Claims:

1. An apparatus for processing a substrate, comprising:

a gas distribution conduit disposed in a processing volume of a process chamber above a substrate support to distribute a process gas to a processing surface of the substrate when disposed on the substrate support; and

an actuator coupled to the gas distribution conduit to move the gas distribution conduit with respect to the substrate support.

2. An apparatus for processing a substrate, comprising:

a process chamber having a substrate support;

a heating system to provide heat energy to a substrate when disposed on the substrate support;

a gas inlet port disposed at a first side of the substrate support to provide a first process gas across a processing surface of a substrate when disposed on the substrate support;

the gas distribution conduit of claim 1 disposed in a processing volume of the process chamber above a substrate support to distribute a second process gas to a processing surface of the substrate when disposed on the substrate support;

the actuator of claim 1 coupled to the gas distribution conduit to move the gas distribution conduit with respect to the substrate support; and

an exhaust manifold disposed to a second side of the substrate support opposite the gas inlet port to exhaust the first process gas and the second process gas from the process chamber.

3. The apparatus of any of claims 1 or 2, further comprising:

a seal disposed between the gas distribution conduit and a surface of the process chamber to seal an opening in the process chamber through which the gas distribution conduit is disposed, the seal forming a seal between the processing volume of the process chamber and the opening in the process chamber.

4. The apparatus of claim 3, wherein the seal is at least one of a flexible material, a bellows, a ferrofluid seal, or a differentially pumped sliding seal.

5. The apparatus of any of claims 1 or 2, wherein the gas distribution conduit is made of quartz.

6. The apparatus of any of claims 1 or 2, wherein the gas distribution conduit is substantially linear.

7. The apparatus of any of claims 1 or 2, wherein the gas distribution conduit has one or more outlets disposed along a length of the gas distribution conduit to provide the process gas to the substrate, wherein the one or more outlets are linearly arranged.

8. The apparatus of any of claims 1 or 2, further comprising a controller coupled to the actuator and configured to control movement of the gas distribution conduit.

9. The apparatus of any of claims 1 or 2, further comprising a plurality of gas distribution conduits disposed in the processing volume above the substrate and a corresponding plurality of actuators coupled to respective ones of the plurality of gas distribution conduits.

10. The apparatus of any of claims 1 or 2, wherein the actuator moves the gas distribution conduit in at least one of a linear axial direction or in a lateral, non-axial direction with respect to the substrate support.

11. The apparatus of any of claims 1 or 2, wherein the gas distribution conduit is disposed in and is constrained to move only in a plane.

12. The apparatus of claim 11, wherein the plane is substantially parallel to a plane defined by the substrate support of claim 2.

13. The apparatus of any of claims 1 or 2, further comprising one or more of:
a heating element disposed within or around the gas distribution conduit;

a heat pipe disposed within the gas distribution conduit;

wherein the gas distribution conduit is fabricated as a Dewar tube to thermally insulate an interior of the gas distribution conduit from an exterior environment;

wherein the gas distribution conduit is fabricated from materials that absorb energy from other energy sources disposed within the chamber to passively control a temperature of the second process gas; or

wherein the gas distribution conduit is fabricated from materials having a high thermal conductivity and is coupled to a heat sink.

14. A method of processing a substrate, comprising:

introducing a process gas to a process chamber through a gas distribution conduit disposed above a substrate having a processing surface; and

moving the gas distribution conduit within the process chamber and with respect to the substrate to distribute the process gas across the processing surface of the substrate.

15. The method of claim 14, wherein moving the gas distribution conduit further comprises one or more of moving the gas distribution conduit linearly in an axial direction, or moving the gas distribution conduit in a lateral, non-axial direction with respect to the processing surface of the substrate.

Claims

1. An apparatus for processing a substrate, comprising:

a process chamber having a substrate support;

a heating system to provide heat energy to a substrate when disposed on the substrate support;

a gas inlet port disposed at a first side of the substrate support to provide a first process gas across a processing surface of a substrate when disposed on the substrate support;

a gas distribution conduit of disposed in a processing volume of the process chamber above the substrate support to distribute a second process gas to a processing surface of the substrate when disposed on the substrate support;

an actuator coupled to the gas distribution conduit to move the gas distribution conduit with respect to the substrate support;

an exhaust manifold disposed to a second side of the substrate support opposite the gas inlet port to exhaust the first process gas and the second process gas from the process chamber;

a heating element disposed within or around the gas distribution conduit;

a heat pipe disposed within the gas distribution conduit;

wherein the gas distribution conduit is fabricated as a Dewar tube to thermally insulate an interior of the gas distribution conduit from an exterior environment;

wherein the gas distribution conduit is fabricated from materials that absorb energy from other energy sources disposed within the chamber to passively control a temperature of the second process gas; and

wherein the gas distribution conduit is fabricated from materials having a high thermal conductivity and is coupled to a heat sink.