CLAIMS

~~What is claimed is:~~

1. A plasma processing system for generating plasma to process at least a wafer and for optimizing distribution of generated plasma on the wafer, the plasma processing system comprising:

a chuck for supporting said wafer;

a chamber structure for containing said plasma, said chamber structure including a cylindrical chamber wall, said chamber structure further including a dielectric member disposed above said cylindrical chamber wall and coupled with said cylindrical chamber wall, said dielectric member comprising a one-piece structure having ~~including at least~~ a top ~~disposed over said chuck~~, a vertical wall ~~connected to said top,~~ and a flange as integral parts of the dielectric member, wherein the dielectric member is coupled ~~connected to said vertical wall, said top being connected through said vertical wall to said flange, said top being connected through said vertical wall and said flange~~ to said cylindrical ~~chamber~~ wall through said flange, wherein the flange includes a plurality of channels for transmitting one or more gases into the chamber structure, and wherein the top is disposed over said chuck;

a set of top coils disposed above said top for initiating generation of said plasma, a horizontal bottom surface of said top being configured to be exposed to said plasma when said wafer is processed with said plasma; ~~and~~

a set of side coils surrounding said vertical wall and disposed over at least a portion of said flange for affecting distribution of said plasma~~,~~; and

a shielding arrangement disposed between the set of side coils and the flange, a vertical inner surface of said vertical wall being configured to be exposed to said plasma when said wafer is processed with said plasma, the inner diameter of said vertical wall being smaller than the inner diameter of said cylindrical chamber wall;

wherein the shielding arrangement is at least part of a gas manifold coupled with said flange for delivering said one or more gases to said plurality of channels, and wherein the shielding arrangement shields the plurality of channels from a magnetic field associated with the set of side coils.

2. The plasma processing system of claim 1 further comprising:

a first generator electrically connected to said set of top coils for powering said set of top coils; and

a second generator electrically connected to said set of side coils for powering said set of side coils.

~~3. The plasma processing system of claim 1 wherein~~

~~said flange is made of a ceramic material, and~~

~~said flange includes a plurality of channels for transmitting one or more gases into the chamber structure.~~

~~4. The plasma processing system of claim 3 further comprising a gas manifold coupled with said flange for delivering said one or more gases to said plurality of channels, said gas manifold being made of at least a metal material, at least a portion of said gas manifold being disposed between said plurality of channels and said set of side coils for shielding said plurality of channels from a magnetic field associated with said set of side coils.~~

~~5.~~3. ~~The plasma processing system of claim 4~~A plasma processing system for generating plasma to process at least a wafer and for optimizing distribution of generated plasma on the wafer, the plasma processing system comprising:

a chuck for supporting said wafer;

a chamber structure for containing said plasma, said chamber structure including a cylindrical chamber wall, said chamber structure further including a dielectric member disposed above said cylindrical chamber wall and coupled with said cylindrical chamber wall, said dielectric member comprising a one-piece structure having a top, a vertical wall and a flange as integral parts of the dielectric member, wherein the dielectric member is coupled to said cylindrical wall through said flange, wherein the flange includes a plurality of channels for transmitting one or more gases into the chamber structure, and wherein the top is disposed over said chuck;

a set of top coils disposed above said top for initiating generation of said plasma, a horizontal bottom surface of said top being configured to be exposed to said plasma when said wafer is processed with said plasma;

a set of side coils surrounding said vertical wall and disposed over at least a portion of said flange for affecting distribution of said plasma; and

a shielding arrangement disposed between the set of side coils and the flange, a vertical inner surface of said vertical wall being configured to be exposed to said plasma when said wafer is processed with said plasma, the inner diameter of said vertical wall being smaller than the inner diameter of said cylindrical chamber wall;

wherein:

the shielding arrangement is at least part of a gas manifold coupled with said flange for delivering said one or more gases to said plurality of channels, and wherein the shielding arrangement shields the plurality of channels from a magnetic field associated with the set of side coils;

said gas manifold includes an indentation structure, and

at least a portion of said set of side coils is disposed inside said indentation structure.

~~6. The plasma processing system of claim 1 further comprising:~~

~~a plurality of tubes; and~~

~~a plurality of coupling elements for coupling said plurality of tubes with said flange, wherein~~

~~said flange includes a plurality of channels connected to said plurality of tubes,~~

~~said flange, said vertical wall, and said plurality of coupling elements form a plurality of receptacle structures, and~~

~~a plurality of portions of said set of side coils is disposed inside said plurality of receptacle structures.~~

~~7. The plasma processing system of claim 6 further comprising a metal shield disposed between said plurality of channels and said set of side coils for shielding said plurality of channels from a magnetic field associated with said set of side coils, said metal shield surrounding said vertical wall.~~

~~8. The plasma processing system of claim 6 wherein~~

~~said plurality of tubes includes at least a first tube and a second tube,~~

~~said first tube is connected through said second tube to one or more of said plurality of channels,~~

~~said second tube is disposed lower than said first tube, and~~

~~said second tube is disposed closer to said vertical wall than said first tube.~~

~~9. The plasma processing system of claim 6 wherein~~

~~said plurality of coupling elements are distributed along an outer edge of said flange,~~

~~said plurality of tubes includes at least a first tube and a second tube,~~

~~said first tube is connected through said second tube to said set of channels,~~

~~said first tube is disposed over said second tube, and~~

~~said second tube is disposed over at least portions of said plurality of coupling elements.~~

~~10.~~4. The plasma processing system of claim 1, further comprising a positioning mechanism for moving the set of side coils along a vertical outer surface of said vertical wall.

~~11. A method for processing a wafer with plasma in a plasma processing system, said plasma processing system including a chamber structure for containing said plasma, said chamber structure including a cylindrical chamber wall, said chamber structure further including a dielectric member disposed above said cylindrical chamber wall and coupled with said cylindrical chamber wall, said dielectric member including a first element and a second element connected to said first element, the method comprising:~~

~~initiating, using a set of top coils disposed above said first element of said dielectric member, said plasma inside said chamber structure, said initiating including providing a first signal of a first frequency to said set of top coils;~~

~~after said initiating, affecting, using a set of side coils surrounding said second element, distribution of said plasma, said affecting including providing a second signal of a second frequency to said set of side coils, said second frequency being different from said first frequency, said second element being perpendicular to said first element.~~

~~12. The method of claim 11 wherein said second frequency is lower than said first frequency.~~

~~13. The method of claim 11 further comprising moving said set of side coils along an outer surface of said second element in a direction perpendicular to a top surface of said wafer when said wafer is processed in said plasma processing system, for tuning said distribution of said plasma.~~

~~14. The method of claim 11 further comprising:~~

~~after processing said wafer using a first plasma processing recipe, moving said set of side coils along an outer surface of said second element in a direction perpendicular to a top surface of said wafer; and~~

~~after said moving said set of side coil, processing said wafer using a second plasma processing recipe.~~

~~15. The method of claim 11 further comprising:~~

~~using a metal manifold to provide one or more to gases to a plurality of channels in a third element of said dielectric member, said third element of said dielectric member being made of a dielectric material, said third element of said dielectric member being connected through said second element to said first element, said metal manifold being disposed above said third element of said dielectric member; and~~

~~using said plurality of channels to transmitted said one or more gases into a space inside said chamber structure for producing said plasma.~~

~~16. The method of claim 15 further comprising moving said set of side coils into an indentation structure of said metal manifold to increase an ion density at an edge of said wafer.~~

~~17. The method of claim 15 further comprising using said metal manifold to shield said plurality of channels from a magnetic field associated with said set of side coils.~~

~~18. The method of claim 11 further comprising:~~

~~using a plurality of tubes to provide one or more to gases to a plurality of channels in a third element of said dielectric member, said third element of said dielectric member being made of a dielectric material, said third element of said dielectric member being connected through said second element to said first element, said plurality of tubes being coupled with said third element of said dielectric member by a plurality of coupling elements;~~

~~using said plurality of channels to transmitted said one or more gases into a space inside said chamber structure for producing said plasma; and~~

~~disposing a plurality of portions of said set of side coils into a plurality of receptacle structures formed by said plurality of coupling elements, said second element, and said third element of said dielectric member, to increase an ion density at an edge of said wafer.~~

~~19. The method of claim 11 further comprising:~~

~~using a plurality of tubes to provide one or more to gases to a plurality of channels in a third element of said dielectric member, said third element of said dielectric member being made of a dielectric material, said third element of said dielectric member being connected through said second element to said first element, said plurality of tubes being coupled with said third element of said dielectric member by a plurality of coupling elements;~~

~~using said plurality of channels to transmitted said one or more gases into a space inside said chamber structure for producing said plasma; and~~

~~using a metal shield disposed above said third element of said dielectric member to shield said plurality of channels from a magnetic field associated with said set of side coils.~~

~~20. The method of claim 19 further comprising disposing a plurality of portions of said set of side coils into a plurality of receptacle structures formed by said plurality of coupling elements, said second element, and said metal shield, to increase an ion density at an edge of said wafer.~~

5. The plasma processing system of claim 1, wherein the dielectric member comprises a ceramic material.

6. The plasma processing system of claim 5, wherein the ceramic material comprises aluminium nitride.

7. The plasma processing system of claim 5, wherein the ceramic material comprises aluminium oxide.

8. The plasma processing system of claim 1, wherein the top of the dielectric member comprises a horizontal bottom surface configured to be exposed to plasma for confining plasma under the top of the dielectric member to process the wafer.

9. The plasma processing system of claim 1, wherein the inner diameter of the set of side coils is larger than the outer diameter of the set of top coils to prevent interference between the set of side coils and the set of top coils.

10. The plasma processing system of claim 2, wherein the first generator and the second generator are configured to simultaneously provide a frequency of signal to the set of top coils that is at least 3x greater than the frequency of signal to the set of side coils.

11. The plasma processing system of claim 2, wherein the first generator is configured to provide higher frequency of signal to the set of top coils than the second generator is configured to provide, simultaneously, as frequency of signal to the set of side coils.

12. The plasma processing system of claim 2, wherein the first generator is configured to provide a signal of 13.56 MHz to the set of top coils and the second generator is configured to simultaneously provide a signal in the range from 500 KHz to 4 MHz to the set of side coils.

13. The plasma processing system of claim 1, wherein the plurality of channels include inner walls having a corrosion-resistant coating material.

14. The plasma processing system of claim 3, wherein the indentation structure is disposed in the gas manifold proximal to the vertical wall.

15. A plasma processing system for generating plasma to process at least a wafer and for optimizing distribution of generated plasma on the wafer, the plasma processing system comprising:

a chuck for supporting said wafer;

a chamber structure for containing said plasma, said chamber structure including a cylindrical chamber wall, said chamber structure further including a dielectric member disposed above said cylindrical chamber wall and coupled with said cylindrical chamber wall, said dielectric member comprising a one-piece structure having a top, a vertical wall and a flange as integral parts of the dielectric member, wherein the dielectric member is coupled to said cylindrical wall through said flange, wherein the flange includes a plurality of channels for transmitting one or more gases into the chamber structure, and wherein the top is disposed over said chuck;

a set of top coils disposed above said top for initiating generation of said plasma, a horizontal bottom surface of said top being configured to be exposed to said plasma when said wafer is processed with said plasma;

a set of side coils surrounding said vertical wall and disposed over at least a portion of said flange for affecting distribution of said plasma; and

a shielding arrangement disposed between the set of side coils and the flange, a vertical inner surface of said vertical wall being configured to be exposed to said plasma when said wafer is processed with said plasma, the inner diameter of said vertical wall being smaller than the inner diameter of said cylindrical chamber wall;

wherein the shielding arrangement is at least part of a gas manifold coupled with said flange for delivering said one or more gases to said plurality of channels, and wherein the gas manifold comprises a metal material, thus shielding the plurality of channels from a magnetic field associated with the set of side coils.