horizontal section includes a plurality of holes, each hole of the plurality of holes configured to receive a portion of a fastener means, the fastener means configured to couple the confinement ring to an extension of the upper electrode, wherein the extension of the upper electrode is electrically grounded.
16. The apparatus of claim 11, wherein the extension section of the lower horizontal section is configured to rest on a radio frequency gasket disposed on a top surface of an outer ring disposed adjacent to a ground ring defined in the lower electrode.
17. The apparatus of claim 11, wherein the confinement ring defined by the lower horizontal section, the upper horizontal section and the vertical section is a continuous structure made from one of silicon, or polysilicon, or silicon carbide, or boron carbide, or ceramic, or aluminum.
18. The apparatus of claim 11, wherein a height of the vertical section of the confinement ring is defined by a separation distance defined between the upper electrode and the lower electrode of the plasma processing chamber, when the plasma processing chamber is engaged for plasma processing.
19. The apparatus of claim 11, wherein the lower horizontal section, the upper horizontal section and the vertical section of the confinement ring form part of a confined chamber volume that extends radially outward between the lower electrode and upper electrode to define extended plasma processing region, when said confinement ring is installed in said plasma processing chamber.
20. The apparatus of claim 11, wherein the extension section is integral with the lower horizontal section, the vertical section and the upper horizontal section of the confinement ring, the extension section configured to extend below a lower surface of the lower horizontal section.
21. The apparatus of claim 11, wherein each of the plurality of slots defines a path for gases out of a confined volume formed by the confinement ring, when the plasma processing chamber is in operation.