

CLAIMS

What is claimed is:

1. An electrostatic chuck comprising:
 - a ceramic structural element;
 - at least one electrode disposed on the ceramic structural element; and
 - a surface dielectric layer disposed over the at least one electrode, the surface dielectric layer activated by a voltage in the electrode to form an electric charge to electrostatically clamp a substrate to the electrostatic chuck, the surface dielectric layer comprising:
 - (i) an insulator layer of amorphous alumina, of a thickness of less than 5 microns, disposed over the at least one electrode; and
 - (ii) a stack of dielectric layers disposed over the insulator layer, the stack of dielectric layers including:
 - (a) at least one dielectric layer including aluminum oxynitride; and
 - (b) at least one dielectric layer including at least one of silicon oxide and silicon oxynitride.
2. The electrostatic chuck of claim 1, wherein the surface dielectric layer includes a silicon nitride layer.
3. The electrostatic chuck of claim 1, wherein the surface dielectric layer includes a silicon oxynitride layer.
4. The electrostatic chuck of claim 1, wherein at least one of the insulator layer and the dielectric layers is an electrically insulating layer.
5. The electrostatic chuck of claim 4, wherein the electrically insulating layer is deposited with the thin film deposition technique of atomic layer deposition.

6. The electrostatic chuck of claim 4, wherein the electrically insulating layer is deposited with a thin film deposition technique selected from the group consisting of chemical vapor deposition, plasma enhanced chemical vapor deposition, physical vapor deposition, electron beam deposition, spray coating, atmospheric plasma deposition, high pressure plasma deposition, electrochemical deposition, and sputter deposition.
7. The electrostatic chuck of claim 1, wherein the surface dielectric layer fulfills the function of at least one of: (1) high strength dielectric barrier, (2) dielectric layer with inherently low metals contamination and low particle source, (3) a plasma etch resistant surface, (4) an abrasion resistant surface.
8. The electrostatic chuck of claim 1, wherein the insulator layer of amorphous alumina is deposited by atomic layer deposition over the at least one electrode.
9. The electrostatic chuck of claim 1, wherein the stack of dielectric layers includes:
 - i) a first dielectric layer deposited over the insulator layer, the first dielectric layer including silicon oxide;
 - ii) the at least one dielectric layer including aluminum oxynitride, deposited as a second dielectric layer over the first dielectric layer; and
 - iii) the at least one dielectric layer including at least one of silicon oxide and silicon oxynitride, deposited as a third dielectric layer over the second dielectric layer, the third dielectric layer including silicon oxide.
10. The electrostatic chuck of claim 1, wherein the stack of dielectric layers includes:
 - i) the at least one dielectric layer including aluminum oxynitride, being a first dielectric layer disposed over the insulator layer; and
 - ii) the at least one dielectric layer including at least one of silicon oxide and silicon oxynitride, being a second dielectric layer disposed over the first dielectric layer.
11. The electrostatic chuck of claim 1, wherein a substrate contacting surface of the electrostatic chuck comprises a plurality of protrusions extending to a height above portions of the substrate contacting surface of the electrostatic chuck surrounding the plurality of protrusions.

12. The electrostatic chuck of claim 11, wherein the plurality of protrusions comprise at least one of etched protrusions and deposited protrusions.
13. The electrostatic chuck of claim 11, wherein at least one protrusion of the plurality of protrusions comprises a substrate contacting surface coating over an underlying protrusion.
14. The electrostatic chuck of claim 13, wherein the substrate contacting surface coating comprises alumina deposited by atomic layer deposition.
15. The electrostatic chuck of claim 1, further comprising a diffusion barrier layer of amorphous alumina deposited by atomic layer deposition, disposed over the stack of dielectric layers.
16. The electrostatic chuck of claim 1, wherein the insulator layer of amorphous alumina has a minimum dielectric strength of at least 200 V per micron.
17. The electrostatic chuck of claim 1, comprising a rounded edge on at least one of: a gas hole; a gas channel; a lift pin hole; and a ground pin hole.
18. The electrostatic chuck of claim 1, wherein a substrate contacting surface of the electrostatic chuck comprises at least one of: alumina deposited by atomic layer deposition, silicon oxide, silicon nitride, silicon oxynitride and silicon-rich oxide.