

CLAIMS:

1. An isolation valve, comprising:
a valve body defining a first fluid volume, a second fluid volume, and a seating surface;
5 a flapper assembly having a flapper disposed inside the valve body having a flapper surface complimentary to the seating surface, wherein the flapper is pivotable within the valve body to a first position such that the flapper surface is away from the seating surface to allow fluid flow between the first fluid volume and the second fluid volume, wherein the flapper is further pivotable within the valve body to a second position such that the flapper surface is
10 proximate the seating surface to form a non-contact seal to restrict fluid flow between the first fluid volume and the second fluid volume.
2. The isolation valve of claim 1, wherein when the flapper is in the second position, a gap ranging between 2 mm and 0.1 mm is formed between the seating surface and the complimentary flapper surface to form the non-contact seal.
- 15 3. The isolation valve of claim 1, wherein when the flapper is in the second position, a ratio of a length of a flow path defined by the flapper surface and the seating surface to a distance between the flapper surface and the seating surface ranges between about 1000:1 and about 10:1.
- 20 4. The isolation valve of claim 1, wherein the flapper assembly further comprises a flapper shaft configured to pivot the flapper between the first position and the second position, wherein the valve body comprises a first sidewall defining a first aperture for coupling with a first end portion of the flapper shaft, wherein the valve body further comprises a second sidewall opposite to the first sidewall, wherein the second sidewall defines a second aperture for coupling with a second end portion of the flapper shaft.
- 25 5. The isolation valve of claim 4, wherein the flapper assembly further comprises a driving mechanism operable to drive the flapper shaft, and wherein the driving mechanism is disposed outside the valve body and mounted on the exterior of the first sidewall.

6. The isolation valve of claim 1, wherein the flapper assembly further comprises a flapper shaft for pivoting the flapper between the first position and the second position, and wherein the flapper shaft comprises a hollow core configured to pass through a cooling fluid to cool the flapper shaft and the flapper.

5 7. The isolation valve of claim 1, wherein the valve body comprises a plurality of walls, and wherein a cooling loop is disposed in at least one wall of the plurality of walls and configured to pass through a cooling fluid to cool the valve body.

8. The isolation valve of claim 1, wherein the valve body further defines a first port for providing fluid access to the first fluid volume and a second port for providing fluid
10 access to the second fluid volume, wherein the first port and the second port define a common flow cross-sectional area, and wherein the first port and the second port are shaped differently.

9. The isolation valve of claim 8, wherein the first port is circular, and wherein the second port is rectangular.

10 10. The isolation valve of claim 8, wherein the second port includes a first dimension parallel to a pivoting axis of the flapper and a second dimension perpendicular to the pivoting axis of the flapper, and wherein a ratio of the first dimension to the second dimension ranges between about 10:1 and about 1:1.

11. A chamber system, comprising:
a first chamber unit;
20 a second chamber unit; and
an isolation valve coupled to the first chamber unit and the second chamber unit and configured to control fluid flow between the first chamber unit and the second chamber unit, wherein the isolation valve comprises:

25 a valve body defining a first port providing fluid access to the first chamber unit, and a second port providing fluid access to the second chamber unit; and
a flapper disposed inside the valve body having a flapper surface, wherein the flapper is pivotable within the valve body to a first position such that the flapper surface is away from a seating surface defined by the valve body to allow fluid flow

between the first chamber unit and the second chamber unit, wherein the flapper is further pivotable within the valve body to a second position such that the flapper surface is proximate the seating surface to restrict fluid flow between the first chamber unit and the second chamber unit, wherein when the flapper is in the second position, the seating surface and the flapper surface form a non-contact seal to restrict fluid flow between the first chamber unit and the second chamber unit.

12. The chamber system of claim 11, wherein when the flapper is in the second position, a ratio of a length of a flow path defined by the flapper surface and the seating surface to a distance between the flapper surface and the seating surface ranges between about 1000:1 and about 10:1.

13. The chamber system of claim 11, wherein the isolation valve is a first isolation valve, the chamber system further comprising a third chamber unit and a second isolation valve coupled to the first chamber unit and the third chamber unit and configured to control fluid flow between the first chamber unit and the third chamber unit.

14. A method, comprising:
closing an isolation valve coupled with a first chamber unit and a second chamber unit, wherein the isolation valve is operable to control fluid flow between the first chamber unit and the second chamber unit, wherein the isolation valve comprises:

a valve body defining a first fluid volume fluidly coupled with the first chamber unit, and a second fluid volume fluidly coupled with the second chamber unit;
and

a flapper disposed inside the valve body having a flapper surface, wherein the flapper is pivotable within the valve body to a first position such that the flapper surface is away from a seating surface defined by the valve body to allow fluid flow between the first chamber unit and the second chamber unit, wherein the flapper is further pivotable within the valve body to a second position such that the flapper surface is proximate the seating surface to restrict fluid flow between the first chamber unit and the second chamber unit, wherein when the flapper is in the second position, the seating

surface and the flapper surface form a non-contact seal to restrict fluid flow between the first chamber unit and the second chamber unit; and

flowing a shielding gas into the first fluid volume.

15. The method of claim 14, further comprising dynamically control a flow
5 rate of the shielding gas such that a pressure in the first fluid volume is greater than a pressure in the second fluid volume.