

CLAIMS

1. A silicon-based showerhead electrode comprising a backside, a frontside, a plurality of showerhead passages, a plurality of backside recesses, and a plurality of backside inserts, wherein:

the plurality of showerhead passages extend from the backside of the silicon-based showerhead electrode to the frontside of the silicon-based showerhead electrode;

the plurality of backside recesses are formed in the backside of the silicon-based showerhead electrode, the backside recesses leaving a thickness of silicon-based electrode material between the recess and the frontside of the silicon-based showerhead electrode;

the backside inserts are positioned in the backside recesses along the backside of the silicon-based showerhead electrode;

the backside inserts comprise a threaded outside diameter, a threaded inside diameter, and a tool engaging portion formed in the threaded inside diameter;

~~the tool engaging portion of the backside insert comprises a plurality of torque-receiving slots arranged about an axis of rotation of the backside insert; and~~

~~the torque-receiving slots are arranged to avoid on-axis rotation of the backside insert via opposing pairs of torque-receiving slots~~ is formed such that the backside insert further comprises one or more lateral shielding portions between the tool engaging portion and the threaded outside diameter to prevent a tool engaged with the tool engaging portion of the backside insert from extending beyond the threaded outside diameter of the insert wherein the silicon-based electrode material comprises single crystal silicon.

2. A silicon-based showerhead electrode as claimed in claim 1 wherein: ~~the tool engaging portion is formed such that the backside insert further comprises one or more lateral shielding portions between the tool engaging portion and the threaded~~

~~outside diameter to prevent a tool engaged with the tool engaging portion of the backside insert from extending beyond the threaded outside diameter of the insert~~
the tool engaging portion of the backside insert comprises a plurality of torque-receiving slots arranged about an axis of rotation of the backside insert; and
the torque-receiving slots are arranged to avoid on-axis rotation of the backside insert via opposing pairs of torque receiving slots.

3. A silicon-based showerhead electrode as claimed in claim 1 wherein:
the tool engaging portion of the backside insert comprises three torque-receiving slots arranged about an axis of rotation of the backside insert as three opposing pairs of torque receiving slots; and
the torque-receiving slots are arranged to avoid on-axis rotation of the backside insert via each of the three opposing pairs of torque receiving slots.
4. A silicon-based showerhead electrode as claimed in claim 1 wherein:
the tool engaging portion of the backside insert comprises n torque-receiving slots arranged about an axis of rotation of the backside insert as $n(n-1)/2$ opposing pairs of torque receiving slots; and
the torque-receiving slots are arranged to avoid on-axis rotation of the backside insert via each of the $n(n-1)/2$ opposing pairs of torque receiving slots.
5. A silicon-based showerhead electrode as claimed in claim 4 wherein the torque-receiving slots are spaced equidistantly about the axis of rotation and $n = 3$ or $n = 5$.
6. A silicon-based showerhead electrode as claimed in claim 4 wherein the torque-receiving slots are spaced equidistantly or non-equidistantly about the axis of rotation and $3 \leq n \leq 5$.

7. A silicon-based showerhead electrode as claimed in claim 1 wherein the torque receiving slots define a progressively non-constrictive cross sectional profile along a direction parallel to the axis of rotation of the backside insert.

8. A silicon-based showerhead electrode as claimed in claim 1 wherein the torque receiving slots are defined by apex-free side walls that extend parallel to the axis of rotation.

9. A silicon-based showerhead electrode as claimed in claim 1 wherein the hardness of the backside inserts does not exceed the hardness of the silicon-based electrode material.

10. A silicon-based showerhead electrode as claimed in claim 1 wherein the backside inserts comprise polyetheretherketone (PEEK) formulated and manufactured such that the hardness of the backside inserts does not exceed the hardness of the silicon-based electrode material.

11. A silicon-based showerhead electrode as claimed in claim 1 wherein the backside inserts are positioned in the backside recesses such that they are inset relative to the backside of the silicon-based showerhead electrode.

12. A silicon-based showerhead electrode as claimed in claim 1 wherein at least one of the backside inserts is configured as an anchor in one of the backside recesses formed in the backside of the silicon-based showerhead electrode.

13. A silicon-based showerhead electrode as claimed in claim 12 wherein the backside insert is anchored in the backside recess by a threaded portion formed in the silicon-based electrode material.

14. A silicon-based showerhead electrode as claimed in claim 1 wherein the silicon-based electrode material comprises polysilicon, silicon nitride, silicon carbide, boron carbide, aluminum nitride, aluminum oxide, or combinations thereof.

15. A silicon-based showerhead electrode as claimed in claim 1 wherein the silicon-based showerhead electrode comprises a single-piece, circular showerhead construction or a multi-component, circular showerhead construction comprising a circular central electrode and one or more peripheral electrodes arranged about the circumference of the central electrode.

16. A silicon-based showerhead electrode comprising a backside, a frontside, a plurality of showerhead passages, a plurality of backside recesses, and a plurality of backside inserts, wherein:

the plurality of showerhead passages extend from the backside of the silicon-based showerhead electrode to the frontside of the silicon-based showerhead electrode;

the plurality of backside recesses are formed in the backside of the silicon-based showerhead electrode, the backside recesses leaving a thickness of silicon-based electrode material between the recess and the frontside of the silicon-based showerhead electrode;

the backside inserts are positioned in the backside recesses along the backside of the silicon-based showerhead electrode;

the backside inserts comprise a threaded outside diameter, a threaded inside diameter, and a tool engaging portion formed in the threaded inside diameter;

the tool engaging portion of the backside insert comprises a plurality of torque-receiving slots arranged about an axis of rotation of the backside insert; and

the torque-receiving slots are arranged to avoid on-axis rotation of the backside insert via opposing pairs of torque receiving slots wherein the silicon-based electrode material comprises single crystal silicon.

17. A silicon-based showerhead electrode comprising a backside, a frontside, a plurality of showerhead passages, a plurality of backside recesses, and a plurality of backside inserts, wherein:

the plurality of showerhead passages extend from the backside of the silicon-based showerhead electrode to the frontside of the silicon-based showerhead electrode;

the plurality of backside recesses are formed in the backside of the silicon-based showerhead electrode, the backside recesses leaving a thickness of silicon-based electrode material between the recess and the frontside of the silicon-based showerhead electrode;

the backside inserts are positioned in the backside recesses along the backside of the silicon-based showerhead electrode;

the backside inserts comprise a threaded outside diameter, a threaded inside diameter, and a tool engaging portion formed in the threaded inside diameter;

the tool engaging portion of the backside insert comprises n torque-receiving slots arranged about an axis of rotation of the backside insert as $n(n-1)/2$ opposing pairs of torque receiving slots;

the torque-receiving slots are arranged to avoid on-axis rotation of the backside insert via each of the $n(n-1)/2$ opposing pairs of torque receiving slots, define a progressively non-constrictive cross sectional profile along a direction parallel to the axis of rotation of the backside insert, and comprise apex-free side walls that extend parallel to the axis of rotation wherein the silicon-based electrode material comprises single crystal silicon.