CLAIMS

1. A top plate of an electrostatic chuck for a substrate processing system, the top plate configured to bond to a baseplate of the electrostatic chuck via an intermediate layer disposed on the baseplate, the top plate comprising:

a monopolar clamping electrode disposed in the top plate, wherein the monopolar clamping electrode comprises a groove opening pattern with a plurality of coolant gas groove opening sets; and

a plurality of seals disposed on the top plate and separating a plurality of coolant gas zones,

wherein

the plurality of coolant gas zones comprise four or more coolant gas zones,

each of the plurality of coolant gas zones includes a plurality of distinct coolant gas groove sets, wherein the top plate comprises the plurality of distinct coolant gas groove sets, and

each of the plurality of distinct coolant gas groove sets has one or more coolant gas supply holes and corresponds to a respective one of the plurality of coolant gas groove opening sets.

2. The top plate of claim 1, wherein the plurality of coolant gas groove opening sets are disposed in one or more layers of the top plate and on a layer of the monopolar clamping electrode.

3. The top plate of claim 1, wherein the plurality of coolant gas groove opening sets are disposed respectively below the plurality of distinct coolant gas groove sets.

4. The top plate of claim 1, wherein each of the plurality of coolant gas groove sets includes a plurality of coolant gas grooves for distributing coolant gas across a top of the top plate.

5. The top plate of claim 1, wherein:

each of the plurality of distinct coolant gas groove sets in an outermost one of the plurality of coolant gas zones includes a plurality of grooves and a plurality of supply holes arranged as an annular series of elements; and

each of the plurality of distinct coolant gas groove sets in three or more innermost ones of the plurality of coolant gas zones includes a radially extending groove and a plurality of annularly extending grooves.

6. The top plate of claim 5, wherein the plurality of annularly extending grooves of each of the plurality of distinct coolant gas groove sets extend from and away from the corresponding one of the radially extending grooves.

7. The top plate of claim 1, wherein the groove opening pattern is similar to an arranged pattern of the plurality of distinct coolant gas groove sets.

8. The top plate of claim 1, wherein there are a same number of coolant gas openings in the groove opening pattern as there are distinct coolant gas groove sets in the top plate.

9. The top plate of claim 1, wherein:

one of the plurality of coolant gas zones comprises

a first coolant gas groove set comprising

a first radially extending groove, and

a first plurality of grooves extending from the first radially extending groove, and

a second coolant gas groove set comprising

a second radially extending groove, and

a second plurality of grooves extending from the second radially extending groove; and

the plurality of distinct coolant gas groove sets comprise the first coolant gas groove set and the second coolant gas groove set.

10. The top plate of claim 9, wherein:

the first plurality of grooves comprise a first plurality of branch pairs; and

the second plurality of grooves comprise a second plurality of branch pairs; and

the first plurality of branch pairs extend along same circular paths as the second plurality of branch pairs and are separated by the second plurality of branch pairs by gaps; and

the gaps are disposed between the first plurality of branch pairs and the second plurality of branch pairs.

11. The top plate of claim 1, wherein:

the plurality of distinct coolant gas groove sets comprise

a first coolant gas groove set disposed in a first coolant gas zone, and

a second coolant gas groove set disposed in a second coolant gas zone; and

the first coolant gas groove set is radially aligned with the second coolant gas groove set, such that the first coolant gas groove set and the second coolant gas groove set are centered on a same radially extending line extending from a center of the top plate.

12. The top plate of claim 1, wherein:

the plurality of distinct coolant gas groove sets comprise

a first coolant gas groove set disposed in a first coolant gas zone, and

a second coolant gas groove set disposed in a second coolant gas zone; and

the first coolant gas groove set is disposed radially outward and annularly offset from the second coolant gas groove set.

13. The top plate of claim 1, wherein:

the plurality of coolant gas groove opening sets comprise

a first coolant gas groove opening set disposed below a first coolant gas zone, and

a second coolant gas groove opening set disposed below a second coolant gas zone; and

the first coolant gas groove opening set is radially aligned with the second coolant gas groove opening set, such that the first coolant gas groove set and the second coolant gas groove set are centered on a same radially extending line extending from a center of the top plate.

14. The top plate of claim 1, wherein:

the plurality of coolant gas groove opening sets comprise

a first coolant gas groove opening set disposed below a first coolant gas zone, and

a second coolant gas groove opening set disposed below a second coolant gas zone; and

the first coolant gas groove opening set is disposed radially outward and annularly offset from the second coolant gas groove opening set.

15. The top plate of claim 1, wherein the plurality of coolant gas zones are concentric.

16. The top plate of claim 1, wherein the monopolar clamping electrode covers at least 95% of a radial surface area of the top plate.

17. The top plate of claim 1, wherein the plurality of seals are integrally formed as part of the top plate.

18. An electrostatic chuck, comprising:

the top plate of claim 1, wherein the top plate is configured to electrostatically clamp to a substrate;

the baseplate; and

the intermediate layer.