CLAIMS

1. A gas distribution plate for a showerhead assembly, the gas distribution plate comprising:

a first plate comprising a first plurality of holes, wherein each of the first plurality of holes has a diameter of at least 100 um; and

a second plate bonded to the first plate, the second plate comprising a second plurality of holes, each of the second plurality of holes has a diameter of at least 100 um, wherein each of the first plurality of holes is aligned with a respective one of the second plurality of holes forming a plurality of interconnected holes, wherein each of the plurality of interconnected holes is isolated from each other of the plurality of interconnected hole;

wherein the bond between the first plate and the second plate comprises one of a diffusion bond and a brazed bond;

wherein the bonded first and second plates form a structure including a top surface and a bottom surface; and

wherein each interconnected hole comprises:

a first diameter at the top surface;

a first frustoconical taper from the first diameter to a smaller second diameter;

a transition from the second diameter to a smaller third diameter below the first frustoconical taper, the transition including a step change in hole diameter; and

the third diameter at the bottom surface.

2. The gas distribution plate of claim 1, wherein each of the plurality of interconnected holes has an aspect ratio of at least 25 to 1.

3. The gas distribution plate of claim 1, wherein each of the first plurality of holes and each of the second plurality of holes has a diameter of 100 um to 600 um.

4. The gas distribution plate of claim 1, wherein the first plate and the second plate has a thickness in a range 100 um to 12.7 mm.

5. The gas distribution plate of claim 1, wherein the gas distribution plate further comprises a third plate coupled to the second plate, the third plate comprising a third plurality of holes, wherein each of the third plurality of holes is aligned with a respective one of the first plurality of holes and a respective one of the second plurality of holes.

6. A method for forming a showerhead, the method comprising:

generating a first plurality of holes in a first plate, each of the first plurality of holes has a diameter of at least 100 um;

generating a second plurality of holes in a second plate, each of the second plurality of holes has a diameter of 100 um;

aligning each of the first plurality of holes with a respective one of the second plurality of holes to generate a plurality of interconnected holes, wherein each of the plurality of interconnected holes is isolated from each other of the plurality of interconnected holes; and

bonding the first plate to the second plate forming a structure including a top surface and a bottom surface, wherein bonding the first plate to the second plate comprises one of diffusion bonding and brazing the first plate to the second plate;

wherein each interconnected hole comprises:

a first diameter at the top surface;

a first frustoconical taper from the first diameter to a smaller second diameter;

a transition from the second diameter to a smaller third diameter below the first frustoconical taper, the transition including a step change in hole diameter; and

the third diameter at the bottom surface.

7. The method of claim 6, wherein each of the plurality of interconnected holes has an aspect ratio of 25 to 1, and wherein each of the first plurality of holes and each of the second plurality of holes has a diameter in a range of 100 um to 600 um.

8. The method of claim 6 further comprising:

aligning a rolling direction of the first plate with a rolling direction of the second plate.

9. A processing chamber comprising:

a showerhead assembly comprising:

a gas distribution plate comprising:

a first plate comprising a first plurality of holes, wherein each of the first plurality of holes has a diameter of at least 100 um;

a second plate coupled to the first plate, the second plate comprising a second plurality of holes, each of the second plurality of holes has a diameter of at least 100 um, wherein each of the first plurality of holes is aligned with a respective one of the second plurality of holes forming a plurality of interconnected holes, wherein each of the plurality of interconnected holes is isolated from each other of the plurality of interconnected holes;

wherein the coupled first and second plates form a structure including a top surface and a bottom surface;

wherein the bond between the first plate and the second plate comprises one of a diffusion bond and a brazed bond;

wherein each interconnected hole comprises:

a first diameter at the top surface;

a first frustoconical taper from the first diameter to a smaller second diameter;

a transition from the second diameter to a smaller third diameter below the first frustoconical taper, the transition including a step change in hole diameter; and

the third diameter at the bottom surface;

a substrate support configured to support a substrate; and

a gas supply fluidly coupled with the showerhead assembly and configured to provide a process gas to the showerhead assembly.

10. The processing chamber of claim 9, wherein each of the plurality of interconnected holes has an aspect ratio of at least 25 to 1.

11. The gas distribution plate of claim 1, wherein the step change in hole diameter corresponds to an interface of a lower surface of the first plate and an upper surface of the second plate.

12. The gas distribution plate of claim 11, wherein the transition from the second diameter to the third diameter further includes a second frustoconical taper between the upper surface of the second plate and the bottom surface of the structure.

13. The gas distribution plate of claim 12, wherein:

each interconnected hole further comprises a fourth diameter at the upper surface of the second plate, the fourth diameter smaller than the second diameter and larger than the third diameter; and

the second frustoconical taper extends from the fourth diameter to the third diameter.

14. The gas distribution plate of claim 13, wherein each interconnected hole further comprises:

a first portion of uniform diameter equal to the second diameter and extending from the first frustoconical taper to the transition; and

a second portion of uniform diameter equal to the third diameter and extending from the transition to the bottom surface.

15. The gas distribution plate of claim 1, wherein each interconnected hole further comprises a first portion of uniform diameter equal to the second diameter and extending from the first frustoconical taper to the transition.

16. The gas distribution plate of claim 15, wherein each interconnected hole further comprises a second portion of uniform diameter equal to the third diameter and extending from the transition to the bottom surface.

17. The gas distribution plate of claim 16, wherein the step change in hole diameter corresponds to an interface of a lower surface of the first plate and an upper surface of the second plate.

18. The gas distribution plate of claim 17, wherein the transition from the second diameter to the third diameter further includes a second frustoconical taper between the upper surface of the second plate and the bottom surface of the structure.

19. The gas distribution plate of claim 18, wherein:

each interconnected hole further comprises a fourth diameter at the upper surface of the second plate, the fourth diameter smaller than the second diameter and larger than the third diameter; and

the second frustoconical taper extends from the fourth diameter to the third diameter.