CLAIMS

1. A chemical deposition apparatus, comprising:

a chemical isolation chamber;

a deposition chamber formed within the chemical isolation chamber;

a showerhead module having a faceplate and a backing plate, the faceplate including a plurality of inlets which deliver reactor chemistries to a cavity and exhaust outlets radially outward of the inlets which remove reactor chemistries from the cavity; and

at least one conductance control assembly, which is in fluid communication with the cavity via the exhaust outlets and an evacuation apparatus fluidly connected to the at least one conductance control assembly by one or more evacuation vacuum lines, the at least one conductance control assembly comprising

a fluidic valve free of moving parts, the fluidic valve having a modulating gas portion and a chamber outflow portion in fluid communication with the one or more evacuation vacuum lines, the modulating gas portion configured to direct a stream of modulating gas from a modulating gas supply into a flow of reactor chemistries from the cavity, and wherein the stream of modulating gas modulates flow resistance experienced by the flow of the reactor chemistries from the cavity by directing the stream of the modulating gas into the flow of reactor chemistries from the cavity.

2. The apparatus of claim 1, comprising: a source of purge gas, which is supplied to the cavity to purge the cavity of the reactor chemistries.

3. The apparatus of claim 1, comprising: a substrate pedestal module configured to support a substrate and which moves vertically to close the cavity between the pedestal module and an outer portion of the faceplate, and wherein the at least one conductance control assembly is a plurality of conductance control assemblies, which are evenly spaced circumferentially around the substrate pedestal module.

4. The apparatus of claim 3, wherein each of the plurality of conductance control assemblies is configured to be fluidly connected to two or more exhaust outlets.

5. The apparatus of claim 1, comprising:

a semiconductor substrate; and

wherein at least one of chemical vapor deposition, plasma-enhanced chemical vapor deposition, atomic layer deposition, plasma-enhanced atomic layer deposition, pulsed deposition layer, and/or plasma enhanced pulsed deposition layer is performed on the semiconductor substrate.

6. The apparatus of claim 1, wherein the modulating gas of the fluidic valve is an inert gas.

7. The apparatus of claim 6, wherein the modulating gas portion of the fluidic valve has a modulating inlet, which receives the modulating gas from the modulating gas supply, an inner cavity, at least one inlet and at least one outlet, and wherein the at least one outlet is configured to direct the stream of the modulating gas into the flow of reactor chemistries from the cavity.

8. The apparatus of claim 7, wherein the at least one inlet and the at least one outlet are cylindrical holes within the modulating gas portion of the fluidic valve forming a conduit.

9. The apparatus of claim 1, wherein the modulating gas and the reactor chemistries of the fluidic valve are combined within an exhaust conduit of the modulating gas portion, which is in fluid communication with the one or more vacuum gas lines.

10. The apparatus of claim 1, wherein the exhaust outlets are concentric exhaust outlets.

11. The apparatus of claim 1, wherein the at least one conductance control assembly has a minimum to a maximum conductance range, which has three orders of magnitude.

12. A chemical deposition apparatus, comprising:

a chemical isolation chamber;

a deposition chamber formed within the chemical isolation chamber;

a showerhead module having a faceplate and a backing plate, the faceplate including a plurality of inlets which deliver reactor chemistries to a cavity and exhaust outlets radially

outward of the inlets which remove reactor chemistries from the cavity via exhaust passages extending radially from an outer edge of the cavity; and

at least one conductance control assembly, which is in fluid communication with the cavity via the exhaust outlets and an evacuation apparatus fluidly connected to the at least one conductance control assembly by one or more evacuation vacuum lines, the at least one conductance control assembly comprising a ball valve assembly, the ball valve assembly comprising:

a housing having a conical lower portion;

a conduit extending from the conical lower portion of the housing to one or more of the exhaust outlets of the cavity, the conduit having an inlet and an outlet; and

a spherical body configured to fit within the conical lower portion, and wherein the spherical body is configured to block the outlet of the conduit and prevent a flow of the reactor chemistries through the conduit during a dosing step, and to allow the reactor chemistries and a purge gas to flow from the cavity into the one or more evacuation vacuum lines upon exceeding a first pressure and flow rate within the cavity during a purging step by rising upward as a result of the flow of purge gas exceeding the first pressure to provide an opening between a lower surface of the spherical body and the outlet of the conduit.

13. The apparatus of claim 12, comprising: a source of purge gas, which is supplied to the cavity to purge the cavity of the reactor chemistries.

14. The apparatus of claim 12, wherein the housing of the ball valve assembly includes an upper portion, which is in fluid communication with the one or more evacuation vacuum lines.

15. The apparatus of claim 12, wherein the spherical body of the ball valve assembly is configured to block the outlet of the conduit, at or below the first pressure and flow rate within the cavity during the dosing step.

16. The apparatus of claim 12, comprising: a substrate pedestal module configured to support a substrate and which moves vertically to close the cavity between the pedestal module and an outer portion of the faceplate, and wherein the at least one conductance control assembly is a plurality of conductance control assemblies, which are evenly spaced circumferentially around the substrate pedestal module.

17. The apparatus of claim 16, wherein each of the plurality of conductance control assemblies is configured to be fluidly connected to two or more exhaust outlets.

18. The apparatus of claim 12, wherein the spherical body of the ball valve assembly is made of a corrosion resistant material, and wherein the weight and size of the spherical body is configured to lift upward only during purging of the reactor chemistries from the cavity.

19. The apparatus of claim 12, comprising:

a semiconductor substrate; and

wherein at least one of chemical vapor deposition, plasma-enhanced chemical vapor deposition, atomic layer deposition, plasma-enhanced atomic layer deposition, pulsed deposition layer, and/or plasma enhanced pulsed deposition layer is performed on the semiconductor substrate.

20. The apparatus of claim 12, wherein the exhaust outlets are concentric exhaust outlets.

21. The apparatus of claim 12, wherein the at least one conductance control assembly has a minimum to a maximum conductance range, which has three orders of magnitude.

22. A chemical deposition apparatus, comprising:

a chemical isolation chamber;

a deposition chamber formed within the chemical isolation chamber;

a showerhead module having a faceplate and a backing plate, the faceplate including a plurality of inlets which deliver reactor chemistries to a cavity and exhaust outlets radially outward of the inlets which remove reactor chemistries from the cavity; and

at least one conductance control assembly, which is in fluid communication with the cavity via the exhaust outlets and an evacuation apparatus fluidly connected to the at least

one conductance control assembly by one or more evacuation vacuum lines, the at least one conductance control assembly comprising a rotary valve, the rotary valve comprising:

an upper rotating plate; and

a lower rotating plate magnetically coupled to the upper rotating plate with the upper rotating plate rotating in atmosphere and the lower rotating plate rotating in vacuum, the lower rotating plate having a plurality of conduits in fluid communication with a plenum between the lower rotating plate and the upper rotating plate, the plenum in fluid communication with the one or more evacuation vacuum lines, each of the plurality of conduits configured to receive reactor chemistries from the cavity from a corresponding evacuation conduit within the showerhead module, which is in fluid communication with one or more of the exhaust outlets.

23. The apparatus of claim 22, comprising: a source of purge gas, which is supplied to the cavity to purge the cavity of the reactor chemistries.

24. The apparatus of claim 22, wherein the upper rotating plate and the lower rotating plate rotate in the same direction.

25. The apparatus of claim 22, wherein each of the plurality of conduits within the lower rotating plate has an inlet on a lower surface and an outlet on an upper surface of the lower rotating plate, and each of the plurality of evacuation conduits also includes an inlet in fluid communication with the cavity and an outlet in fluid communication with the inlets of the lower rotating plate.

26. The apparatus of claim 22, wherein each of the outlets of the lower rotary plate are in fluid communication with an inner cavity, which is in fluid communication with the one or more evacuation gas lines.

27. The apparatus of claim 22, comprising: a substrate pedestal module configured to support a substrate and which moves vertically to close the cavity between the pedestal module and an outer portion of the faceplate, and wherein the at least one conductance control assembly is a plurality of conductance control assemblies, which are evenly spaced circumferentially around the substrate pedestal module.

28. The apparatus of claim 27, wherein each of the plurality of conductance control assemblies is configured to be fluidly connected to two or more exhaust outlets.

29. The apparatus of claim 22, comprising:

a semiconductor substrate; and

wherein at least one of chemical vapor deposition, plasma-enhanced chemical vapor deposition, atomic layer deposition, plasma-enhanced atomic layer deposition, pulsed deposition layer, and/or plasma enhanced pulsed deposition layer is performed on the semiconductor substrate.

30. The apparatus of claim 22, wherein the exhaust outlets are concentric exhaust outlets.

31. The apparatus of claim 22, wherein the at least one conductance control assembly has a minimum to a maximum conductance range, which has three orders of magnitude.