CLAIMS

1. A gas diffusing device, comprising:

a first portion defining a gas supply conduit having a first inlet and a first outlet and including a second inlet, a second outlet and passages connecting the second inlet to the second outlet, wherein the passages receive non-conductive fluid to cool the first portion;

a second portion connected to the first portion, including a diffuser face with spaced holes and defining a cavity that is in fluid communication with the first outlet of the gas supply conduit and the diffuser face; and

a heater in contact with the second portion to heat the second portion,

wherein

the first portion defines an outer surface, an inner surface and an inner cavity,

the gas supply conduit passes through the inner cavity and the passages are located between the gas supply conduit and the inner surface of the first portion,

the first portion includes baffles extending (i) radially from the gas supply conduit to the inner surface and (ii) vertically with the inner cavity from the second inlet to the second outlet to define the passages,

the second portion and the passages of the first portion define a serpentine path such that the non-conductive fluid is directed by the baffles of the first portion and through at least a part of the second portion from the second inlet to the second outlet.

2. The gas diffusing device of claim 1, further comprising a radio frequency (RF) lead connected to the first portion.

3. The gas diffusing device of claim 1, wherein the first portion includes a stem portion of a showerhead and the second portion includes a base portion of the showerhead.

4. The gas diffusing device of claim 3, wherein the heater includes a connecting portion and a heating element portion, wherein the heating element portion is located around a periphery of the base portion, and wherein the connecting portion passes through the stem portion and is connected to the heating element portion.

5. The gas diffusing device of claim 4, wherein the base portion comprises:

an upper layer;

a middle layer; and

a lower layer comprising the diffuser face,

wherein the heating element is arranged between the upper layer and the middle layer.

6. The gas diffusing device of claim 5, wherein the upper layer and the middle layer of the base portion are vacuum brazed.

7. The gas diffusing device of claim 5, further comprising:

a conductor passing through the first portion and between the upper layer and the middle layer of the second portion; and

a thermocouple connected to the conductor and arranged in the middle layer of the second portion.

8. The gas diffusing device of claim 7, wherein the thermocouple is located adjacent to a radially outer edge of the middle layer.

9. A system for controlling a temperature of a gas diffusing device, comprising:

the gas diffusing device of claim 7; and

a controller configured to control a temperature of the gas diffusing device by:

supplying current to the heating element in response to a signal from the thermocouple; and

supplying process gas to the gas supply conduit and the non-conductive fluid to the inlet.

10. A substrate processing system comprising:

a processing chamber;

the gas diffusing device of claim 3; and

a pedestal arranged adjacent to the diffuser face of the gas diffusing device.

11. The substrate processing system of claim 10, wherein the substrate processing system performs plasma-enhanced chemical vapor deposition.

12. A method for controlling a temperature of a gas diffusing device, comprising:

supplying non-conductive fluid to a first portion of the gas diffusing device,

wherein the first portion defines a gas supply conduit having a first inlet and a first outlet and includes a second inlet, a second outlet and passages connecting the second inlet to the second outlet to receive the non-conductive fluid; and

supplying current to a heater arranged in a second portion of the gas diffusing device,

wherein the second portion is connected to the first portion, includes a diffuser face with spaced holes and defines a cavity that is in fluid communication with the first outlet of the gas supply conduit and the diffuser face,

wherein the first portion defines an outer surface, an inner surface and an inner cavity,

the gas supply conduit passes through the inner cavity and the passages are located between the gas supply conduit and the inner surface of the first portion,

the first portion includes baffles extending (i) radially from the gas supply conduit to the inner surface and (ii) vertically with the inner cavity from the second inlet to the second outlet to define the passages, and

the second portion and the passages of the first portion define a serpentine path such that the non-conductive fluid is directed by the baffles of the first portion and through at least a part of the second portion from the second inlet to the second outlet.

13. The method of claim 12, further comprising selectively supplying a radio frequency (RF) signal to the first portion.

14. The method of claim 12, wherein the first portion includes a stem portion of a showerhead and the second portion includes a base portion of the showerhead.

15. The method of claim 14, wherein the heater includes a connecting portion and a heating element portion, and further comprising

arranging the heating element portion around a periphery of the base portion;

passing the connecting portion through the stem portion; and

connecting the connecting portion to the heating element portion.

16. The method of claim 14, wherein the base portion comprises an upper layer, a middle layer, and a lower layer comprising the diffuser face, and further comprising arranging a heating element between the upper layer and the middle layer.

17. The method of claim 16, wherein the upper layer and the middle layer of the base portion are vacuum brazed.

18. The method of claim 16, further comprising:

passing a conductor through the first portion and between the upper layer and the middle layer of the second portion; and

connecting a thermocouple to the conductor.

19. The method of claim 18, further comprising locating the thermocouple adjacent to a radially outer edge of the middle layer.

20. The method of claim 12, further comprising using the gas diffusing device in a plasma-enhanced chemical vapor deposition system.