CLAIMS

1. An outer distribution ring comprising

A round body having a top, bottom, inner diameter with an inner diameter face and an outer diameter with an outer diameter face;

a plenum formed in the top of the round body, the plenum having an outer peripheral face and an inner peripheral face defining a width and having a volume in a range of 100mL to 900mL ; and

a plurality of openings in the inner peripheral face of the plenum forming a plurality of trenches connecting the plenum with the inner diameter face, the plurality of trenches equally spaced about the inner peripheral face, the plurality of trenches extending from a top of the inner diameter face to a bottom of the inner diameter face, and the trenches having a combined volume in a range of 20mL to 240mL,

wherein a ratio of the combined volume of the trenches to the volume of the plenum is in the range of 10% to 30%.

2. The outer distribution ring of claim 1, wherein the plenum has a volume in the range of 400 mL to 600 mL.

3. The outer distribution ring of claim 2, wherein the trenches have a combined volume in the range of 40 mL to 180 mL.

4. The outer distribution ring of claim 1, further comprising a second plenum in fluid communication with the plenum through a plurality of apertures.

5. The outer distribution ring of claim 1, wherein the inner diameter face is shaped so that a gas flowing down the inner diameter face from the plurality of trenches flows concentric with an axis of the body.

6. The outer distribution ring of claim 1, further comprising a gas inlet in fluid communication with the plenum.

7. The outer distribution ring of claim 6, wherein the gas inlet connects to the plenum through the top of the body.

8. The outer distribution ring of claim 6, wherein the gas inlet connects to the plenum through the outer diameter face of the body.

9. A gas distribution apparatus comprising:

a gas distribution plate having an outer peripheral edge, a front side and a back side with at least one delivery channel recessed in the back side of a gas distribution plate, the delivery channel having an inlet end, an outlet end and a length, the delivery channel including a plurality of apertures spaced along the length extending through the gas distribution plate to the front side of the gas distribution plate; and

an outer distribution ring around the outer peripheral edge of the gas distribution plate, the outer distribution ring comprising:

a round body having a top, bottom, inner diameter with an inner diameter face and an outer diameter with an outer diameter face, the outer distribution ring positioned so that there is a gap between the outer peripheral edge of the gas distribution plate and the inner diameter face of the outer distribution ring;

a plenum formed in the top of the round body, the plenum having an outer peripheral face and an inner peripheral face defining a width;

at least one gas inlet in fluid communication with the plenum; and

a plurality of openings in the inner peripheral face of the plenum forming a plurality of trenches connecting the plenum with the gap between the inner diameter face and the outer peripheral edge of the gas distribution plate, the plurality of trenches equally spaced about the inner peripheral face.

10. The gas distribution apparatus of claim 9, wherein the plenum has a volume in the range of 400 mL to 600 mL and the trenches have a combined volume in the range of 40 mL to 180 mL.

11. The gas distribution apparatus of claim 9 or 10, wherein a ratio of a combined volume of the trenches to a volume of the plenum is in the range of 10% to 30%.

12. The gas distribution apparatus of claim 9 or 10, further comprising a second plenum in fluid communication with the plenum through a plurality of apertures.

13. The gas distribution apparatus of claim 9 or 10, wherein the gap between the inner diameter face of the outer distribution ring and the outer peripheral edge of the gas distribution plate is shaped to direct a gas to flow down the inner diameter face from the plurality of trenches out of a front of the gas distribution apparatus in a direction concentric with an axis of the body.

14. The gas distribution apparatus of claim 9 or 10, further comprising a gas line in fluid communication with two gas inlets and the gas line comprises a first gas line segment connected to and in fluid communication with a junction that splits the first gas line segment into two second gas line segments, each of the second gas line segments has the same conductance.

15. The gas distribution apparatus of claim 9 or 10, further comprising a supplemental gas inlet in fluid communication with a supplemental gas line passing through the gas distribution apparatus.