CLAIMS

1. A method of manufacturing semiconductor devices comprising:

a) operably coupling a liquid chemical delivery system to a source of liquid chemical, the liquid chemical delivery system comprising:

a three layer arrangement comprising a top layer of active components, a middle layer of substrate blocks which serve to form fluid connections between the active components, and a bottom layer formed by a back plane serving as a support structure for the top and middle layers;

the middle layer of substrate blocks comprising first and second substrate blocks, each of the first and second substrate blocks comprising: an upper surface; a substrate inlet port in the upper surface; a substrate outlet port in the upper surface; a substrate fluid passageway extending between the substrate inlet port and the substrate outlet port; and each of the substrate outlet port and the substrate inlet port surrounded by a substrate ring and a substrate channel surrounding the substrate ring;

the active components comprising a first active component comprising: a lower surface; a component inlet port in the lower surface; a component outlet port in the lower surface; a component fluid passageway extending from the component inlet port to the component outlet port; each of the component inlet port and the component outlet port surrounded by a component ring and a component channel surrounding the component ring;

first and second seal inserts, each of the first and second seal inserts comprising: an interior sleeve defining a sleeve fluid passageway about an axis; an outer ring connected to and surrounding the interior sleeve so that: (1) an annular upper groove is formed between an upper portion of the outer ring and an upper portion of the interior sleeve; and (2) an annular lower groove is formed between a lower portion of the outer ring and a lower portion of the interior sleeve;

the first active component bridging the first and second substrate blocks so that: (1) the substrate outlet port of the first substrate block and the

component inlet port are aligned; and (2) the substrate inlet port of the second substrate block and the component outlet port are aligned; and

the first seal insert fluidly sealing the substrate outlet port of the first substrate block and the component inlet port together to form a first fluid connection and the second seal insert fluidly sealing the substrate inlet port of the second substrate block and the component outlet port together to form a second fluid connection, thereby forming a portion of a flow pathway through the liquid chemical delivery system; and

b) delivering the chemical liquid from the chemical liquid supply through the flow pathway of the liquid chemical delivery system to a process site to process semiconductor wafers;

wherein the first active component is spaced and isolated from the back plane.

2. The method of claim 1 wherein the first active component is selected from the group consisting of a flow controller, a pressure transducer, a flow measurement sensor, a pressure regulator, a valve, and a flow meter.

3. The method of claim 1 wherein step b) is an etching, cleaning, polishing, drying, or material deposition process.

4. The method of claim 1 wherein the first and second substrate blocks are formed of a polymer or fluoropolymer.

5. The method of claim 4 wherein the first and second substrate blocks are formed of a polypropylene, PTFE, modified PTFE, or PFA.

6. The method of claim 1 wherein step a) further comprises:

a-1) operably coupling the liquid chemical delivery system to the source of the liquid chemical by forming a liquid connection between an inlet fitting of the liquid chemical delivery system; and

a-2) operably coupling the liquid chemical delivery system to the process site by forming a liquid connection between an outlet fitting of the liquid chemical delivery system; and

wherein a portion of the flow pathway from the inlet fitting to the outlet fitting is a weldless and tubeless flow pathway.

7. The method of claim 1 wherein for each of the first and second seal inserts, both the upper and lower portions of the interior sleeve have a tapered outer portion that is sloped away from the sleeve fluid passageway at a first angle relative to the axis.

8. The method of claim 7 wherein for each of the first and second fluid connections, the tapered outer portions of the first and second seal inserts are compressed by the substrate and component rings to form a primary fluid seal at each of the first and second fluid connections.

9. The method of claim 8 wherein for each of the first and second fluid connections, the upper and lower portions of the outer rings of the first and second seal inserts are nested within the component and substrate channels respectively under horizontal interference to form a secondary fluid seal at each of the first and second fluid connections.

10. The method of claim 7 wherein for each of the first and second seal inserts, the interior sleeve has an inner surface extending from an upper edge of the interior sleeve to a lower edge of the interior sleeve that defines the sleeve fluid passageway and is parallel to the axis.

11. The method of claim 7 wherein for each of the first and second seal inserts, both the upper and lower portions of the interior sleeve have a tapered inner portion that is sloped toward the sleeve fluid passageway at a second angle relative to the axis.

12. The method of claim 11 wherein the second angle is greater than the first angle.

13. A method of manufacturing semiconductor devices comprising:

a) operably coupling a liquid chemical delivery system to a source of liquid chemical, the liquid chemical delivery system comprising:

a three layer arrangement comprising a top layer of active components, a middle layer of substrate blocks which serve to form fluid connections between the active components, and a bottom layer formed by a back plane serving as a support structure for the top and middle layers;

the middle layer of substrate blocks comprising first and second substrate blocks, each of the first and second substrate blocks comprising: an

upper surface; a substrate inlet port in the upper surface; a substrate outlet port in the upper surface; a substrate fluid passageway extending between the substrate inlet port and the substrate outlet port; each of the substrate outlet port and the substrate inlet port surrounded by a substrate ring and a substrate channel surrounding the substrate ring; and the substrate fluid passageway intersecting the substrate inlet port and the substrate outlet port at an angle;

the active components comprising a first active component comprising: a lower surface; a component inlet port in the lower surface; a component outlet port in the lower surface; a component fluid passageway extending from the component inlet port to the component outlet port; each of the component inlet port and the component outlet port surrounded by a component ring and a component channel surrounding the component ring;

first and second seal inserts, each of the first and second seal inserts comprising: an interior sleeve defining a sleeve fluid passageway about an axis; an outer ring connected to and surrounding the interior sleeve so that: (1) an annular upper groove is formed between an upper portion of the outer ring and an upper portion of the interior sleeve; and (2) an annular lower groove is formed between a lower portion of the outer ring and a lower portion of the interior sleeve;

the first active component bridging the first and second substrate blocks so that: (1) the substrate outlet port of the first substrate block and the component inlet port are aligned; and (2) the substrate inlet port of the second substrate block and the component outlet port are aligned; and

the first seal insert fluidly sealing the substrate outlet port of the first substrate block and the component inlet port together to form a first fluid connection and the second seal insert fluidly sealing the substrate inlet port of the second substrate block and the component outlet port together to form a second fluid connection, thereby forming a portion of a flow pathway through the liquid chemical delivery system; and

b) delivering the chemical liquid from the chemical liquid supply through the flow pathway of the liquid chemical delivery system to a process site to process semiconductor wafers;

wherein the first active component is spaced and isolated from the back plane.

14. The method of claim 13 wherein for each of the first and second seal inserts, both the upper and lower portions of the interior sleeve have a tapered outer portion that is sloped away from the sleeve fluid passageway at a first angle relative to the axis.

15. The method of claim 14 wherein for each of the first and second fluid connections, the tapered outer portions of the first and second seal inserts are compressed by the substrate and component rings to form a primary fluid seal at each of the first and second fluid connections.

16. The method of claim 15 wherein for each of the first and second fluid connections, the upper and lower portions of the outer rings of the first and second seal inserts are nested within the component and substrate channels respectively under horizontal interference to form a secondary fluid seal at each of the first and second fluid connections.

17. The method of claim 14 wherein for each of the first and second seal inserts, the interior sleeve has an inner surface extending from an upper edge of the interior sleeve to a lower edge of the interior sleeve that defines the sleeve fluid passageway and is parallel to the axis.

18. The method of claim 14 wherein for each of the first and second seal inserts, both the upper and lower portions of the interior sleeve have a tapered inner portion that is sloped toward the sleeve fluid passageway at a second angle relative to the axis.

19. The method of claim 18 wherein the second angle is greater than the first angle.

20. The method of claim 13 wherein the substrate fluid passageway comprises an arc, the arc meeting the substrate inlet port and the substrate outlet port.