Claims:

1. A method of processing a substrate, comprising:

positioning a substrate on a substrate support assembly disposed in a processing volume of a processing chamber, wherein the substrate support assembly comprises a substrate supporting portion and an annular portion extending upwardly from the substrate supporting portion, wherein the annular portion is disposed radially outward of the substrate supporting portion, and wherein the radially inward facing surface of the annular portion is sized to be spaced apart from a circumferential edge of the substrate by a distance of 5 mm or less;

exposing the substrate to a treatment plasma, wherein the treatment plasma is formed of a treatment gas which is substantially free of carbon, silicon, and metal deposition precursors, and wherein the treatment plasma is formed by igniting and maintaining the treatment plasma by applying a first RF power to a showerhead disposed in the processing volume, wherein the first RF power is 1.42 Watts per cm^2 of substrate surface (W/cm^2) or less;

after exposing the substrate to the treatment plasma, applying a chucking voltage to an electrode embedded in a dielectric material of the substrate support to chuck the substrate a surface of the substrate support; and

depositing an amorphous carbon layer onto the surface of the substrate by igniting and maintaining a deposition plasma of one or more deposition material precursors by applying a second RF power to the showerhead, wherein the second RF power is 2.12 Watts per cm2 of substrate surface (W/cm2) or more, and

exposing the surface of the substrate to the deposition plasma.

2. The method of claim 1, wherein exposing the substrate to the treatment plasma comprises exposing a silicon surface proximate to a circumferential edge of the substrate to the treatment plasma.

3. The method of claim 2, further comprising forming the treatment plasma, comprising:

flowing the treatment gas into the processing volume, the treatment gas comprising He, Ar, NH_3, N_2, O_2, or a combination thereof.

4. The method of claim 1, wherein at least a portion of the radially inward facing surface of the annular portion is sloped upward and away from a plane parallel to a surface of the substrate supporting portion to form an angle of between about 5 degrees and 60 degrees therewith.

5. A method of processing a substrate, comprising:

positioning a substrate on a substrate support assembly, the substrate support assembly disposed in a processing volume of a processing chamber, wherein the substrate support assembly comprises a substrate supporting portion and an annular portion extending upwardly from the substrate supporting portion, wherein the annular portion is disposed radially outward of the substrate supporting portion, and wherein the radially inward facing surface of the annular portion is sized to be spaced apart from a circumferential edge of the substrate by a distance of 5 mm or less;

heating the substrate to a temperature of 300º C or more; and

after maintaining the substrate at 300º C or more at for at least about 60 seconds, exposing the substrate to a treatment plasma, wherein the treatment plasma is formed by igniting and maintaining the treatment plasma by applying a first RF power to a showerhead disposed in the processing volume, wherein the first RF power is 1.42 Watts per cm^2 of substrate surface (W/cm^2) or less; and

depositing an amorphous carbon layer on a surface of the substrate, comprising:

flowing one or more deposition material precursors into the processing volume;

igniting and maintaining a deposition plasma of the one or more deposition material precursors by applying an RF power to a showerhead disposed in the processing volume, wherein the RF power is 2.12 Watts per cm^2 of substrate surface (W/cm^2) or more; and

exposing a surface of the substrate to the deposition plasma.

6. The method of claim 5, wherein the substrate support assembly comprises a substrate supporting portion and an annular portion extending upwardly from the substrate supporting portion, wherein the annular portion is disposed radially outward of the substrate supporting portion, and wherein a radially inward facing surface of the annular portion is sized to be spaced apart from a circumferential edge of the substrate by a distance of 5 mm or less.

7. The method of claim 7, wherein at least a portion of the radially inward facing surface of the annular portion is sloped upward and away from a plane parallel to a surface of the substrate supporting portion to form an angle of between 5 degrees and 60 degrees therewith.

8. The method of claim 7, wherein the substrate support assembly comprises a unitary body of dielectric material which forms both the substrate supporting portion and the annular portion.

9. A processing system, comprising:

a chamber comprising a chamber lid assembly, one or more chamber sidewalls, and a chamber base which collectively define a processing volume;

a substrate support assembly disposed in the processing volume, the substrate support assembly comprising a substrate supporting portion and an annular portion extending upwardly from the substrate supporting portion, wherein the annular portion is disposed radially outward of the substrate supporting portion, and wherein a radially inward facing surface of the annular portion is sized to be spaced apart from a circumferential edge of a to-be-processed substrate by a distance of 5 mm or less; and

a computer readable medium having instructions stored thereon for a plasma treatment method and a material deposition method, the instructions further including wherein after exposing the substrate to the treatment plasma, applying a chucking voltage to an electrode embedded in a dielectric material of the substrate support assembly and depositing an amorphous carbon layer onto the surface of the substrate using the deposition method,

the plasma treatment method comprising:

positioning the substrate on the substrate supporting portion of the substrate support assembly;

exposing a surface of the substrate to a treatment plasma, wherein the treatment plasma is formed of a treatment gas which is substantially free of carbon, silicon, and metal deposition precursors; and

after exposing the substrate to the treatment plasma, applying a chucking voltage to an electrode embedded in a dielectric material of the substrate support assembly and depositing an amorphous carbon layer onto the surface of the substrate using the deposition method; and

the material deposition method comprising:

flowing one or more deposition material precursors into the processing volume;

igniting and maintaining a deposition plasma of the one or more deposition material precursors by applying an RF power to a showerhead of the chamber lid assembly, wherein the RF power is 2.12 Watts per cm^2 of substrate surface (W/cm^2) or more; and

exposing the surface of a substrate positioned on the substrate supporting portion of the substrate assembly to the deposition plasma to deposit an amorphous carbon layer thereon.

10. The processing system of claim 9, further comprising instructions stored on the computer readable medium for a substrate annealing method, the substrate annealing method comprising:

positioning the substrate on the substrate supporting portion of the substrate supporting assembly;

heating the substrate to a temperature of 300º C or more; and

after maintaining the substrate at 300º C or more at for at least 60 seconds, depositing the amorphous carbon layer onto a surface of the substrate using the deposition method.

11. The processing system of claim 9, wherein at least a portion of the radially inward facing surface of the annular portion is sloped upward and away from a plane parallel to a surface of the substrate supporting portion to form an angle of between 5 degrees and 60 degrees therewith.

12. The method of claim 9, wherein the substrate support assembly comprises a unitary body of dielectric material which forms both the substrate supporting portion and the annular portion.