

## **Claims**

1. A process kit for a plasma processing chamber, the apparatus comprising:  
an upper shield comprising:
  - an interior cylindrical liner defining a cylindrical volume, wherein a bottom edge of the cylindrical liner defines a plane; and
  - a circular interior top surface, wherein a center of the circular interior top surface includes a circular aperture, wherein the circular interior top surface includes a first portion extending radially outward from the aperture in which a distance from the interior top surface to the plane increases as the distance from the aperture increases, wherein the circular top surface includes a second portion extending radially outward from the first portion in which the interior top surface smoothly curves toward and mates with an inward-facing surface of the cylindrical liner further comprising a gas diffuser arranged in the circular aperture of the upper shield, the gas diffuser comprising:
    - a cylindrical housing that defines a cylindrical exterior surface, wherein the cylindrical exterior surface and the circular aperture define an annular gap;
    - an interior cylindrical cavity in a side of the housing facing away from the cylindrical volume, wherein the interior cylindrical cavity is adapted for fluid communication with a process gas supply; and
    - a plurality of holes in the housing in communication with the interior cylindrical cavity and the annular gap.
2. The process kit of claim 1, wherein the annular gap defines an aspect ratio of between 20 to 1 and 40 to 1.
3. The process kit of claim 1, wherein a ratio of an area of the annular gap to the total area of the plurality of holes is between 4 to 1 and 15 to 1.

4. The process kit of claim 1, further comprising a lower shield, the lower shield comprising:

an annular ring;

an annular channel in a top surface of the annular ring, wherein a radially-outward-facing liner and a bottom line include a circularly-curved liner portion there between, and wherein the annular channel includes a radially-outward-projecting undercut portion;

a first plurality of slots between the undercut portion and the top surface of the annular ring, wherein the first plurality of slots are arranged around a circumference of the annular ring; and

a second plurality of slots between the undercut portion and a bottom surface of the annular ring, wherein the second plurality of slots are arranged around a circumference of the annular ring.

5. The process kit of claim 4, wherein an outward-facing surface of the cylindrical liner of the upper shield is separated from a radially-inward-facing surface of the annular channel in the lower shield above the radially-outward-facing undercut portion by another annular gap.

6. The process kit of claim 1, wherein the first portion of the interior top surface defines a parabolic profile.

7. The process kit of claim 1, wherein the first portion of the interior top surface defines a circular profile that includes a radius of curvature between 30 inches and 40 inches.

8. The process kit of claim 1, wherein the second portion of the interior top surface defines a radius of curvature between 0.9 inches and 2 inches.

9. A process kit for a plasma processing chamber, the process kit comprising:

a gas diffuser configured to be arranged within a circular aperture on an upper shield for a plasma processing chamber, the gas diffuser comprising:

- a cylindrical housing that defines a cylindrical exterior surface, wherein the cylindrical exterior surface defines a diameter that is smaller than a diameter of the circular aperture of the upper shield to form an annular gap when the gas diffuser is arranged within the circular aperture;

- an interior cylindrical cavity in a side of the housing facing away from the cylindrical volume, wherein the interior cylindrical cavity is adapted for fluid communication with a process gas supply; and

- a plurality of holes in the housing in communication with the interior cylindrical cavity and the annular gap.

10. The process kit of claim 9, wherein the plurality of holes in the housing include a diameter between 0.020 inches and 0.040 inches.

11. The process kit of claim 9, wherein the plurality of holes are arranged in a plurality of rows about the circumference of the interior cylindrical cavity of the gas diffuser, and wherein each of the plurality of rows is arranged at a different longitudinal location of the interior cylindrical cavity.