Claims

1. An electrode for transmitting radiofrequency power to a plasma processing region, comprising:

a plate formed of a silicon material as a bottom layer, and the plate having a top layer of a silicide material formed on a top surface of the silicon material, the top layer of the silicide material having a lower electrical resistance than the bottom layer of the silicon material, the bottom layer of the silicon material having a thickness that is less than a radiofrequency signal skin effect distance within the silicon material, the top layer of the silicide material having a thickness within a range extending from about 1000 angstroms to about 2000 angstroms, the bottom layer of the silicon material configured for exposure to the plasma processing region,

the plate including a distribution of through-holes, each through-hole extending through an entire thickness of the plate.

2. The electrode as recited in claim 1, wherein the electrode is configured to physically separate a process gas plenum from a plasma processing region and provide for flow of a process gas through the distribution of through-holes from the process gas plenum to the plasma processing region.

3. The electrode as recited in claim 1, wherein the silicon material is either monocrystalline silicon or polycrystalline silicon.

4. The electrode as recited in claim 1, wherein the silicide material does not form a volatile etch byproduct in exposure to a fluorine-containing process gas.

5. The electrode as recited in claim 1, wherein the silicide material is one or more of titanium silicide, molybdenum silicide, tungsten silicide, and nickel silicide.

6. The electrode as recited in claim 1, wherein the entire thickness of the plate is within a range extending from about 0.1 inch to about 0.75 inch.

7. The electrode as recited in claim 1, wherein a diameter of each through-hole is within a range extending from about 0.005 inch to about 0.02 inch.

8. The electrode as recited in claim 1, wherein a diameter of each through-hole is within a range extending from about 0.005 inch to about 0.009 inch.

9. The electrode as recited in claim 1, wherein a diameter of each through-hole is within a range extending from about 0.005 inch to about 0.007 inch.

10. The electrode as recited in claim 1, wherein the silicide material has an electrical resistivity at least one order of magnitude lower than an electrical resistivity of the silicon material.

11. A plasma processing system, comprising:

a plasma generation chamber including a plasma processing region;

a substrate support structure disposed within the plasma generation chamber at a location below the plasma processing region;

a process gas plenum;,

an electrode disposed within the plasma generation chamber, the electrode configured to physically separate the process gas plenum from the plasma processing region, the electrode including a plate formed of a silicon material as a bottom layer, and the plate having a top layer of a silicide material formed on a top surface of the silicon material, the top layer of the silicide material having a lower electrical resistance than the bottom layer of the silicon material, the

plate including a distribution of through-holes, each through-hole extending through an entire thickness of the plate, the electrode configured to provide for flow of a process gas through the distribution of through-holes from the process gas plenum to the plasma processing region, a top surface of the top layer of the silicide material exposed to the process gas plenum, a bottom surface of the bottom layer of the silicon material exposed to the plasma processing region, the bottom layer of the silicon material having a thickness that is less than a radiofrequency signal skin effect distance within the silicon material, the top layer of the silicide material having a thickness within a range extending from about 1000 angstroms to about 2000 angstroms; and

radiofrequency power supply connected to supply radiofrequency power to the plate of the electrode.

12. The plasma processing system as recited in claim 11, further comprising:

matching circuitry connected to an output of the radiofrequency power supply, the radiofrequency power supply in electrical communication with the plate of the electrode through the matching circuitry.

13. The plasma processing system as recited in claim 11, wherein the entire thickness of the plate is within a range extending from about 0.1 inch to about 0.75 inch.

14. The plasma processing system as recited in claim 11, wherein a diameter of each through-hole is within a range extending from about 0.005 inch to about 0.02 inch.

15. The plasma processing system as recited in claim 11, wherein a diameter of each through-hole is within a range extending from about 0.005 inch to about 0.009 inch.

16. The plasma processing system as recited in claim 11, wherein a diameter of each

through-hole is within a range extending from about 0.005 inch to about 0.007 inch.

17. The plasma processing system as recited in claim 11, wherein the top layer of the silicide material of the plate has an electrical resistivity at least one order of magnitude lower than an electrical resistivity of the bottom layer of the silicon material of the plate.

18. A method for manufacturing an electrode for transmitting radiofrequency power to a plasma processing region, comprising:

forming a plate of a silicon material, the plate having a thickness less than a radiofrequency signal skin effect distance associated with radiofrequency signals applied to the plate of the silicon material for transmission to the plasma processing region;

forming a layer of a silicide material on a top surface of the plate from the silicon material of the plate, the layer of silicide material having a lower electrical resistance than the silicon material of the plate, the layer of the silicide material having a thickness within a range extending from about 1000 angstroms to about 2000 angstroms; and

forming a distribution of through-holes through the plate, each through-hole formed to extend through an entire thickness of the plate that includes the layer of the silicide material.

19. The method as recited in claim 18, wherein the entire thickness of the plate is within a range extending from about 0.1 inch to about 0.75 inch.

20. The method as recited in claim 18, wherein a diameter of each through-hole is within a range extending from about 0.005 inch to about 0.02 inch.

21. The method as recited in claim 18, wherein a diameter of each through-hole is within a range extending from about 0.005 inch to about 0.009 inch.

22. The method as recited in claim 18, wherein a diameter of each through-hole is within a range extending from about 0.005 inch to about 0.007 inch.

23. The method as recited in claim 18, wherein the silicide material has an electrical resistivity at least one order of magnitude lower than an electrical resistivity of the silicon material.