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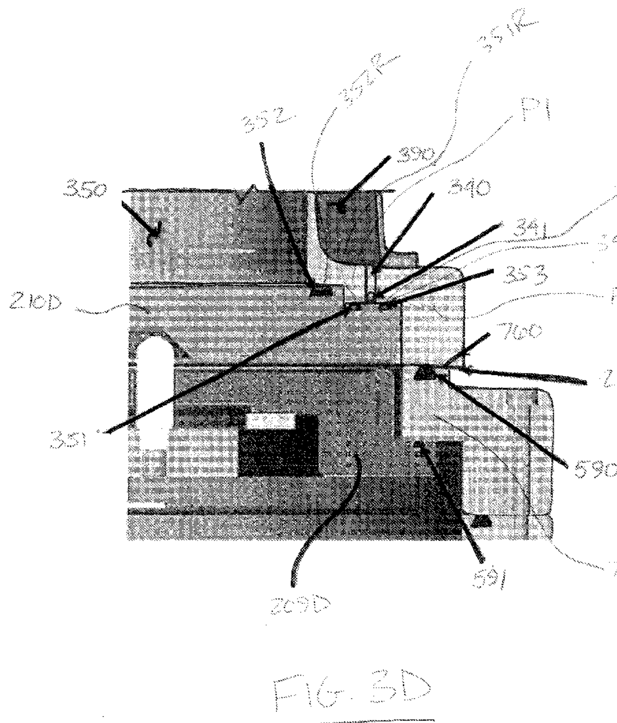
(54) **Title**: SUBSTRATE TRANSPORT



(57) **Abstract**: A substrate transport system includes a carrier having a housing forming an interior environment having an opening for holding at least one substrate and a door for sealing the opening from an outside atmosphere where when sealed the interior environment is configured to maintain an interior atmosphere therein, the housing including a fluid reservoir exterior to the interior environment and configured to contain a fluid, forming a different atmosphere in the fluid reservoir than the interior atmosphere, to form a fluidic barrier seal that seals the interior environment from an environment exterior to the carrier.

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1. A substrate transport system comprising:

a carrier having

a housing forming an interior environment having an opening for holding at least one substrate, and

a door for sealing the opening from an outside atmosphere where when sealed the interior environment is configured to maintain an interior atmosphere therein, the housing including a fluid reservoir exterior to the interior environment and configured to contain a fluid, forming a different atmosphere in the fluid reservoir than the interior atmosphere, and so that the fluid reservoir with fluid forms a fluidic barrier seal that seals the interior environment from an environment exterior to the carrier.

2. The substrate transport system of claim 1, wherein the fluid reservoir is configured to release fluid into the interior environment upon a breach of the first environment.

3. The substrate transport system of claim 1, the substrate transport system further comprises a vacuum chamber having a carrier interface, the carrier interface being configured to support the carrier for transport of the at least one substrate in the vacuum chamber.

4. The substrate transport system of claim 3, wherein the door is released through a dynamic pressure equalization between the interior environment and the vacuum chamber.

5. The substrate transport system of claim 3, wherein the vacuum chamber includes at least one sealable opening for coupling the vacuum chamber to at least one substrate processing module.

6. The substrate transport system of claim 3, wherein the carrier interface includes a redundant seal arrangement including a first seal located in a first plane and a second seal located in a second plane where the first and second planes are substantially orthogonal to each other.

7. The substrate transport system of claim 3, further comprising a passive door lock holding the door to the housing, where the carrier interface is configured to release the passive door lock.

8. The substrate transport system of claim 3, wherein the carrier interface includes a purge port configured to purge at least one of a space between the door and the carrier interface and a seal between the door and the housing.

9. The substrate transport system of claim 3, wherein the carrier interface is a passive interface.

10. The substrate transport system of claim 1, wherein at least one of the housing and door includes a redundant seal arrangement, the redundant seal arrangement including at least one vacuum seal disposed around a periphery of the opening and at least one fluid reservoir seal.

11. The substrate transport system of claim 10, wherein the at least one vacuum seal of the redundant seal arrangement includes a first seal located in a first plane and a second seal located in a second plane where the first and second planes are distinct from one another.

12. The substrate transport system of claim 10, wherein each of the seals of the redundant seal arrangement mate with a recessed sealing surface in at least one of the housing and door.

13. The substrate transport system of claim 1, wherein the fluid reservoir contains a gas at a pressure higher than the pressure of the interior atmosphere.

14. The substrate transport system of claim 1, wherein the fluid reservoir contains a gas at a pressure higher than atmospheric pressure.

15. The substrate transport system of claim 1, wherein the interior atmosphere is at a pressure less than atmospheric pressure.

16. The substrate transport system of claim 1, wherein the housing of the carrier is configured to support a vacuum interior environment.

17. The substrate transport system of claim 1, wherein the housing includes a fluid reservoir channel in communication with the fluid reservoir such that the fluidic barrier seal is disposed outward of the at least one vacuum seal and at least

one fluid reservoir seal is disposed around a periphery of the fluid reservoir channel.

18. The substrate transport system of claim 17, wherein the fluid reservoir is configured to release a fluid through the fluid reservoir channel into the interior environment upon a breach of the at least one vacuum seal.

19. The substrate transport system of claim 1, wherein the door is sealed to the housing from a vacuum force of the interior environment.

20. The substrate transport system of claim 1, further comprising a passive door lock configured to retain the door to the housing upon loss of the vacuum force.

21. The substrate transport system of claim 20, wherein the passive door lock comprises a ball lock detent and a ball lock plunger.

22. A substrate transport comprising:

a housing forming an interior environment for housing at least one substrate in a first atmosphere, the housing including

an opening to the interior environment,

a fluid reservoir forming a fluidic barrier seal with a second atmosphere different from and external to the first atmosphere,

a door configured to close the opening, where when the opening is closed the housing is configured to maintain the first atmosphere within the interior environment, and

a redundant seal arrangement disposed on at least one of the housing and the door, the redundant seal arrangement including at least a first seal disposed around a periphery of the opening and at least a second seal where the second seal is disposed between the first seal and the fluidic barrier seal.

23. The substrate transport of claim 22, wherein the housing includes a fluid reservoir channel in communication with the fluid reservoir and disposed outward of the first seal, the substrate transport further including a fluid reservoir seal outwardly disposed around a periphery of the fluid reservoir channel.

24. The substrate transport of claim 22, wherein the fluid reservoir is configured to release a fluid through the fluid reservoir channel into the interior environment upon a breach of one or more of the first and second seals.

25. The substrate transport of claim 22, wherein the door is sealed to the housing from a vacuum force of the interior environment.

26. The substrate transport of claim 22, wherein the substrate transport includes a passive door lock configured to retain the door to the housing upon loss of the vacuum force.

27. The substrate transport of claim 26, wherein the passive door lock comprises a ball lock detent and a ball lock plunger.

28. The substrate transport of claim 26, wherein the passive door lock is configured to be passively released.

29. The substrate transport of claim 22, wherein the door is configured to support the at least one substrate.

30. A substrate transport comprising:

a housing having

an interior environment configured to hold at least one substrate in a first atmosphere, the first atmosphere being common to a substrate processing atmosphere,

a door for sealing the interior environment, and

a fluidic barrier seal between the door and the housing, the fluidic barrier seal having a second atmosphere different from and isolated from the first atmosphere where an outer seal isolates the fluidic barrier seal from an external atmosphere outside the housing and an inner seal isolates the fluidic barrier seal from the first atmosphere so that a void exists between the fluidic barrier seal and the first atmosphere.

31. The substrate transport of claim 30, further comprising an intermediate seal configured to isolate the fluidic barrier seal from the inner seal.

32. The substrate transport of claim 30, wherein the fluidic barrier seal includes a fluid reservoir distinct from the interior environment and connected to the housing and a fluid channel.

33. The substrate transport of claim 32, wherein the fluid channel connects the fluid reservoir to an interface between the housing and the door.

34. The substrate transport of claim 30, wherein the fluidic barrier seal is a pressurized seal disposed between the external atmosphere and the first atmosphere.

35. A substrate processing tool comprising:

an atmospheric processing chamber having an atmospheric environment therein;

a vacuum processing chamber having a vacuum environment therein and being connected to the atmospheric processing chamber; and

a substrate carrier to processing tool interface module having at least one closable opening through which substrates pass and being configured for coupling to one or more of the atmospheric processing chamber and vacuum processing chamber, the substrate carrier to processing tool interface module including

a vacuum interface configured to allow opening of an internal environment of a substrate carrier to the vacuum environment of the vacuum processing chamber, and

an atmospheric interface configured to allow opening of the internal environment of the substrate carrier to the atmospheric environment of the atmospheric processing chamber.

36. The substrate processing tool of claim 35, wherein the vacuum processing chamber comprises a load lock wherein the substrate carrier to processing tool interface module is connected to the load lock.

37. The substrate processing tool of claim 35, wherein the atmospheric processing chamber comprises a mini-environment wherein the substrate carrier to processing tool interface module is connected to the mini-environment.

38. The substrate processing tool of claim 35, wherein the vacuum processing chamber comprises a load lock and the atmospheric processing chamber comprises a mini-environment where the substrate carrier to processing tool interface module is connected to both the load lock and the mini-environment.

39. The substrate processing tool of claim 35, wherein the substrate carrier to processing tool interface module is configured to evacuate or charge a substrate carrier fluidic barrier seal located between a door of the substrate carrier and a housing of the substrate carrier.

40. The substrate processing tool of claim 35, wherein the substrate carrier to processing tool interface module is

configured to evacuate or charge an internal environment of the substrate carrier.

41. The substrate processing tool of claim 35, wherein the substrate carrier to processing tool interface module is configured to form a pass-through load lock connected to the vacuum processing chamber and the atmospheric processing chamber, the substrate carrier to processing tool interface module having substrate support shelves disposed underneath one of the at least one closable opening.

42. The substrate processing tool of claim 41, wherein the substrate carrier to processing tool interface module is configured so that a substrate is transported through the pass-through load lock into the vacuum processing chamber from the atmospheric processing chamber and for substrate exit into a vacuum environment of a substrate carrier coupled to the substrate carrier to processing tool interface module.

43. The substrate processing tool of claim 35, wherein the atmospheric processing chamber is an equipment front end module having a back connected to the vacuum processing chamber, a BOLTS interface opposite the back and sides extending between the BOLTS interface and the back, the substrate carrier to processing tool interface module being coupled to one of the back, sides and BOLTS interface.