

What is claimed is:

1. A component for a plasma processing apparatus for processing semiconductor substrates, the component comprising:
 - a first member having a plurality of first through openings, the first member having a plasma-exposed surface and a first coefficient of thermal expansion;
 - a second member bonded to the first member and having a plurality of second through openings corresponding to the openings in the first member, the second member having a second coefficient of thermal expansion greater than the first coefficient of thermal expansion;
 - wherein the centers of the first and second openings are misaligned along an outer periphery at ambient temperature and the centers of the openings in the first member and the openings in the second member are closer together when the first and second members are heated to an elevated processing temperature;
 - wherein the second member comprises multiple pieces, each piece bonded to the first member.
2. The component of claim 33, wherein: (a) the multiple pieces are hexagonal shaped or (b) the multiple pieces comprise a circular plate with concentric annular rings, each ring attached to the first member.
3. The component of claim 34, wherein at least one of the rings is segmented.
4. A component for a plasma processing apparatus for processing semiconductor substrates, the component comprising:
 - a first member having a plurality of first through openings, the first member having a plasma-exposed surface and a first coefficient of thermal expansion;
 - a second member bonded to the first member and having a plurality of second through openings corresponding to the openings in the first member, the second member having a second coefficient of thermal expansion greater than the first coefficient of thermal expansion;
 - wherein the centers of the first and second openings are misaligned along an outer periphery at ambient temperature and the centers of the openings in the first

member and the openings in the second member are closer together when the first and second members are heated to an elevated processing temperature;

wherein the second member has a non-uniform thickness across its width, adapted to impart flexibility to the second member during thermal cycling and the second member comprises a plurality of concentric or helical grooves.

5. The component of claim 36, wherein the second member further comprises a plurality of segments of uniform thickness connected by thinner segments.

6. A showerhead electrode assembly for a plasma processing apparatus, comprising:

a silicon inner electrode with a plasma-exposed surface, the electrode having a plurality of axially extending gas distribution passages;

a metallic backing member bonded to the electrode and having a plurality of axially extending gas distribution passages in fluid communication with the passages in the electrode, wherein the passages in the backing member are wider than the passages in the electrode, to reduce exposure of the second member to a plasma environment;

wherein the centers of passages in the electrode and the passages in the backing member are misaligned at ambient temperature and the centers of the passages in the electrode and the centers of the passages in the backing member are closer together when the electrode and backing member are heated to an elevated processing temperature.

7. A method of processing a semiconductor substrate in a plasma processing apparatus, the method of comprising:

placing a substrate on a substrate support in a reaction chamber of a plasma processing apparatus;

introducing a process gas into the reaction chamber with the showerhead electrode assembly of claim 38;

generating a plasma from the process gas in the reaction chamber between the showerhead electrode assembly and the substrate; and

processing the substrate with the plasma.

8. The method of claim 39, wherein the process gas is a fluorine-containing gas.
9. The method of claim 39, wherein the backing member is composed of aluminum or an aluminum alloy and the radially larger passages in the backing member are adapted to reduce aluminum fluoride formation.
10. The method of claim 39, wherein the gas distribution passages in the backing member and the distribution passages in the electrode are substantially concentric at the elevated processing temperature.
11. The method of claim 38, wherein the elevated processing temperature is about 80°C to about 160°C.

What is claimed is:

1. A component for a plasma processing apparatus for processing semiconductor substrates, the component comprising:

a first member having a plurality of first through openings, the first member having a plasma-exposed surface and a first coefficient of thermal expansion;

a second member bonded to the first member and having a plurality of second through openings corresponding to the openings in the first member, the second member having a second coefficient of thermal expansion greater than the first coefficient of thermal expansion;

wherein the centers of the first and second openings are misaligned along an outer periphery at ambient temperature and the centers of the openings in the first member and the openings in the second member are closer together when the first and second members are heated to an elevated processing temperature;

wherein the second member comprises multiple pieces, each piece bonded to the first member.

2. The component of claim 1, wherein: (a) the multiple pieces are hexagonal shaped or (b) the multiple pieces comprise a circular plate with concentric annular rings, each ring attached to the first member.

3. The component of claim 2, wherein at least one of the rings is segmented.

4. A component for a plasma processing apparatus for processing semiconductor substrates, the component comprising:

a first member having a plurality of first through openings, the first member having a plasma-exposed surface and a first coefficient of thermal expansion;

a second member bonded to the first member and having a plurality of second through openings corresponding to the openings in the first member, the second member having a second coefficient of thermal expansion greater than the first coefficient of thermal expansion;

wherein the centers of the first and second openings are misaligned along an outer periphery at ambient temperature and the centers of the openings in the first member and the openings in the second member are closer together when the first and second members are heated to an elevated processing temperature;

wherein the second member has a non-uniform thickness across its width, adapted to impart flexibility to the second member during thermal cycling and the second member comprises a plurality of concentric or helical grooves.

5. The component of claim 4, wherein the second member further comprises a plurality of segments of uniform thickness connected by thinner segments.

6. A showerhead electrode assembly for a plasma processing apparatus, comprising:

- a silicon inner electrode with a plasma-exposed surface, the electrode having a plurality of axially extending gas distribution passages;

- a metallic backing member bonded to the electrode and having a plurality of axially extending gas distribution passages in fluid communication with the passages in the electrode, wherein the passages in the backing member are wider than the passages in the electrode, to reduce exposure of the second member to a plasma environment;

wherein the centers of passages in the electrode and the passages in the backing member are misaligned at ambient temperature and the centers of the passages in the electrode and the centers of the passages in the backing member are closer together when the electrode and backing member are heated to an elevated processing temperature.

7. A method of processing a semiconductor substrate in a plasma processing apparatus, the method of comprising:

- placing a substrate on a substrate support in a reaction chamber of a plasma processing apparatus;

- introducing a process gas into the reaction chamber with the showerhead electrode assembly of claim 6, the showerhead electrode assembly configured such that the centers of passages in the electrode and the passages in the backing member are misaligned at ambient temperature and the centers of the passages in the electrode and the centers of the passages in the backing member are closer together when the electrode and backing member are heated to an elevated processing temperature;

- generating a plasma from the process gas in the reaction chamber between the showerhead electrode assembly and the substrate while heating the electrode and backing member to the elevated processing temperature;

- processing the substrate with the plasma.

8. The method of claim 7, wherein the process gas is a fluorine-containing gas.

9. The method of claim 7, wherein the backing member is composed of aluminum or an aluminum alloy and the radially larger passages in the backing member are adapted to reduce aluminum fluoride formation.

10. The method of claim 7, wherein the gas distribution passages in the backing member and the distribution passages in the electrode are substantially concentric at the elevated processing temperature.

11. The method of claim 7, wherein the elevated processing temperature is about 80° C. to about 160° C.