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(54) **PROCESSING CHAMBER PURGE PLATE WITH SHROUD, AND PEDESTAL SHIELD SYSTEM**

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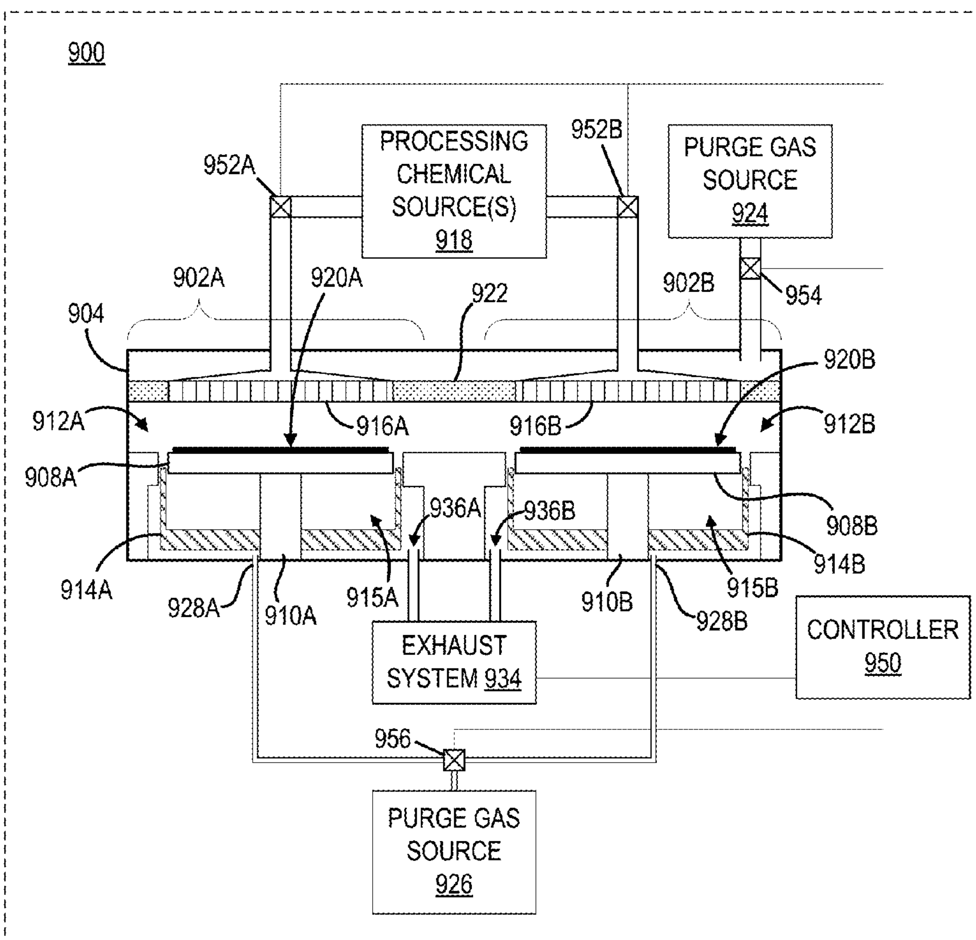
(57) **ABSTRACT**

Examples are disclosed that relate to a purge plate comprising a shroud. The shroud helps to avoid crosstalk between stations in a multi-station processing chamber. One example provides a processing tool comprising a processing chamber comprising a plurality of stations. The processing tool also comprises a purge plate comprising a chamber-facing surface. The purge plate further comprises a plurality of cutouts configured to accommodate process gas outlets of the plurality of stations. The purge plate further comprises a shroud arranged around at least a portion of a perimeter of a first cutout of a plurality of cutout. The shroud extends away from the chamber-facing surface. The purge plate further comprises a plurality of purge gas holes formed in the chamber-facing surface and the shroud.



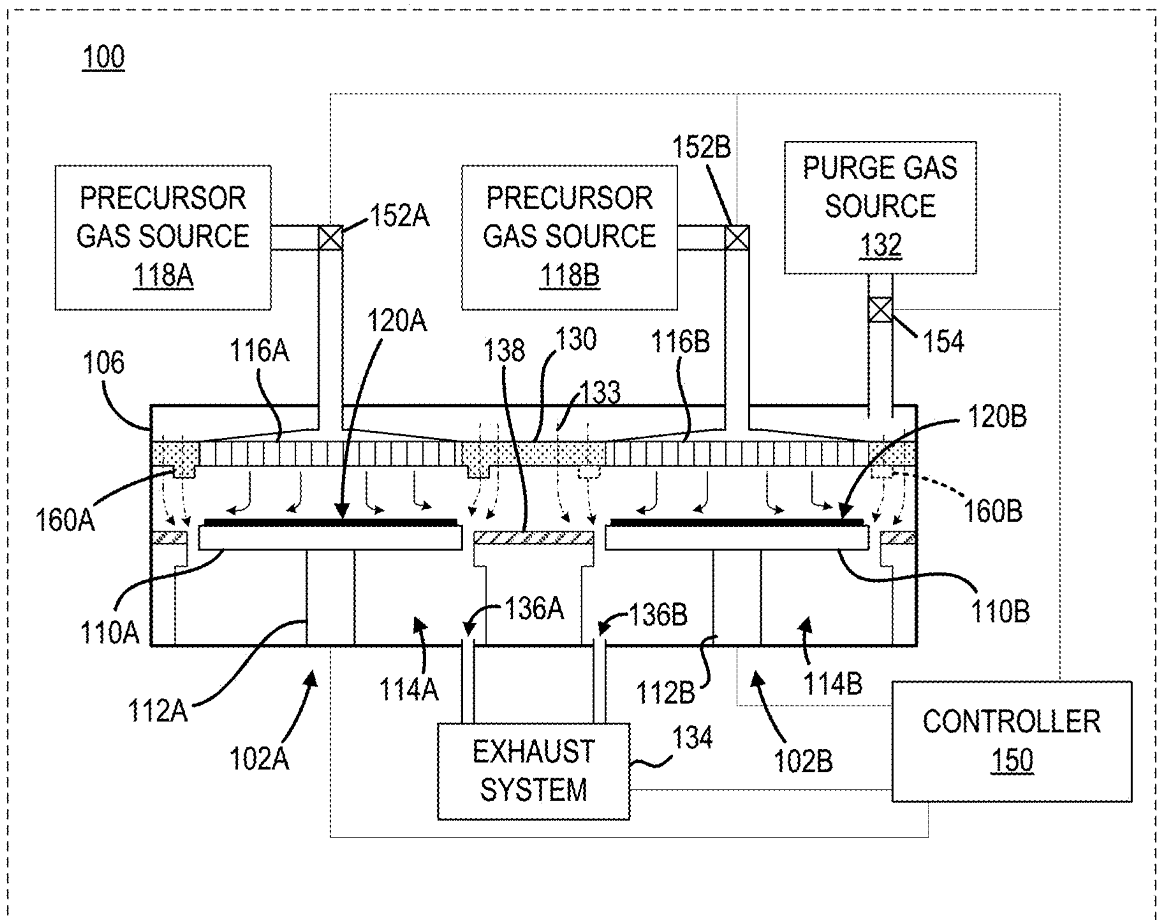

100
PRECURSOR GAS SOURCE 118A
152A
PRECURSOR GAS SOURCE 118B
152B
PURGE GAS SOURCE 132
154
106
116A
120A
138
130
133
116B
120B
160A
160B
110A
110B
136A
136B
112A
114A
112B
114B
102A
102B
EXHAUST SYSTEM
134
CONTROLLER 150

FIG. 1

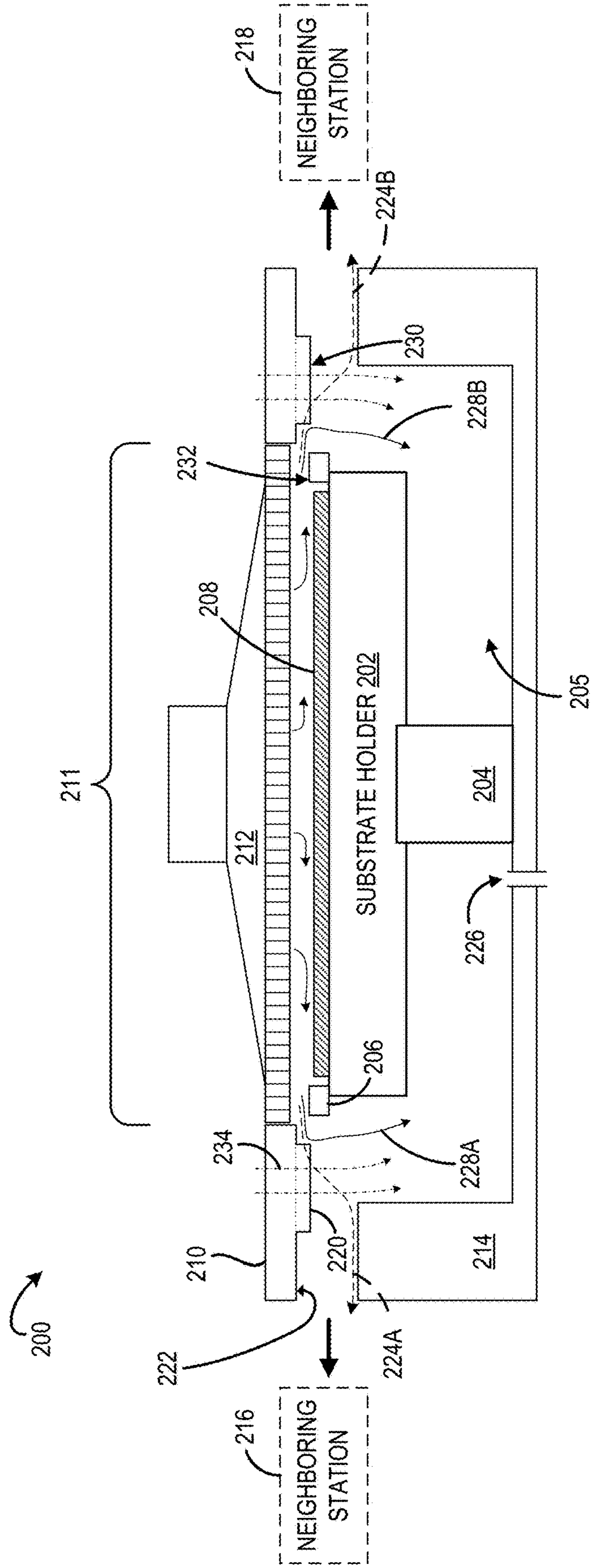

200
NEIGHBORING STATION
216
NEIGHBORING STATION
218
222
210
220
224A
224B
234
214
228A
228B
206
226
211
212
SUBSTRATE HOLDER 202
204
205
208
232
230

FIG. 2

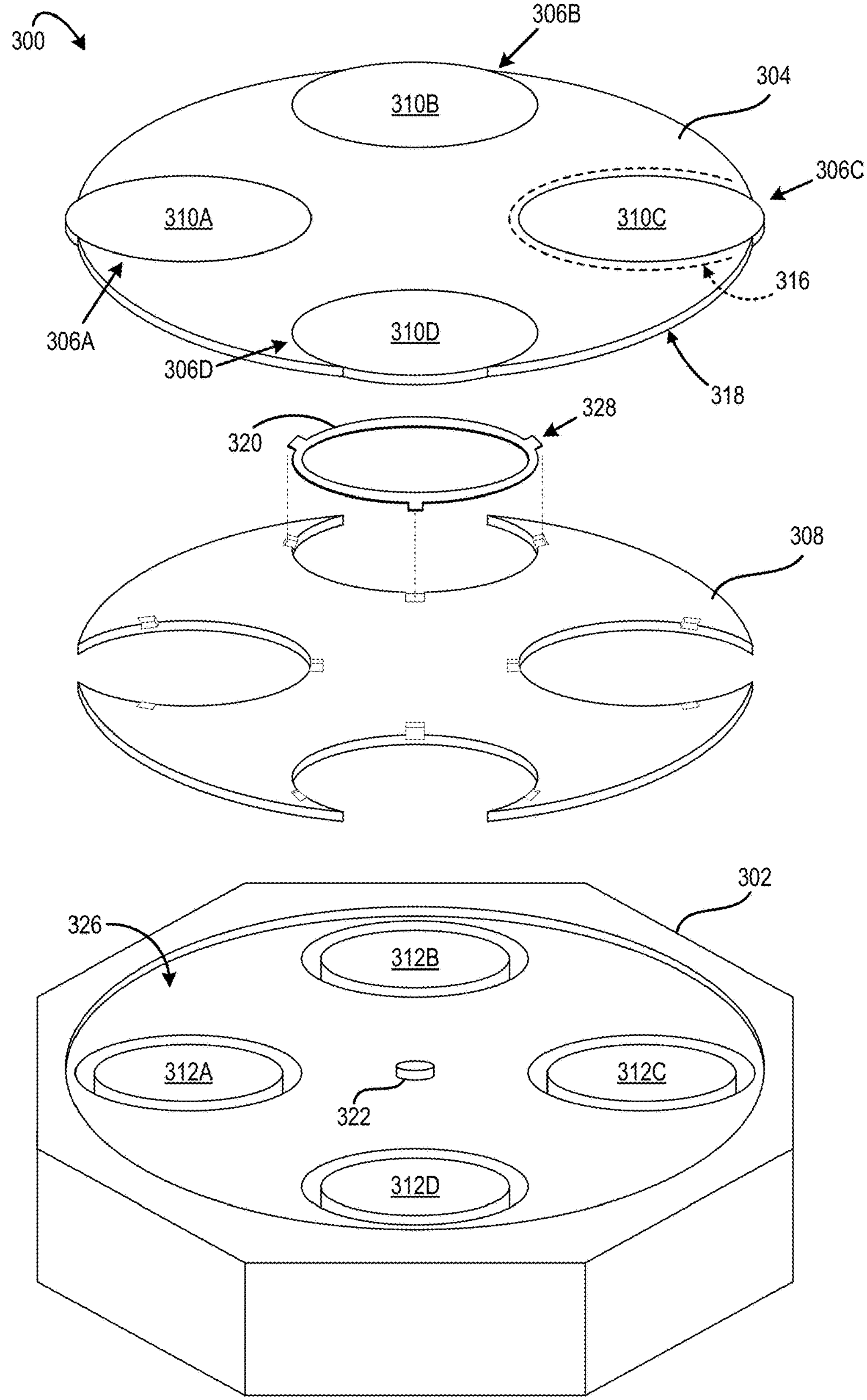

300
306B
304
310B
310A
310C
306C
316
306A
310D
306D
318
328
320
308
302
326
312B
312A
312C
322
312D

FIG. 3

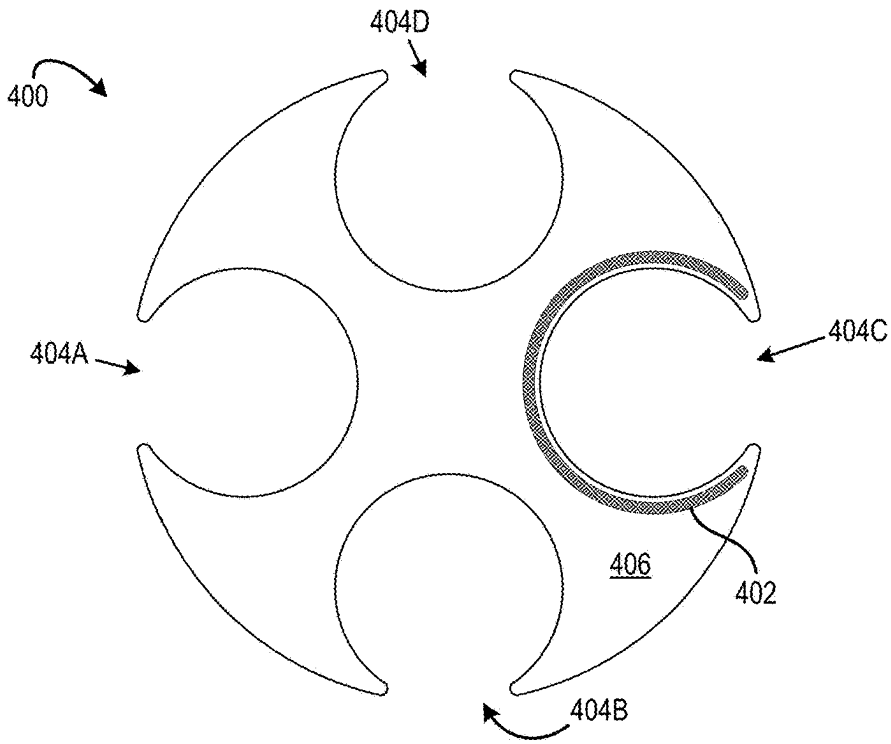

400
404D
404A
404C
406
402
404B

FIG. 4

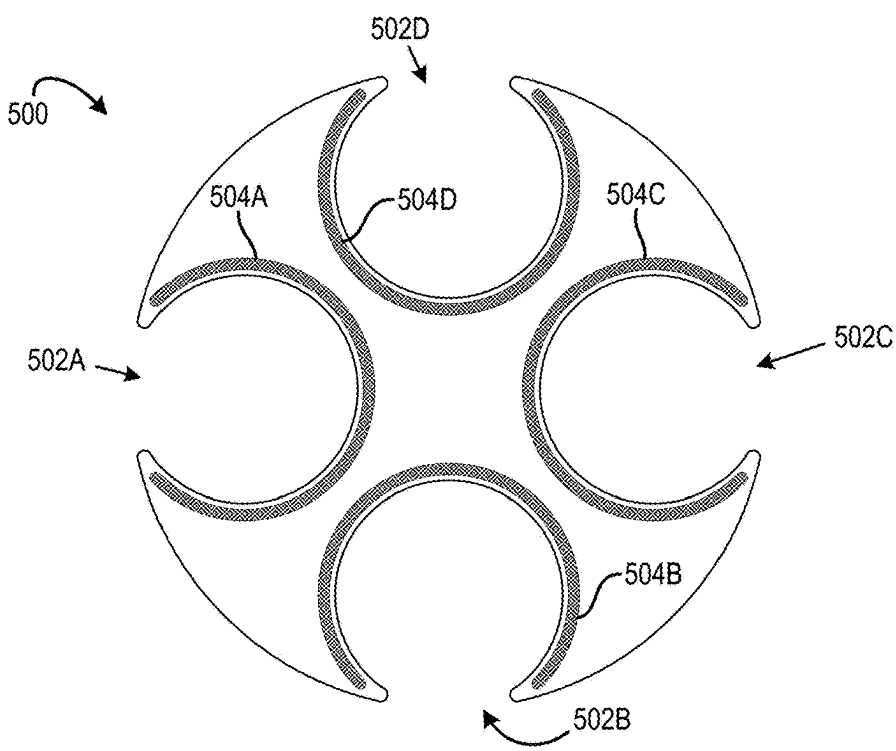

500
502D
504A
504D
504C
502A
502C
504B
502B

FIG. 5

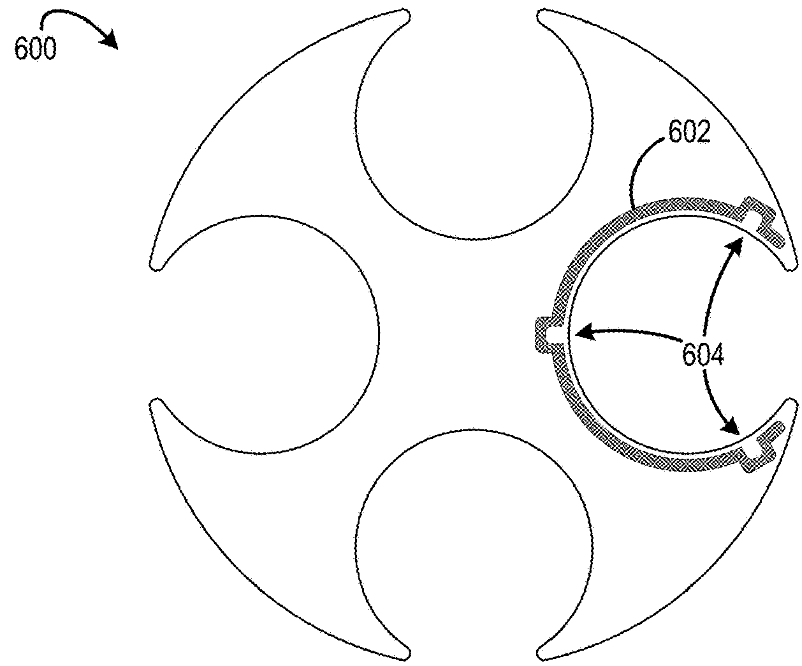


FIG. 6

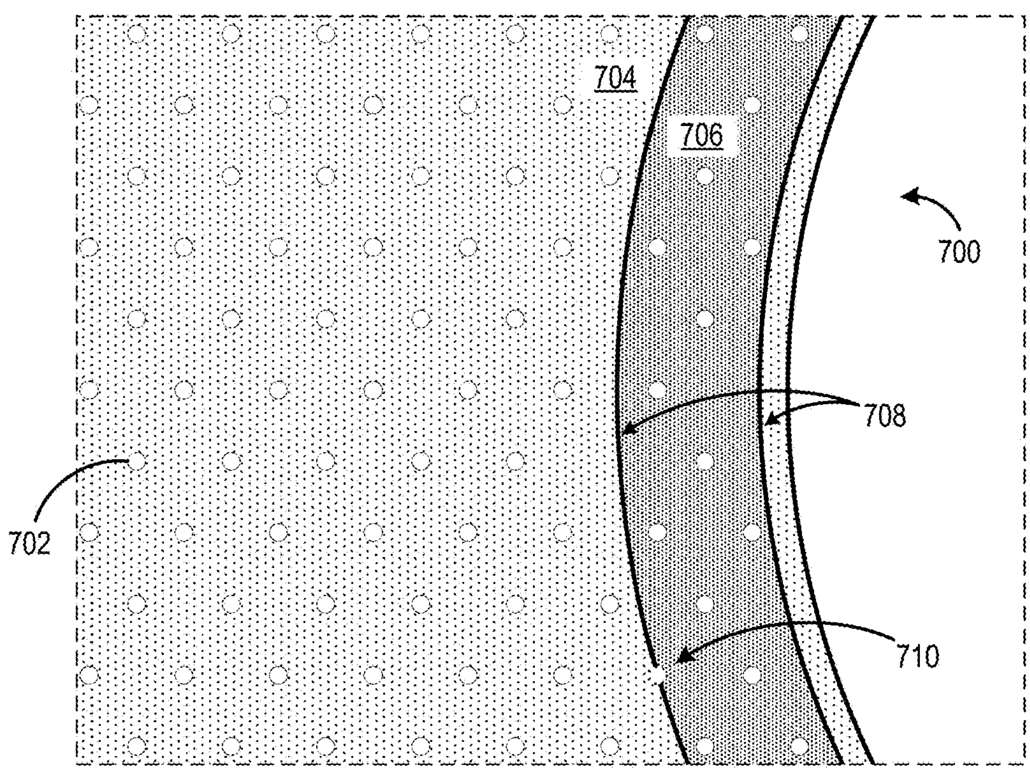


FIG. 7

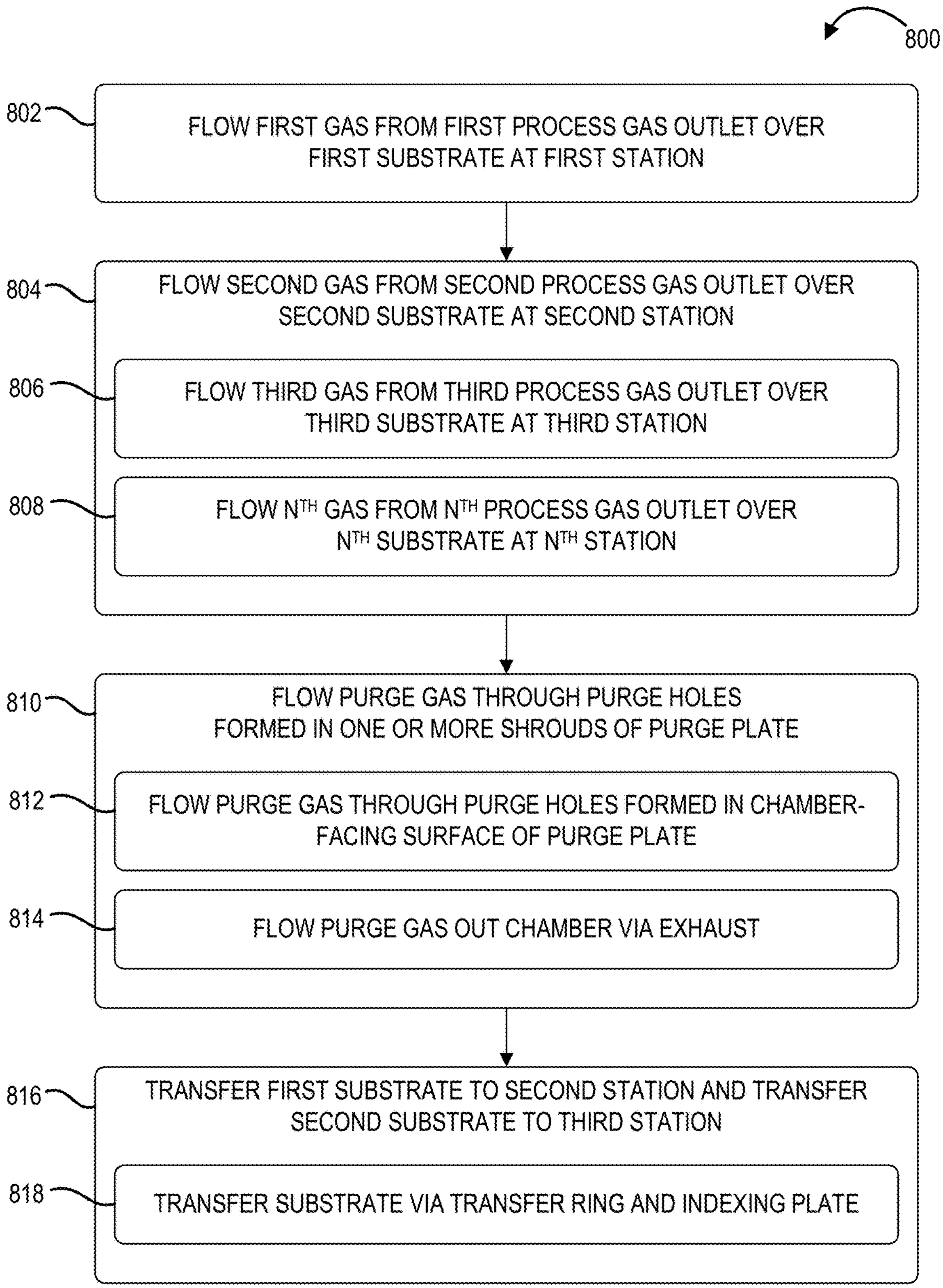

800
802
FLOW FIRST GAS FROM FIRST PROCESS GAS OUTLET OVER FIRST SUBSTRATE AT FIRST STATION
804
FLOW SECOND GAS FROM SECOND PROCESS GAS OUTLET OVER SECOND SUBSTRATE AT SECOND STATION
806
FLOW THIRD GAS FROM THIRD PROCESS GAS OUTLET OVER THIRD SUBSTRATE AT THIRD STATION
808
FLOW N^TH GAS FROM N^TH PROCESS GAS OUTLET OVER N^TH SUBSTRATE AT N^TH STATION
810
FLOW PURGE GAS THROUGH PURGE HOLES FORMED IN ONE OR MORE SHROUDS OF PURGE PLATE
812
FLOW PURGE GAS THROUGH PURGE HOLES FORMED IN CHAMBER-FACING SURFACE OF PURGE PLATE
814
FLOW PURGE GAS OUT CHAMBER VIA EXHAUST
816
TRANSFER FIRST SUBSTRATE TO SECOND STATION AND TRANSFER SECOND SUBSTRATE TO THIRD STATION
818
TRANSFER SUBSTRATE VIA TRANSFER RING AND INDEXING PLATE

FIG. 8

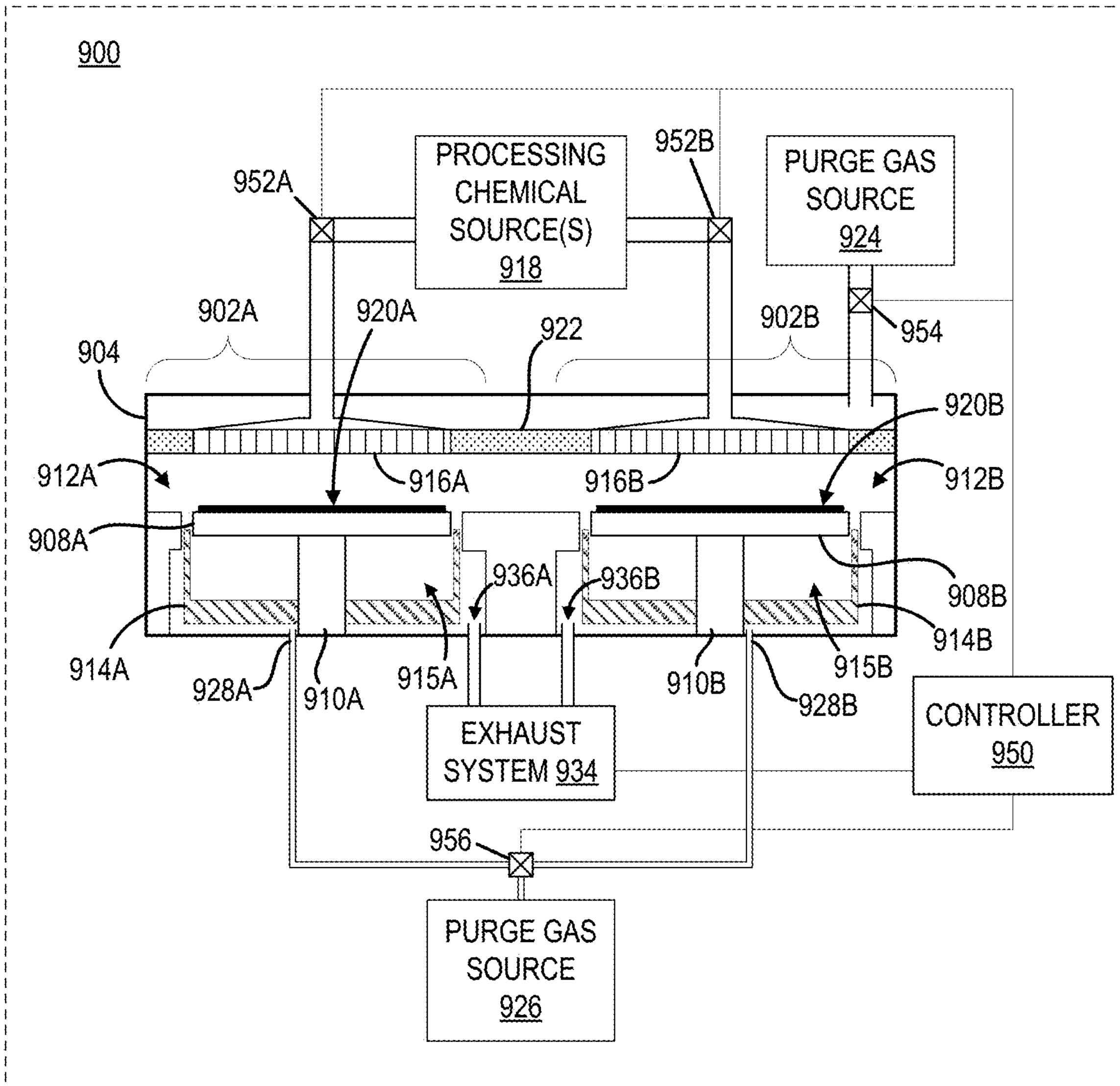

900
PROCESSING CHEMICAL SOURCE(S) 918
952A
952B
PURGE GAS SOURCE 924
954
902A
920A
922
902B
904
920B
912A
916A
916B
912B
908A
936A
936B
908B
914A
928A
910A
915A
910B
928B
915B
914B
EXHAUST SYSTEM 934
CONTROLLER 950
956
PURGE GAS SOURCE 926

FIG. 9

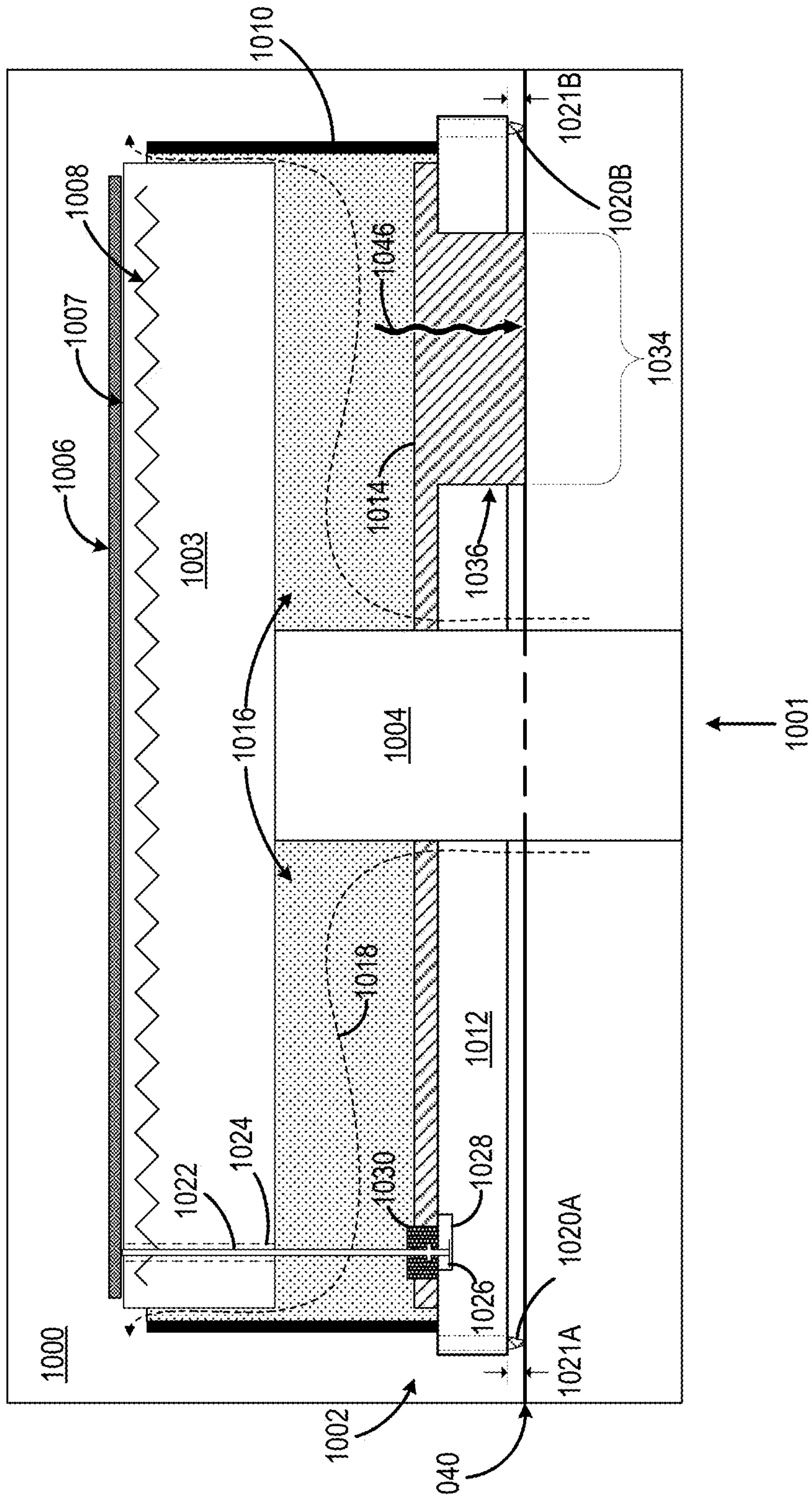

1010
1021B
1008
1007
1006
1020B
1046
1034
1003
1014
1036
1016
1004
1001
1018
1012
1022
1024
1030
1028
1020A
1026
1021A
1000
1002
1040

FIG. 10

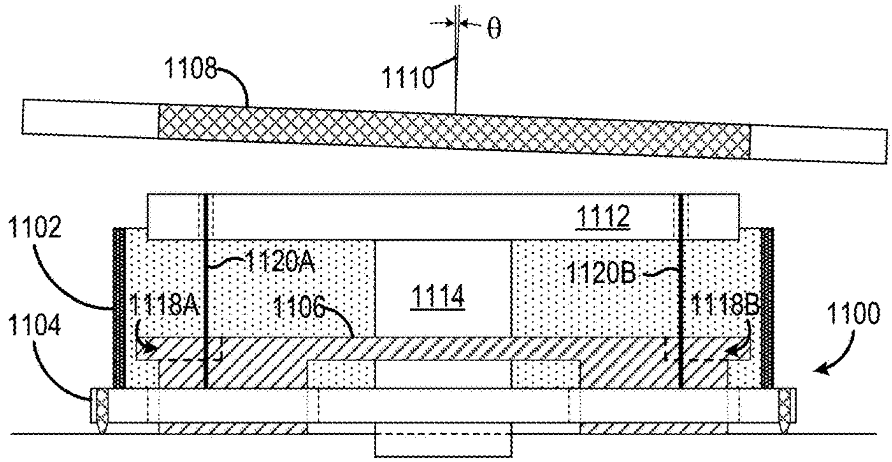


FIG. 11A

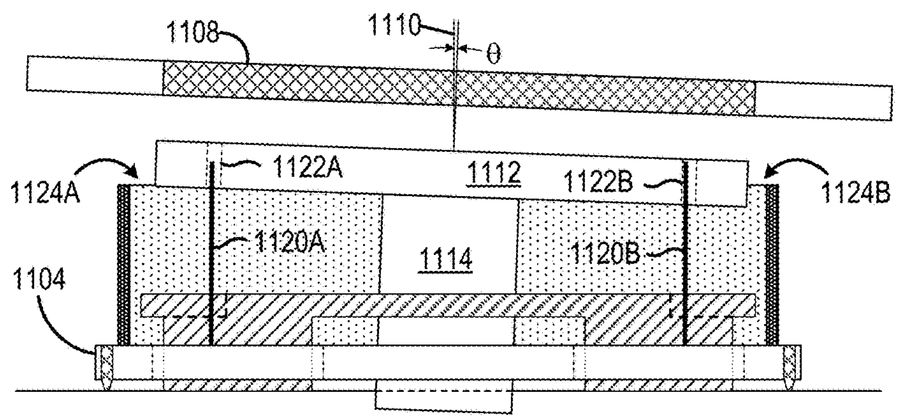


FIG. 11B

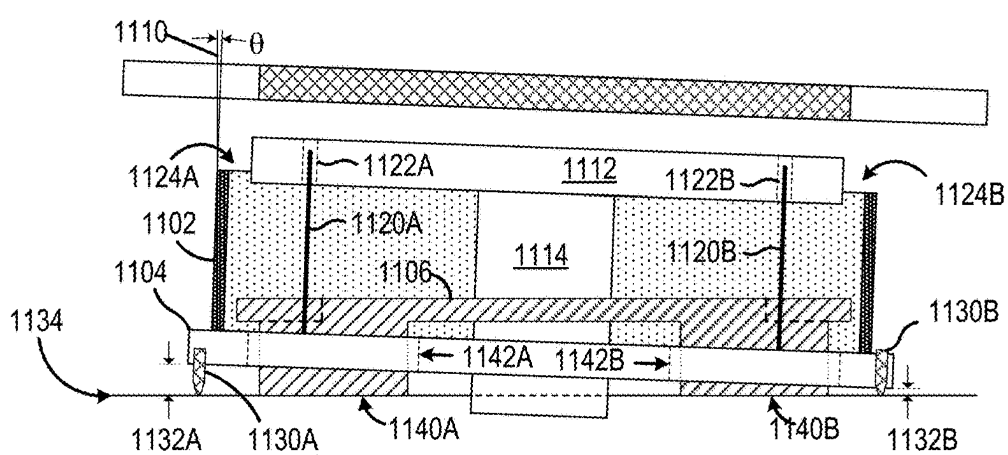


FIG. 11C

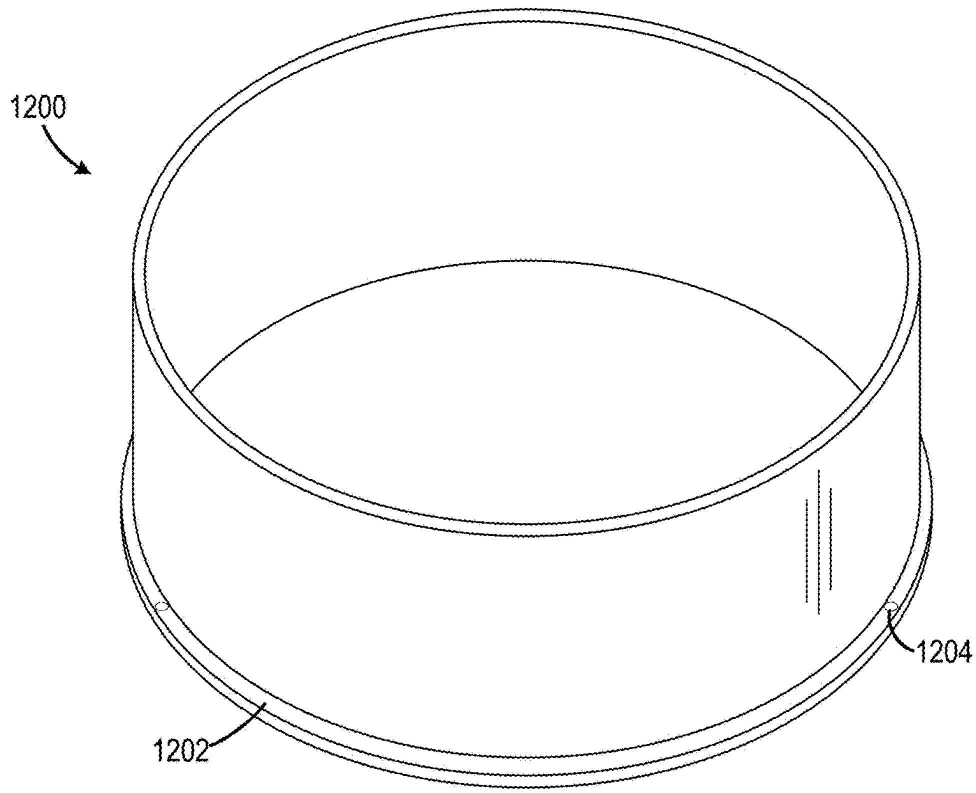

1200
1204
1202

FIG. 12

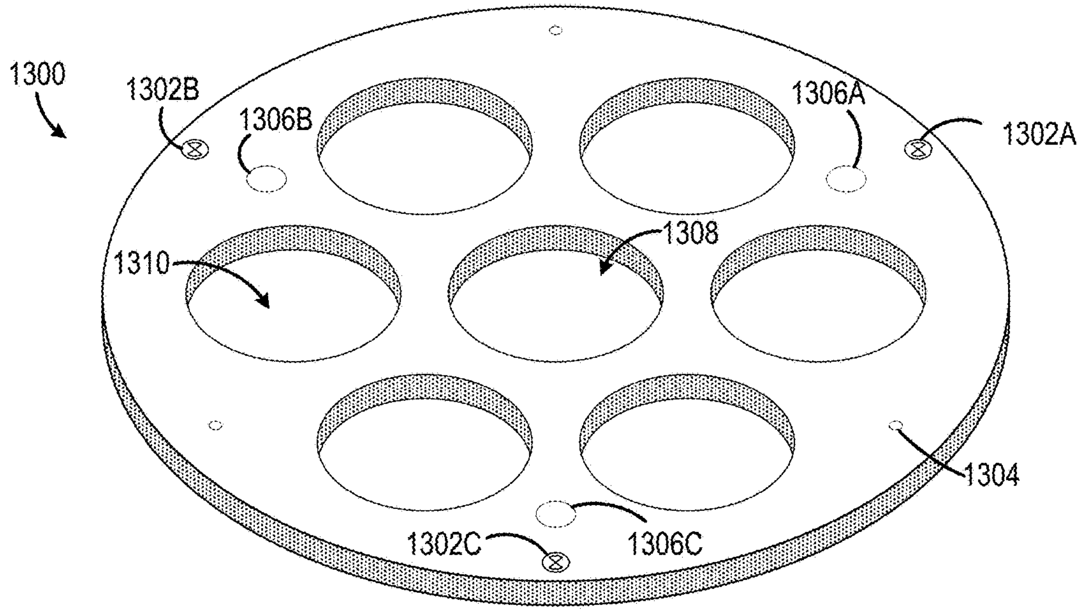

1300
1302B
1306B
1306A
1302A
1310
1308
1304
1302C
1306C

FIG. 13

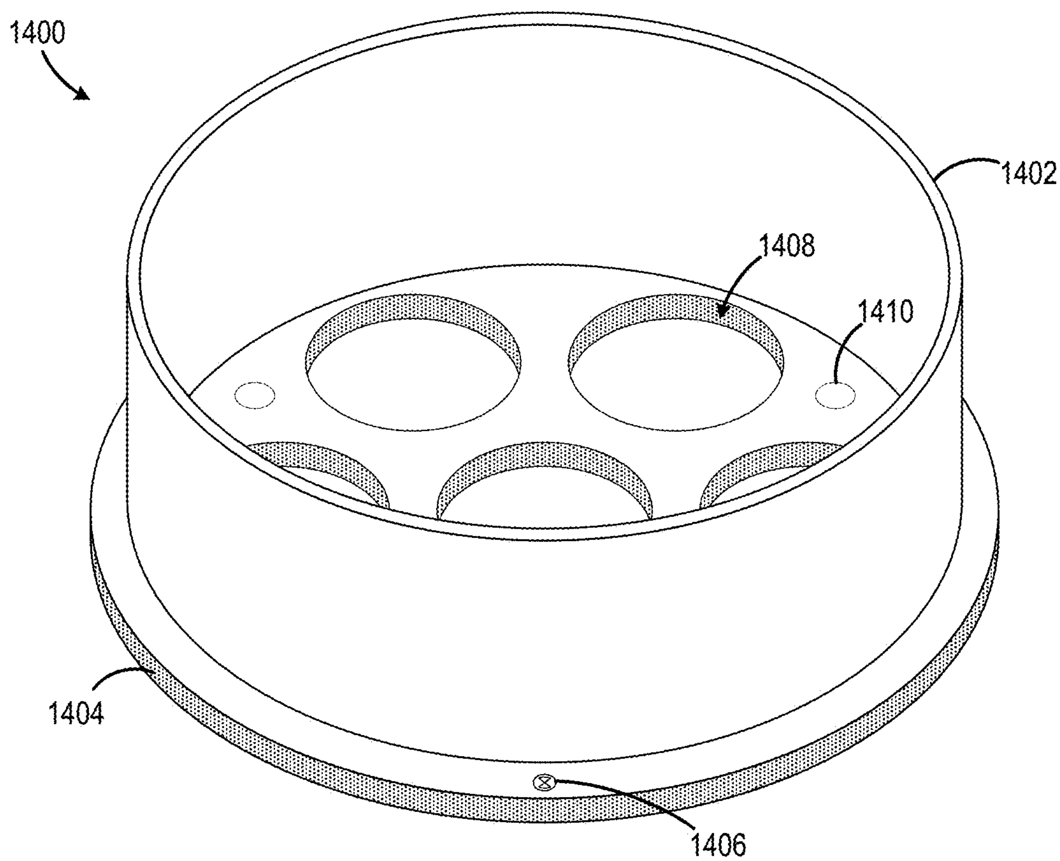


FIG. 14

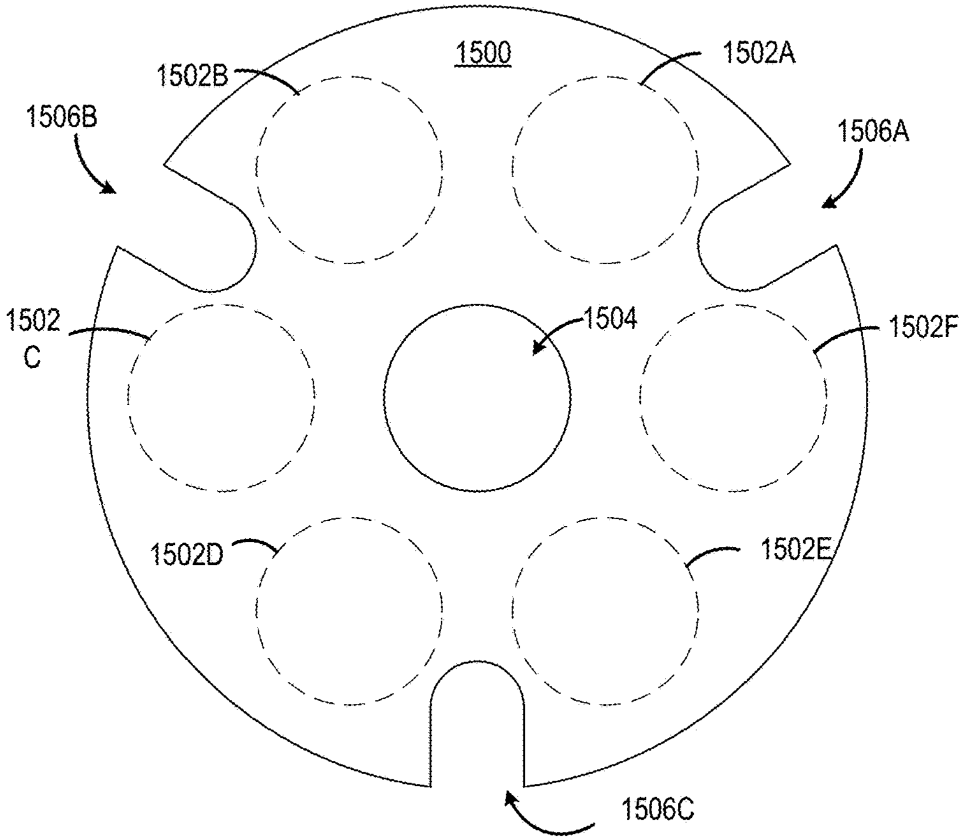

1500
1502A
1502B
1506B
1506A
1502
C
1504
1502F
1502D
1502E
1506C

FIG. 15

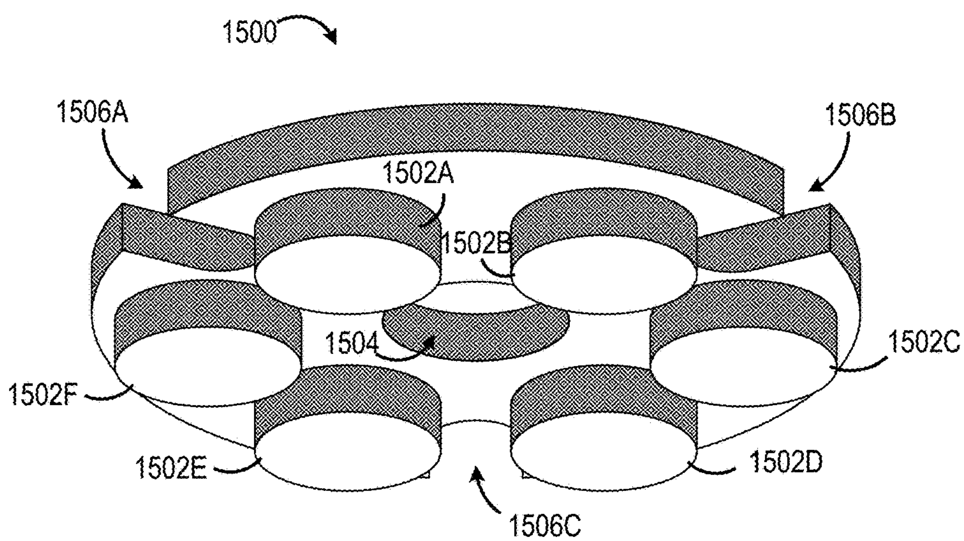

1500
1506A
1506B
1502A
1502B
1504
1502C
1502F
1502E
1502D
1506C

FIG. 16

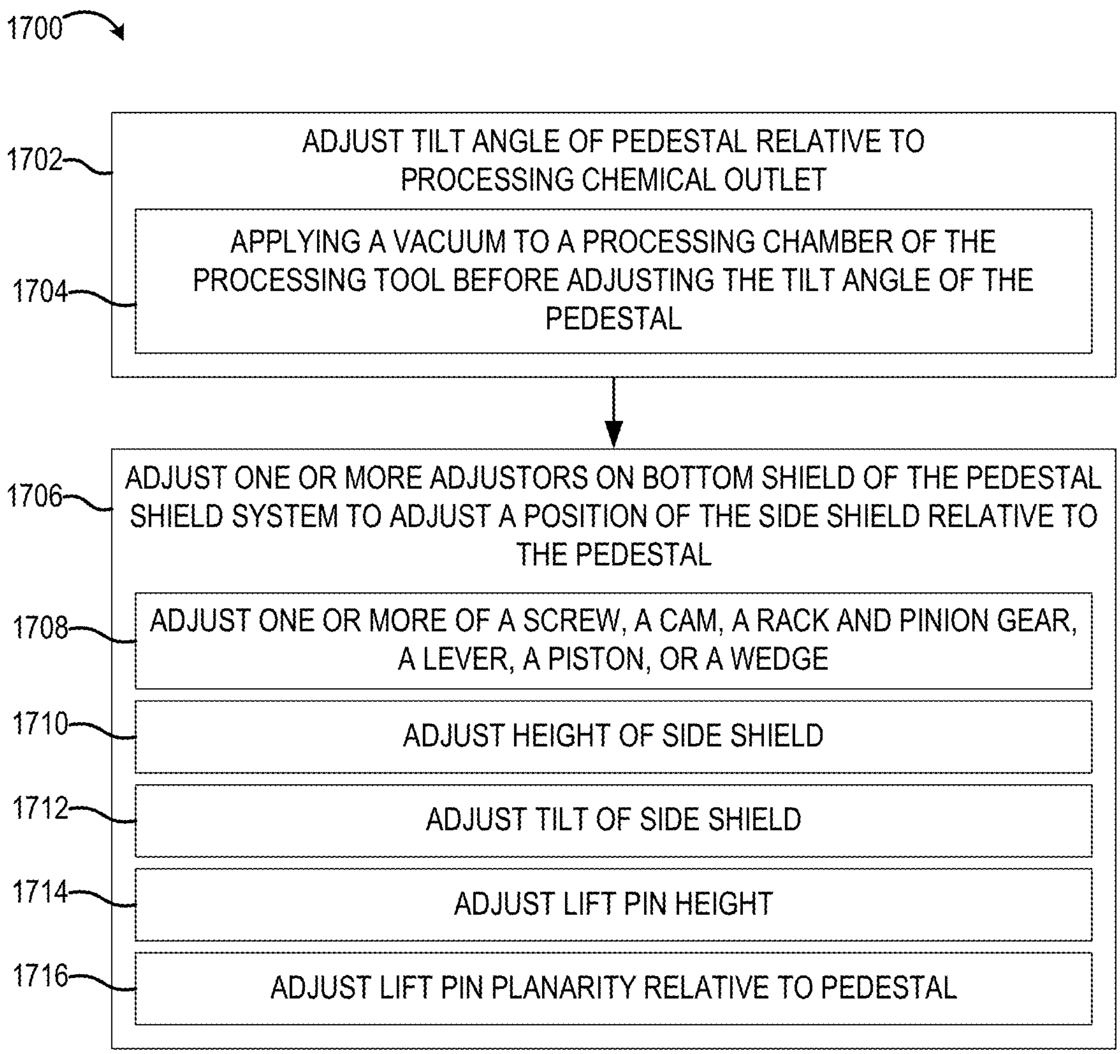

1700
1702
ADJUST TILT ANGLE OF PEDESTAL RELATIVE TO PROCESSING CHEMICAL OUTLET
1704
APPLYING A VACUUM TO A PROCESSING CHAMBER OF THE PROCESSING TOOL BEFORE ADJUSTING THE TILT ANGLE OF THE PEDESTAL
1706
ADJUST ONE OR MORE ADJUSTORS ON BOTTOM SHIELD OF THE PEDESTAL SHIELD SYSTEM TO ADJUST A POSITION OF THE SIDE SHIELD RELATIVE TO THE PEDESTAL
1708
ADJUST ONE OR MORE OF A SCREW, A CAM, A RACK AND PINION GEAR, A LEVER, A PISTON, OR A WEDGE
1710
ADJUST HEIGHT OF SIDE SHIELD
1712
ADJUST TILT OF SIDE SHIELD
1714
ADJUST LIFT PIN HEIGHT
1716
ADJUST LIFT PIN PLANARITY RELATIVE TO PEDESTAL

FIG. 17

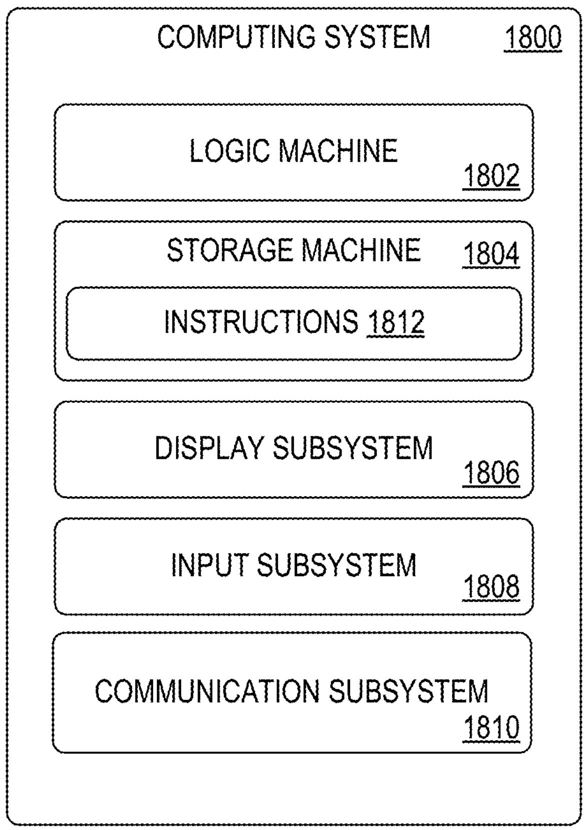

COMPUTING SYSTEM 1800
LOGIC MACHINE 1802
STORAGE MACHINE 1804
INSTRUCTIONS 1812
DISPLAY SUBSYSTEM 1806
INPUT SUBSYSTEM 1808
COMMUNICATION SUBSYSTEM 1810

FIG. 18

PROCESSING CHAMBER PURGE PLATE WITH SHROUD, AND PEDESTAL SHIELD SYSTEM

BACKGROUND

[0001] Semiconductor device fabrication processes may involve many steps of material deposition, patterning, and removal to form integrated circuits on substrates. Various methods can be used to selectively deposit materials onto a substrate. One example is chemical vapor deposition. Chemical vapor deposition processes involve flowing one or more precursor gases over a substrate within a processing chamber. Conditions in the chamber are controlled to cause the precursor gases to react and/or decompose on the substrate surface, thereby forming a film.

SUMMARY

[0002] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter. Furthermore, the claimed subject matter is not limited to implementations that solve any or all disadvantages noted in any part of this disclosure.

[0003] Examples are disclosed that relate to a purge plate comprising a shroud. The shroud helps to avoid crosstalk between stations in a multi-station processing chamber. One example provides a processing tool comprising a processing chamber comprising a plurality of stations. The processing tool also comprises a purge plate comprising a chamber-facing surface. The purge plate further comprises a plurality of cutouts configured to accommodate process gas outlets of the plurality of stations. The purge plate further comprises a shroud arranged around at least a portion of a perimeter of a first cutout of the plurality of cutouts. The shroud extends away from the chamber-facing surface. The purge plate further comprises a plurality of purge gas holes formed in the chamber-facing surface and the shroud.

[0004] In some such examples, the shroud is a first shroud, and the processing tool comprises a second shroud arranged at least partially around the perimeter of a second cutout of the plurality of cutouts.

[0005] In some such examples, the plurality of purge gas holes alternatively or additionally comprises a pattern, and wherein the pattern is interrupted at an edge of the shroud.

[0006] In some such examples, the shroud alternatively or additionally extends away from the chamber-facing surface a distance within a range of between 0.10 inches and 0.25 inches.

[0007] In some such examples, the shroud alternatively or additionally is configured to accommodate one or more tabs of a transfer ring.

[0008] In some such examples, the processing chamber alternatively or additionally comprises four stations.

[0009] In some such examples, the processing tool further comprises a pedestal located at a station of the plurality of stations, a pedestal support that supports the pedestal above a bottom surface of the processing chamber, and a pedestal shield system comprising a side shield disposed around the pedestal support, a bottom shield that supports the side shield, the bottom shield comprising a plurality of adjustors configured to adjust one or more of a side shield tilt and a side shield height, the bottom shield further comprising one or more openings, and a radiation shield configured to absorb heat radiated from the pedestal and transfer the heat for removal from the processing chamber, the radiation shield comprising one or more foot pads that extend through the one or more openings of the bottom shield. Alternatively or additionally, in some such examples, the side shield is disposed around the pedestal, and the processing tool further comprises a purge gas outlet to flow purge gas into a space at least partially enclosed by the side shield. Alternatively or additionally, in some such examples, the processing tool further comprises a plurality of lift pins supported by the bottom shield, and wherein the plurality of adjustors of the bottom shield are further configured to adjust one or more of lift pin height and lift pin angle relative to pedestal angle, wherein the radiation shield comprises a plurality of cutouts configured to accommodate the plurality of lift pins.

[0010] In some such examples, the processing chamber alternatively or additionally comprises a chemical vapor deposition tool.

[0011] Another example provides a purge plate for a processing chamber in a processing tool. The purge plate comprises a chamber-facing surface. The purge plate further comprises a cutout configured to accommodate a corresponding process gas outlet of the processing tool. The purge plate further comprises a shroud arranged around at least a portion of a perimeter of the cutout. The shroud extends from the chamber-facing surface. The purge plate further comprises a plurality of purge gas holes formed in the chamber-facing surface and the shroud.

[0012] In some such examples, the purge plate comprises a unitary body.

[0013] In some such examples, the purge plate alternatively or additionally is formed from aluminum.

[0014] In some such examples, the shroud is a first shroud, and the purge plate comprises a second shroud arranged around a second cutout.

[0015] In some such examples, the plurality of purge gas holes alternatively or additionally comprises a pattern, and the pattern being interrupted at an edge of the shroud.

[0016] In some such examples, the shroud alternatively or additionally extends away from the chamber-facing surface a distance within a range of between 0.10 inches and 0.25 inches.

[0017] In some such examples, the purge plate alternatively or additionally comprises a second, third, and fourth cutout.

[0018] In some such examples, the shroud alternatively or additionally comprises one or more notches configured to accommodate one or more tabs of a transfer ring.

[0019] In some such examples, the purge plate alternatively or additionally is configured for a deposition chamber of a chemical vapor deposition tool.

[0020] Another example provides a method of processing a plurality of substrates within a processing chamber of a processing tool. The processing chamber comprises a plurality of stations and a corresponding plurality of process gas outlets. The processing chamber further comprises a purge plate. The purge plate comprises a plurality of cutouts configured to accommodate the plurality of process gas outlets. The method comprises flowing a first precursor gas over a first substrate at a first station. The method further comprises flowing a second precursor gas over a second

substrate at a second station. The method further comprises flowing a purge gas through purge holes formed through a chamber-facing surface of the purge plate. The method further comprises flowing the purge gas through purge holes formed through a shroud of the purge plate. The shroud is arranged around at least a portion of a perimeter of a first cutout of the plurality of cutouts.

[0021] In some such examples, the shroud is a first shroud, and the method further comprises flowing the purge gas through purge holes formed in a second shroud of the purge plate. The second shroud arranged at least partially around a portion of a second cutout of the plurality of cutouts.

[0022] In some such examples, the method of processing the plurality of substrates alternatively or additionally further comprises an additional method, the additional method comprising performing a chemical vapor deposition process.

[0023] In some such examples, the method alternatively or additionally further comprises, after flowing the first precursor gas, transferring the first substrate to the second station, and after flowing the second precursor gas, transferring the second substrate to a third station.

[0024] Examples also are disclosed that relate to a pedestal shield system for protecting a pedestal system of a substrate processing tool. One example provides a substrate processing tool comprising a processing chamber, a substrate heater, and a pedestal system disposed within the processing chamber. The pedestal system comprises a pedestal and a pedestal support configured to support the pedestal above a bottom surface of the processing chamber. The substrate processing tool further comprises a pedestal shield system. The pedestal shield system comprises a side shield disposed around the pedestal support. The pedestal shield system further comprises a bottom shield that supports the side shield, the bottom shield comprising a plurality of adjustors configured to adjust one or more of a side shield tilt and a side shield height, the bottom shield further comprising one or more openings. The pedestal shield system further comprises a radiation shield configured to absorb heat radiated from the pedestal and transfer the heat for removal from the processing chamber, the radiation shield comprising one or more foot pads that extend through the one or more openings of the bottom shield.

[0025] In some such examples, the side shield is disposed around the pedestal.

[0026] In some such examples, the substrate processing tool additionally or alternatively further comprises a purge gas outlet to flow purge gas into a space at least partially enclosed by the side shield.

[0027] In some such examples, the substrate processing tool additionally or alternatively further comprises a plurality of lift pins supported by the bottom shield.

[0028] In some such examples, the plurality of adjustors of the bottom shield additionally or alternatively are further configured to adjust one or more of lift pin height and lift pin angle relative to pedestal angle.

[0029] In some such examples, the radiation shield additionally or alternatively comprises a plurality of cutouts configured to accommodate the plurality of lift pins.

[0030] In some such examples, the substrate processing tool additionally or alternatively comprises a chemical vapor deposition tool.

[0031] In some such examples, the side shield and bottom shield additionally or alternatively are integrated.

[0032] In some such examples, the side shield additionally or alternatively comprises aluminum.

[0033] Another example provides a pedestal shield system for a substrate processing tool. The pedestal shield system comprises a side shield configured to be disposed around a pedestal support of a pedestal system of the substrate processing tool. The pedestal shield system further comprises a bottom shield configured to support the side shield. The bottom shield comprises a plurality of adjustors configured to adjust one or more of a side shield tilt and a side shield height. The bottom shield further comprises one or more openings. The pedestal shield system further comprises a radiation shield configured to absorb heat radiated from the pedestal support and the pedestal. The radiation shield comprises one or more foot pads configured to extend through the one or more openings of the bottom shield.

[0034] In some such examples, the bottom shield is configured to support a plurality of lift pins.

[0035] In some such examples, the adjustors of the bottom shield additionally or alternatively are further configured to adjust one or more of lift pin height and lift pin angle relative to pedestal angle.

[0036] In some such examples, the plurality of lift pins additionally or alternatively comprises three or more lift pins and the adjustors of the bottom shield are further configured to adjust a lift pin planarity relative to a pedestal surface.

[0037] In some such examples, the radiation shield additionally or alternatively further comprises a plurality of cutouts configured to accommodate the plurality of lift pins.

[0038] In some such examples, the side shield and bottom shield additionally or alternatively are integrated.

[0039] In some such examples, the side shield additionally or alternatively comprises aluminum.

[0040] Another examples provides a method of adjusting a processing tool comprising a processing chemical outlet, a pedestal system, and a pedestal shield system. The pedestal system comprises a pedestal and a pedestal support. The pedestal shield system comprises a bottom shield, a side shield disposed around the pedestal and supported by the bottom shield, and a radiation shield comprising one or more foot pads that extend through one or more openings in the bottom shield. The method comprises adjusting a tilt angle of the pedestal relative to the processing chemical outlet. The method further comprises adjusting one or more adjustors on the bottom shield to adjust a position of the side shield relative to the pedestal.

[0041] In some such examples, the method further comprises applying a vacuum to a processing chamber of the processing tool before adjusting the tilt angle of the pedestal.

[0042] In some such examples, the method additionally or alternatively further comprises introducing a purge gas into a space that is at least partially surrounded by the side shield.

[0043] In some such examples, adjusting the one or more adjustors additionally or alternatively comprises adjusting one or more of a screw, a cam, a rack and pinion gear, a level, a piston, or a wedge.

BRIEF DESCRIPTION OF THE DRAWINGS

[0044] FIG. **1** shows an example processing tool comprising a plurality of stations within a processing chamber.

[0045] FIG. **2** shows a side schematic view of an example station comprising a purge plate with a shroud.

[0046] FIG. **3** schematically shows an exploded view of selected components of an example four-station processing chamber.

[0047] FIG. **4** schematically shows a bottom view of an example purge plate comprising a shroud positioned around a portion of a cutout.

[0048] FIG. **5** schematically shows a bottom view of an example purge plate comprising a plurality of shrouds.

[0049] FIG. **6** schematically shows a bottom view of an example purge plate comprising a shroud including notches to accommodate a transfer ring.

[0050] FIG. **7** schematically shows an example pattern of purge holes formed in a purge plate.

[0051] FIG. **8** shows a flow diagram of an example method for processing substrates in a multi-station processing chamber.

[0052] FIG. **9** schematically shows an example processing tool comprising a plurality of pedestal systems and a corresponding plurality of pedestal shield systems located within a processing chamber.

[0053] FIG. **10** shows a schematic view of a cross-section of an example a pedestal shield system within a processing chamber.

[0054] FIGS. **11**A-**11**C schematically show adjustment of a pedestal and pedestal shield system relative to a processing chemical outlet.

[0055] FIG. **12** shows an example side shield configured for use in a pedestal shield system.

[0056] FIG. **13** shows an example bottom shield configured for use in a pedestal shield system.

[0057] FIG. **14** shows an example integrated side shield and bottom shield.

[0058] FIG. **15** shows a top view of an example radiation shield configured for use in a pedestal shield system.

[0059] FIG. **16** shows a bottom view of the radiation shield of FIG. **15**.

[0060] FIG. **17** shows a flow diagram of an example method for adjusting a processing tool comprising a pedestal system and a pedestal shield system.

[0061] FIG. **18** shows a block diagram of an example computing system.

DETAILED DESCRIPTION

[0062] The term "adjustor" generally represents a component of a bottom shield that is capable of adjusting a height of a location of the bottom shield relative to an underlying surface, such as a bottom surface of a processing chamber. Example adjustors may include one or more of a screw, a cam, a rack and pinion gear, a lever, a piston, or a wedge.

[0063] The term "atomic layer deposition" generally represents a process in which a film is formed on a substrate in one or more individual layers by sequentially adsorbing a precursor conformally to the substrate and reacting the adsorbed precursor to form a film layer. Examples of ALD processes comprise plasma-enhanced ALD (PEALD) and thermal ALD (TALD). PEALD utilizes a plasma of a reactive gas to facilitate a chemical conversion of a precursor adsorbed to a substrate to a film on the substrate. TALD uses heat to facilitate a chemical conversion of a precursor adsorbed to a substrate to a film on the substrate.

[0064] The term "bottom shield" generally represents a component in a pedestal shield system that supports a side shield and/or one or more lift pins.

[0065] The term "bottom surface of a processing chamber" generally represents a surface which defines a lower interior boundary of a processing chamber.

[0066] The term "chemical vapor deposition" generally represents a process for depositing a film on a substrate by flowing one or more precursor gases over a substrate under conditions which cause the precursor gas(es) to react to form a film on the substrate surface.

[0067] The term "chemical vapor deposition tool" generally represents a processing tool configured to perform chemical vapor deposition.

[0068] The term "cutout" generally represents a feature in a purge plate that is configured to accommodate a process gas outlet. A cutout may be formed in an edge of a purge plate. A cutout also may be formed in an interior of a purge plate.

[0069] The term "foot pad" generally represents a structural feature of a radiation shield that is configured to extend downwardly through an opening in a bottom shield.

[0070] The term "indexing plate" generally represents a substrate transfer mechanism in a multi-station processing tool that can rotate substrates between stations.

[0071] The term "lift pin" generally represents a structure configured to extend through a corresponding hole in a pedestal to support a substrate above a pedestal surface when a height of an upper end of the lift pin is elevated above a height of the pedestal surface.

[0072] The term "lift pin cutout" generally represents a structure in a radiation shield that is configured to accommodate one or more lift pins.

[0073] The term "lift pin height" generally represents a distance from a bottom surface of a processing chamber to an upper end of a lift pin.

[0074] The term "lift pin angle" generally represents an angle of a direction of a long axis of a lift pin relative to a direction of a long axis of a pedestal support.

[0075] The term "lift pin planarity" generally represents a degree of planarity between a plane defined by upper ends of three or more lift pins and a pedestal surface.

[0076] The term "lift pin hole" generally represents an opening in a pedestal to accommodate a lift pin.

[0077] The term "pedestal" generally represents a structure configured to support a substrate within a processing chamber. A pedestal may include any suitable structure for supporting and/or holding a substrate, such as a chuck.

[0078] The term "pedestal system" generally represents a system including a pedestal and a pedestal support.

[0079] The term "pedestal support" generally represents a support column configured to support a pedestal. In some examples, a pedestal support is configured to adjust a tilt angle of a pedestal relative to a processing chemical outlet.

[0080] The term "pedestal shield system" generally represents a system configured to at least partially protect a pedestal system from processing conditions in a processing chamber. A pedestal shield system may comprise a bottom shield, a side shield, and a radiation shield. The bottom shield and side shield may be integrated or separate in various examples.

[0081] The term "pedestal" generally represents a structure configured to support a substrate within a processing chamber. A pedestal may include any suitable structure for supporting and/or holding a substrate, such as a chuck.

[0082] The term "pedestal system" generally represents a system including a pedestal and a pedestal support.

[0083] The term "pedestal support" generally represents a support column configured to support a pedestal. In some examples, a pedestal support is configured to adjust a tilt angle of a pedestal relative to a processing chemical outlet.

[0084] The term "pedestal shield system" generally represents a system configured to at least partially protect a pedestal system from processing conditions in a processing chamber. A pedestal shield system may comprise a bottom shield, a side shield, and a radiation shield. The bottom shield and side shield may be integrated or separate in various examples.

[0085] The terms "process gas outlet" and "processing chemical outlet" generally represents an outlet configured to introduce a process chemical or process chemical mixture onto a substrate during a chemical process. Showerheads and nozzles are examples of process gas and process chemical outlets. The term "showerhead" generally represents a process chemical outlet comprising a plurality of holes distributed across an area.

[0086] The term "processing chamber" generally represents an enclosure in which chemical and/or physical processes are performed on substrates. Example chemical processes include chemical vapor deposition (CVD), atomic layer deposition (ALD), and dry etching processes.

[0087] The terms "processing tool" and "substrate processing tool" generally represents a machine including a processing chamber and other hardware configured to enable processing to be carried out in the processing chamber. The term "purge gas" generally represents any suitable gas, such as an inert gas, used to remove processing gases from at least a portion of a processing chamber. A purge gas may be used to isolate processing stations from one another in a multi-station processing tool.

[0088] The term "purge gas" generally represents any suitable gas, such as an inert gas, used to remove at least a portion of processing chemicals from a processing chamber. Example purge gases include nitrogen (N_2), argon (Ar), neon (Ne), and helium (He).

[0089] The term "purge gas outlet" generally represents an outlet through which a purge gas is introduced into a location in a processing chamber.

[0090] The term "purge plate" generally represents a structure defining at least a portion of a processing chamber enclosure, and that comprises holes through which a purge gas may flow into the processing chamber. The term "purge hole" may represent any hole in purge plate configured for purge gas flow. The term "chamber-facing surface" generally represents a surface of a purge plate that faces an interior of a processing chamber.

[0091] The term "radiation shield" generally represents a structure configured to absorb heat radiated from a pedestal system within a processing chamber and conduct the heat for removal from the processing chamber. A radiation shield comprises one or more foot pads to transfer heat to another structure in a processing chamber. In some examples, the foot pads may transfer heat to a bottom surface of the processing chamber.

[0092] The term "shim" generally represents a structure that can be placed between a lift pin and an underlying surface, such as a bottom shield.

[0093] The term "shroud" generally represents any structure which extends from a chamber-facing surface of a purge plate to inhibit migration of process gases from one process station toward one or more other process stations in a processing chamber.

[0094] The term "side shield" generally represents a structure disposed around a pedestal support and configured to help protect a pedestal system from processing chamber conditions. A side shield may be supported by and/or integrated with a bottom shield.

[0095] The term "station" generally represents a location in a processing tool at which a chemical and/or physical process is performed on a substrate.

[0096] The term "substrate" generally represents any object that can be processed at a station in a processing chamber of a processing tool.

[0097] The term "substrate heater" generally represents a heater configured to heat a substrate during processing. In some examples, a substrate heater may be incorporated into a pedestal.

[0098] The term "substrate holder" generally represents a structure configured for supporting a substrate and/or a transfer ring holding a substrate. Examples include pedestals and chucks.

[0099] The term "transfer ring" generally represents a structure configured to hold a substrate during transfer between processing stations.

[0100] The term "unitary body" generally represents a single-piece structure, without joints formed by welds, adhesives, or fasteners.

[0101] As mentioned above, the fabrication of integrated circuits on substrates involves many individual steps of material addition, patterning, modification, and removal. For example, chemical vapor deposition may be used to deposit films of a variety of compositions on a substrate surface. Chemical vapor deposition involves exposing a substrate to one or more reactive precursor gases under conditions that cause the precursor gas(es) to react and/or decompose on the substrate.

[0102] Chemical vapor deposition is generally performed in a processing chamber under a controlled gaseous environment. Some processing tools may comprise multiple stations located in a same processing chamber. Such a configuration allows multiple substrates to be processed in parallel. This may help to achieve higher throughput relative to a processing chamber with a single station.

[0103] Different stations within a processing chamber may perform different chemical processes in parallel. However, performing different chemical processes at different stations in parallel may pose a risk of migration of processing gases between process stations. Such migration of processing gases between process stations may be referred to as "crosstalk." In some situations, crosstalk between stations may pose a risk of contaminating a film being grown.

[0104] To help prevent migration of processing gases between stations, a flow of a purge gas may be directed between stations. For example, a processing chamber may comprise a purge plate. The purge plate may comprise a plurality of holes configured to direct a flow a purge gas between stations. The purge gas flow isolates processing environments of the stations. The purge gas may flow from the purge plate toward chamber exhaust ports in a bottom portion of the processing chamber and be removed by a vacuum pumping system. In this manner, unreacted precursor gases and reaction products may be drawn with the flow of purge gas towards the exhaust ports.

[0105] However, some processing conditions may cause transient disruptions in a desired flow pattern of purge gas and process gases (reactants and/or products) toward an exhaust port. Accordingly, to provide further prevention against crosstalk in such conditions, examples are disclosed that relate to the use of a purge plate comprising one or more shrouds. Briefly, a purge plate of a processing chamber comprises a plurality of cutouts configured to accommodate a plurality of process gas outlets within the processing chamber. For at least one of the cutouts, a shroud is arranged around at least a portion of a perimeter of the cutout. The shroud extends from the chamber-facing surface of the purge plate into the processing chamber. The shroud thus helps to direct precursor gases and/or reaction products from the corresponding process gas outlet toward an exhaust port, and away from other processing stations. Further, the purge plate comprises a plurality of purge holes configured to direct a flow of purge gas between process stations. The use of a purge plate comprising purge holes and one or more shrouds as disclosed herein may help to reduce the risk of crosstalk between stations of the processing tool. While described herein in the context of a chemical vapor deposition tool, a purge plate comprising a shroud as disclosed herein may be used in any other suitable processing tool. Examples include atomic layer deposition tools, plasma etching tools, and atomic layer etching tools.

[0106] FIG. **1** shows a schematic view of an example processing tool **100** (e.g., a multi-station processing tool) that can be utilized to process multiple substrates in parallel. FIG. **1** illustrates a first station **102**A and a second station **102**B within a processing chamber **106**. In some examples, processing tool **100** comprises a chemical vapor deposition tool and processing chamber **106** comprises a deposition chamber. First station **102**A and second station **102**B are configured to expose substrates to one or more precursor gases, e.g., as part of chemical vapor deposition. Processing tool **100** further may comprise additional stations not shown in FIG. **1**. In some examples, processing tool **100** comprises four stations. However, any suitable number of stations may be used.

[0107] First station **102**A comprises a first substrate holder **110**A and a first substrate holder support **112**A positioned within a first well **114**A of processing chamber **106**. First station **102**A further comprises a first process gas outlet **116**A in fluid connection with a first precursor gas source **118**A. First precursor gas source **118**A is configured to provide one or more precursor gases to first process gas outlet **116**A. First substrate holder **110**A supports a first substrate **120**A during processing. In some examples, first substrate holder **110**A may support a transfer ring holding first substrate **120**A. First substrate holder support **112**A may be configured to raise and lower first substrate holder **110**A, for example, to adjust the gap between first substrate holder **110**A and first process gas outlet **116**A.

[0108] Similarly, second station **102**B comprises a second substrate holder **110**B and a second substrate holder support **112**B positioned within a second well **114**B. Second station **102**B further comprises a second process gas outlet **116**B in fluid connection with a second precursor gas source **118**B. Second precursor gas source **118**B is configured to provide one or more precursor gases to second process gas outlet **116**B. Second substrate holder **110**B supports second substrate **120**B during processing at second station **102**B. In some examples, second substrate holder **110**B may support a transfer ring holding second substrate **120**B. Second substrate holder support **112**B may be configured to raise and lower second substrate holder **110**B.

[0109] Processing chamber **106** further comprises a purge plate **130**. Purge plate **130** comprises cutouts to accommodate first process gas outlet **116**A and second process gas outlet **116**B. Processing tool **100** further comprises a purge gas source **132** comprising a purge gas that can be directed into processing chamber **106** via purge gas holes (indicated by purge gas flow arrow **133** and similar arrows) formed in purge plate **130**. In the depicted example, purge plate **130** comprises a top plate that forms a top boundary of processing chamber **106**. In other examples, a purge plate may have any other suitable location and/or orientation in a processing chamber.

[0110] Processing chamber **106** may be evacuated via an exhaust system **134** comprising one or more exhaust ports **136**A-B. In the depicted example, first station **102**A comprises a first exhaust port **136**A. Similarly, second station **102**B comprises a second exhaust port **136**B.

[0111] Processing chamber **106** further comprises an indexing plate **138** configured to transfer substrate between stations. Indexing plate **138** may be configured to lift substrates **120**A-B from corresponding substrate holders **110**A-B. In some examples, indexing plate may be configured to lift transfer rings holding substrates **120**A-B. After lifting substrates **120**A-B, indexing plate **138** rotates to advance substrates **120**A-B to respective next stations.

[0112] Processing tool **100** further comprises a controller **150** configured to control processing tool **100** to perform process cycles. For example, controller **150** is controllably connected to valves **152**A, **152**B, and **154** to control process gas flows and purge gas flows during and between process cycles. Controller **150** is also controllably connected to exhaust system **134**. Controller **150** may control valves **152**A, **152**B, **154** and exhaust system **134** to control pressure and gas composition inside processing chamber **106**. Controller **150** also may control substrate holder supports **112**A, **112**B to raise and lower substrates. Controller **150** further may control indexing plate **138** to transfer substrates between stations. Controller **150** additionally may control other components not shown in FIG. **1**, such as substrate holder heaters, gas line heaters, substrate transfer robots, load locks, and/or any other suitable components.

[0113] During substrate processing, controller **150** controls valve **152**A to flow one or more precursor gases from first precursor gas source **118**A over first substrate **120**A at first station **102**A. Likewise, controller **150** controls valve **152**B to flow one or more precursor gases from second precursor gas source **118**B over second substrate **120**B at second station **102**B.

[0114] As mentioned above, different precursor gases may be provided to first process gas outlet **116**A and second process gas outlet **116**B. Thus, to help prevent crosstalk, controller **150** controls valve **154** to flow purge gas through purge holes in purge plate **130**. Purge plate **130** comprises a first shroud **160**A positioned at least partially around the cutout that accommodates first process gas outlet **116**A. First shroud **160**A may help prevent crosstalk between first station **102**A and second station **102**B by directing flows of precursor gases and/or reaction products from first process gas outlet **116**A towards first exhaust port **136**A. This may help to maintain a desired gas flow pattern even when transient conditions disrupt an ordinary flow pattern. In some examples, purge plate **130** may comprise a plurality of shrouds for a corresponding plurality of stations. For example, as indicated at **160**B, purge plate **130** may comprise a second shroud **160**B positioned at least partially around the cutout that accommodates second process gas outlet **116**B. In other examples, second shroud **160**B may be omitted.

[0115] FIG. **2** schematically shows a side view of an example station **200** comprising a purge plate comprising a shroud. Station **200** may represent first station **102**A and/or second station **102**B in FIG. **1** in some examples. Station **200** comprises a substrate holder **202** and substrate holder support **204** positioned in a well **205**. A transfer ring **206** is positioned around a substrate **208** on substrate holder **202**. In other examples, a transfer ring may be omitted, as substrates may be transferred by robots that handle the substrates directly. Station **200** further comprises a purge plate **210** with a cutout **211** to accommodate a process gas outlet **212**. Process gas outlet **212** is configured to distribute a precursor gas or precursor gas mixture over substrate **208**. Station **200** further comprises walls **214** separating well **205** from a neighboring station (e.g., station **216** or station **218**).

[0116] Purge plate **210** comprises a shroud **220** that extends from a chamber-facing surface **222** of purge plate **210** to help prevent crosstalk. In some examples, purge plate **210** comprises a unitary body that includes shroud **220**. Such a purge plate may be machined, cast, or formed in any other suitable manner. In other examples, shroud **220** may be incorporated into purge plate **210** via a welded joint, fasteners, an adhesive, and/or other suitable connection. Purge plate **210** may comprise any suitable material. For example, purge plate **400** may be formed from a metal (e.g., aluminum or corrosion-resistant steel) or a ceramic. As discussed above, in the absence of shroud **220**, there may be a risk of residual precursor gases and/or reaction products migrating toward other stations, as illustrated by arrows **224**A and **224**B. Instead, shroud **220** helps to directs the precursor gas towards an exhaust port **226** in well **205**, as illustrated by arrows **228**A and **228**B.

[0117] In this example, purge gas holes are formed in shroud **220**, as indicated by purge gas flow arrow **234** and similar arrows. While not shown in FIG. **2**, purge gas also may flow through other regions of purge plate **210** via purge holes. Example purge hole arrangements are described in more detail below.

[0118] In some examples, shroud **220** may extend from chamber-facing surface **222** sufficiently far that, when substrate holder **202** and process gas outlet **212** are positioned for substrate processing, a lower surface **230** of shroud **220** is below an upper surface **232** of transfer ring **206**. In other examples shroud **220** may be configured to extend from chamber-facing surface **222** a lesser distance. In some examples, shroud **220** extends out from chamber-facing surface **222** a distance within a range of between 0.10 inches and 0.25 inches. In other examples, a shroud may extend any other suitable distance from chamber-facing surface **222**.

[0119] As mentioned above, a processing chamber may have any suitable number of stations. FIG. **3** shows an exploded view of example components **300** for a processing chamber that includes four process stations. The illustrated components include a chamber base **302**, a purge plate **304** comprising cutouts **306**A-D, an indexing plate **308**, process gas outlets **310**A-D, and substrate holders **312**A-D.

[0120] Purge plate **304** is configured to define an upper boundary of a processing chamber. Purge plate **304** comprises a shroud **316** positioned on a chamber-facing surface **318**. Shroud **316** is hidden from view in FIG. **3**. However, the shroud position is indicated schematically by a dashed line on an opposite surface of purge plate **304**. Shroud **316** is arranged around a perimeter of cutout **306**C. Purge plate **304** further comprises purge holes formed in chamber-facing surface **318** and shroud **316** for flowing purge gas into the processing chamber. The purge holes are omitted from FIG. **3** for clarity, but are described in more detail below. While FIG. **3** illustrates a shroud positioned around one cutout, in other examples shrouds may be positioned around two or more cutouts.

[0121] In some examples, substrates are held by transfer rings, such as transfer ring **320**. In such examples, indexing plate **308** is configured to move the corresponding transfer rings. During indexing, substrate holders **312**A-D may be lowered, and/or indexing plate **308** may be raised via spindle **322**, to lift the transfer rings from corresponding substrate holders. Indexing plate **308** may then rotate to advance the transfer rings and corresponding substrates. Then, indexing plate **308** may be lowered and/or substrate holders **312**A-D may be raised to position the substrates on substrate holders **312**A-D for a process cycle. Shroud **316** of purge plate **304** may be configured to accommodate transfer rings **320**, including tabs **328**, as described below.

[0122] FIGS. **4-6** shows example purge plates which can be used in a four-station processing chamber to help prevent crosstalk between stations. First, FIG. **4** depicts a bottom view of an example purge plate **400** comprising a shroud **402**. In some examples, shroud **402** can be a single shroud. Shroud **402** is located on a chamber-facing surface of purge plate **400**. Purge plate **400** comprises a plurality of cutouts **404**A-D. Each cutout can be configured to accommodate a respective process gas outlet. Shroud **402** is arranged around a portion the perimeter of cutout **404**C. In some examples, purge plate **400** is configured for a deposition chamber of a chemical vapor deposition tool.

[0123] As mentioned above, purge plate **400** may comprise a unitary body. In such examples, purge plate **400** may be machined, cast, or otherwise formed as a single piece. In other examples, shroud **402** may comprise a separate piece from a planar portion **406** of purge plate **400**. In such examples, shroud **402** may be coupled to the planar portion **406** of purge plate **400** in any suitable manner. Examples may include welding, one or more fasteners, and/or a suitable adhesive. Purge plate **400** may comprise any suitable material, such as aluminum, corrosion-resistant steel, or ceramic.

[0124] FIG. **5** depicts a bottom view of another example purge plate. Purge plate **500** comprises a plurality of cutouts **502**A-D configured to accommodate a corresponding plurality of process gas outlets. Purge plate **500** further comprises shrouds **504**A-D respectively arranged partially around cutouts **502**A-D. In other examples, shrouds may be arranged around the perimeter of any suitable number of cutouts. In some examples, purge plate **500** is configured for a deposition chamber of a chemical vapor deposition tool. Purge plate **500** may comprise any suitable material, such as aluminum, corrosion-resistant steel, or ceramic.

[0125] FIG. **6** shows another example purge plate **600**. Purge plate **600** comprises a shroud **602** having notches **604** to accommodate a transfer ring. In the depicted example, shroud **602** comprises three notches **604** to accommodate corresponding tabs of a transfer ring. In other examples, a shroud may have a different number of notches to accommodate a different transfer ring configuration. In some examples, purge plate **600** is configured for a deposition chamber of a chemical vapor deposition tool. Purge plate **600** may comprise any suitable material, such as aluminum, corrosion-resistant steel, or ceramic.

[0126] As mentioned above, a purge plate may comprise purge holes through which a purge gas can flow to help maintain separate processing environments at different processing stations. FIG. **7** shows a magnified view of an example purge plate **700** comprising purge holes **702**. Purge plate **700** may represent any of the example purge plates described herein. In the depicted example, purge holes **702** extend through both a planar portion **704** of purge plate **700** and through shroud **706**. In some examples, purge holes **702** may be formed in a pattern which may help achieve a relatively uniform purge. In such examples, the pattern may be interrupted at edges **708** of shroud **706**. For example, the pattern of purge holes **702** may place a purge hole at **710**. As **710** is located at an edge **708**, the purge hole is omitted at **710**. Purge holes may be omitted at shroud edges for manufacturability and/or to avoid disrupting a desired purge flow pattern. While the example in FIG. **7** depicts a regular pattern of purge holes, any suitable regular or irregular arrangement of purge holes may be used. Purge holes **702** may be formed in any suitable manner. For example, purge holes **702** can be machined into purge plate **700**.

[0127] FIG. **8** shows a flow diagram for an example method **800** for processing multiple substrates within a single processing chamber, such as the example processing chambers described herein. Method **800** may represent a chemical vapor deposition process, or any other suitable process. Method **800** may be controlled by a controller of a processing tool, such as controller **150** of processing tool **100**.

[0128] At **802**, method **800** comprises flowing a first precursor gas or gas mixture from a first process gas outlet over a first substrate at a first station. At **804**, method **800** further comprises flowing a second, different precursor gas or gas mixture from a second process gas outlet over a second substrate at a second station. Further, in some examples, at **806**, method **800** comprises flowing a third precursor gas or gas mixture from a third process gas outlet over a third substrate at a third station. The third precursor gas or gas mixture may be the same as the first or the second gases or gas mixtures, or may be different. In some examples, the processing chamber may comprise additional stations. As such, in some examples, at **808**, method **800** comprises flowing an N^{th} precursor gas from an N^{th} process gas outlet over an N^{th} substrate at an N^{th} station.

[0129] Continuing, at **810**, method **800** comprises flowing purge gas through purge holes formed through one or more shrouds of a purge plate. As described above, the shroud comprises a structure that extends from a chamber-facing surface of the purge plate. The shroud may be arranged at least partially around a perimeter of a cutout accommodating the first process gas outlet or the second process gas outlet. In some examples, a plurality of cutouts may have shrouds. The use of a purge plate including a shroud may help prevent crosstalk between stations of the processing chamber by directing gases away from other stations and towards an exhaust port. In some examples, the purge plate comprises a unitary body that comprises the shroud. In some examples, at **812**, method **800** comprises flowing purge gas through purge holes formed in a chamber-facing surface of the purge plate. In some examples, at **814**, method **800** further comprises flowing purge gas out the processing chamber via an exhaust system.

[0130] In some examples, method **800** further comprises, at **816**, transferring the first substrate to the second station and transferring the second substrate to a third station. In some examples, at **818**, method **800** comprises transferring the substrates via a transfer ring and an indexing plate. In other examples, substrates may be transferred by direct handling, rather than via a transfer ring.

[0131] By processing substrates within a processing chamber comprising a purge plate that includes a shroud, the examples disclosed herein may help to lessen a risk of crosstalk between stations. Thus, the examples disclosed may facilitate processing of multiple substrates within a single processing chamber using different chemistries at different stations.

[0132] In addition to crosstalk, other issues can arise in a deposition system. As described above, chemical vapor deposition and atomic layer deposition processes are generally performed in a processing chamber under a controlled gaseous environment. Processing chemicals may be introduced into the processing chamber through a processing chemical outlet. For example, processing chemicals may be introduced through a showerhead disposed above the substrate. The substrate may be supported by a pedestal system comprising a pedestal and pedestal support. During processing, the substrate may rest on the top surface of the pedestal. In some examples, a pedestal may comprise a substrate heater configured to heat the substrate. The pedestal support may comprise a column, for example, configured to raise and lower the pedestal and substrate. Further, lift pins extending through lift pin holes in the pedestal may help support the substrate during transfer. For example, when the pedestal is lowered, the lift pins may support the substrate above the pedestal to facilitate transfer of the substrate using a robot.

[0133] Processing conditions may involve application of a partial vacuum inside the processing chamber. This may cause a degree of bowing in a chamber top plate, such as a purge plate. The bowing may result in a slight tilting of a surface of the processing chemical outlet, such as a showerhead, relative to a surface of the pedestal. To compensate for this effect, the pedestal can be tilted such that the substrate and processing chemical outlet are approximately parallel when the processing chamber is at a processing pressure.

[0134] In addition to low pressure, processing conditions also may involve high temperatures (e.g., >300° C.) and presence of processing chemicals. Such processing conditions may cause wear to structures inside the processing chamber. For example, a substrate heater may heat a pedestal support and other structures by radiation, conduction, and/or convection of processing chemicals. Further, deposition of processing chemicals may occur on pedestal system surfaces such as the backside of the pedestal, pedestal support, and within lift pin holes. Chemical deposition may be facilitated by elevated temperatures on such surfaces. Over time, high temperatures and/or buildup from chemical deposition may lead to stress on the pedestal support. Maintenance to correct such issues may be labor intensive and/or costly.

[0135] One option to protect a pedestal system from temperature and/or processing chemicals is to position a shield around the pedestal support and pedestal. A purge gas then can be flowed through a space between the pedestal support and the shield to reduce chemical deposition on the pedestal support. However, the use of such shields may pose challenges. For example, some processing conditions may comprise temperatures in a range of 400° C. to 500° C. Under such conditions, shield temperatures may be greater than 300° C. As such, it may not be feasible to use metal alloys (e.g., aluminum **6061**) that may experience outgassing and warping above 300° C. Ceramic shields also can be used to avoid warping and outgassing. However, ceramics may incur additional cost. It can also be difficult to adjust a pedestal shield to match a tilt of a pedestal. Additionally, the use of a shield may complicate lift pin adjustment, as lift pins and shims may not be accessible without removal of the shield.

[0136] Accordingly, examples are disclosed that relate to a pedestal shield system for use in a processing chamber of a substrate processing tool. As described in more detail below, the examples disclosed may help to protect a pedestal system from processing conditions such as high temperature and/or chemical deposition.

[0137] Briefly, a pedestal shield system comprises a side shield, a bottom shield, and a radiation shield. The bottom shield is disposed below a pedestal on a bottom surface of the processing chamber. The side shield is disposed around the pedestal support and is supported by the bottom shield. The bottom shield comprises adjustors configured to adjust side shield height and/or side shield tilt. The side shield at least partially encloses a space under the pedestal which may be purged using a purge gas. As such, the side shield may help protect a pedestal system and lift pins from processing conditions. The radiation shield comprises foot pads that extend through openings in the bottom shield to contact another structure in the processing chamber for heat transfer. The radiation shield is configured to absorb heat radiated from the pedestal system and conduct the heat for removal from the processing chamber. For example, heat may be transferred from the foot pads to a bottom surface of the processing chamber.

[0138] A pedestal shield system according to the present disclosure thus may help to mitigate the detrimental effects of processing conditions on a pedestal system. The disclosed example pedestal shield systems may conduct heat from the pedestal system with sufficient efficiency to allow the use of less expensive aluminum alloys instead of ceramics. For example, when a substrate heater is heated to ~500° C., a side shield temperature may remain below 300° C. This may avoid outgassing and/or warping that can occur in some aluminum alloys at higher temperatures.

[0139] Prior to discussing these examples in detail, FIG. **9** schematically shows an example processing tool **900**. Processing tool **900** is configured as a multi-station processing tool configured to process multiple substrates in parallel. FIG. **9** illustrates a first processing station **902**A and a second processing station **902**B within a processing chamber **904**. Each of first processing station **902**A and second processing station **902**B is configured to expose a substrate to one or more processing chemicals. Processing tool **900** further may comprise additional stations not shown in FIG. **9**. In other examples, a processing tool may comprise a single processing station. In some examples, processing tool **900** comprises a chemical vapor deposition tool configured to perform chemical vapor deposition. In some examples, processing tool **900** alternatively or additionally may comprise an atomic layer deposition tool configured to perform atomic layer deposition.

[0140] First processing station **902**A comprises a first pedestal **908**A and a first pedestal support **910**A positioned within a first well **912**A of processing chamber **904**. First processing station **902**A further comprises a first pedestal shield system **914**A disposed around first pedestal support **910**A. First pedestal shield system **914**A may at least partially enclose a first space **915**A around first pedestal support **910**A and under first pedestal **908**A. Details of example pedestal shield systems suitable for use as first pedestal shield system **914**A are described in more detail below.

[0141] First processing station **902**A further comprises a first processing chemical outlet **916**A in fluid connection with a processing chemical source(s) **918**. Processing chemical source(s) **918** may be configured to provide a processing chemical to first processing chemical outlet **916**A. In some examples, processing chemical source(s) **918** may be configured to provide a mixture of processing chemicals.

[0142] First pedestal **908**A supports a first substrate **920**A during processing. First pedestal support **910**A is configured to raise and lower first pedestal **908**A, for example, to adjust the gap between first pedestal **908**A and first processing chemical outlet **916**A. First pedestal support **910**A further may be configured to adjust a tilt of first pedestal **908**A.

[0143] First pedestal **908**A may comprise lift pin holes through which lift pins (omitted from FIG. **9** for clarity) can extend. Lowering first pedestal **908**A may cause lift pins to extend through the lift pins holes to support first substrate **920**A. Raising first pedestal **908**A may cause the lift pins to retract.

[0144] Similarly, second processing station **902**B comprises a second pedestal **908**B and a second pedestal support **910**B positioned within a second well **912**B. Second pedestal support **910**B is configured to raise and lower second pedestal **908**B. Second pedestal support **910**B also may be configured to adjust a tilt of second pedestal **908**B. Second processing station **902**B further comprises a second pedestal shield system **914**B disposed around second pedestal support **910**B. Second pedestal shield system **914**B may at least partially enclose a second space **915**B around second pedestal support **910**B and under second pedestal **908**B. Details of example pedestal shield systems suitable for use as second pedestal shield system **914**B are described in more detail below.

[0145] Second processing station **902**B further comprises a second processing chemical outlet **916**B in fluid connection with processing chemical source(s) **918**. Processing chemical source(s) **918** may be configured to provide one or more processing chemicals to second processing chemical outlet **916**B. In some examples, a different processing chemical source may be in fluid connection with second processing chemical outlet **916**B. This may allow different processing chemicals to be introduced into first processing station **902**A and second processing station **902**B.

[0146] Processing chamber **904** further comprises a top plate **922**, first processing chemical outlet **916**A, and second processing chemical outlet **916**B. Processing tool **900** further comprises a purge gas source **924** comprising a purge gas that can be directed into processing chamber **904** through purge gas holes formed in top plate **922**. Processing tool **900** further comprises a purge gas source **926** comprising a purge gas that can be directed into first space **915**A through purge gas outlet **928**A, and into second space **915**B through purge gas outlet **928**B. The purge gas may flow into a space through a gap between a pedestal shield system and a pedestal support. In some examples, a same purge gas source may be used for purge gas source **924** and purge gas source **926**.

[0147] As described above, reduced pressure within processing chamber **904** may cause a degree of bowing of top plate **922**. This can lead to a degree of tilting of first processing chemical outlet **916**A and/or tilting of second processing chemical outlet **916**B when processing chamber **904** is under vacuum. Thus, as described above, first pedestal support **910**A may be configured to allow adjustment of a tilt angle of first pedestal **908**A. This may allow first pedestal **908**A to be adjusted to be suitably parallel to first processing chemical outlet **916**A when processing chamber **904** is under vacuum. Likewise, a tilt of second pedestal support **910**B may be adjusted such that second substrate **920**B is suitably parallel to second processing chemical outlet **916**B.

[0148] Processing chamber **904** may be evacuated by an exhaust system **934** comprising one or more exhaust ports **936**A-B. In the depicted example, first processing station **902**A comprises a first exhaust port **936**A. Similarly, second processing station **902**B comprises a second exhaust port **936**B.

[0149] Processing tool **900** may further comprise other components not depicted in FIG. **9**. For example, processing tool **900** may comprise a substrate transfer system configured to transfer substrates between first processing station **902**A and second processing station **902**B.

[0150] Processing tool **900** further comprises a controller **950** configured to control processing tool **900** to perform process cycles. For example, controller **950** is controllably connected to valves **952**A, **952**B, **954**, and **956** to control processing chemical flows and purge gas flows during and between process cycles. Controller **950** is also controllably connected to exhaust system **934**. Controller **950** may control valves **952**A, **952**B, **954**, **956** and exhaust system **934** to control pressure and gas composition inside processing chamber **904**. Controller **950** also may control first pedestal support **910**A and second pedestal support **910**B to raise, lower, and/or tilt first pedestal **908**A and second pedestal **908**B. Controller **950** further may control one or more heaters heat first substrate **920**A and/or second substrate **920**B. Controller **950** additionally may control other components not shown in FIG. **9**, such as gas line heaters, liquid cooling elements, substrate transfer robots, load locks, and/or any other suitable components.

[0151] FIG. **10** schematically shows a cross-sectional side view of an example processing chamber **1000**. Processing chamber **1000** comprises a pedestal system **1001** and a pedestal shield system **1002**. Processing chamber **904** is an example of processing chamber **1000**. Pedestal system **1001** comprises a pedestal **1003** supported by a pedestal support **1004**. Pedestal support **1004** is configured to raise and lower pedestal **1003**. Pedestal support **1004** is further configured to adjust a tilt angle of pedestal **1003** relative to a processing chemical outlet, as described below.

[0152] Pedestal **1003** is configured to support a substrate **1006** on a pedestal surface **1007**. Pedestal **1003** comprises a substrate heater **1008** configured to heat substrate **1006**. In some examples, substrate heater **1008** is configured to heat to a temperature within a range of 350° C. to 550° C. In other examples, a substrate heater may be omitted.

[0153] Processing chamber **1000** further comprises a pedestal shield system **1002** configured to at least partially protect pedestal system **1001** from processing conditions within processing chamber **1000**. Pedestal shield system **1002** comprises a side shield **1010**, a bottom shield **1012**, and a radiation shield **1014**.

[0154] Side shield **1010** is disposed around pedestal support **1004** and is supported by bottom shield **1012**. Side shield **1010** may help protect pedestal system **1001** from processing conditions. For example, side shield **1010** at least partially encloses a space **1016** below pedestal **1003** through which a purge gas may be flowed (indicated by flow arrow **1018** and similar arrows). As such, side shield **1010** may inhibit chemical deposition on pedestal **1003** and pedestal support **1004** by at least partially blocking flow of processing chemicals into space **1016**. In various examples, side shield **1010** and bottom shield **1012** may be integrated or may be separate. In some examples, side shield **1010** comprises aluminum and/or an aluminum alloy.

[0155] Bottom shield **1012** comprises a plurality of adjustors. Two adjustors, adjustor **1020**A and adjustor **1020**B, are shown. Each adjustor is capable of adjusting a height of a location of the bottom shield relative to an underlying surface. For example, adjustor **1020**A is capable of adjusting height **1021**A and adjustor **1020**B is capable of adjusting height **1021**B. As discussed in more detail below with regard to FIGS. **11**A-**11**C, the plurality of adjustors are configured to adjust one or more of side shield height, side shield tilt, lift pin height, and lift pin angle. Example adjustors that may be suitable for use as each adjustor in bottom shield **1012** include a screw, a cam, a rack and pinion gear, a lever, a piston, a wedge, and combinations of two or more thereof. In some examples, a bottom shield may comprise three adjustors. In other examples, any other suitable number of adjustors may be used. Adjustors **1020**A and **1020**B may be accessed from corresponding openings in an upper side of bottom shield **1012**.

[0156] Bottom shield **1012** is further configured to support a plurality of lift pins, such as lift pin **1022**. Lift pin **1022** extends through a lift pin hole **1024** within pedestal **1003** such that an upper end of lift pin **1022** can support substrate **1006**. Lift pin **1022** may support substrate **1006** when the upper end of lift pin **1022** is elevated above a height of pedestal surface **1007**. For example, pedestal **1003** may be raised such that lift pin **1022** retracts through lift pin hole **1024** and substrate **1006** is supported by pedestal **1003**. Likewise, pedestal **1003** may be lowered such that substrate **1006** is supported by the plurality of lift pins. In some examples, the plurality of lift pins comprises three lift pins, including lift pin **1022**. In other examples, any other suitable number of lift pins may be used. Lift pins may comprise any suitable material. Examples include as aluminum, sapphire, corrosion-resistant steel, and ceramic.

[0157] In FIG. **10**, a lower end of lift pin **1022** is supported by a shim **1026** disposed within a recess **1028** of bottom shield **1012**. Shim **1026** may be removable such that a user can exchange shim **1026** for another shim of a different thickness. Shims may comprise any suitable material, such as aluminum, sapphire, corrosion-resistant steel, or ceramic. In other examples, shims and/or recesses may be optional. In other examples, such shims may be omitted.

[0158] As discussed above, pedestal **1003** may be raised and lowered. To avoid lift pin **1022** being pulled upwards when the pedestal is raised, lift pin **1022** may comprise a weight **1030**. In other examples, weight **1030** may be omitted.

[0159] Bottom shield **1012** further comprises one or more openings to accommodate foot pads of radiation shield **1014**. For example, opening **1034** is configured to accommodate foot pad **1036**. In some examples, a bottom shield may have from three to six openings. In other examples, a bottom shield may comprise a number of openings outside of this range.

[0160] Bottom shield **1012** may contact a bottom surface **1040** of processing chamber **1000** at relatively few points, such as three points. As such, there may be little heat conduction from bottom shield **1012** to an underlying surface. Thus, radiation shield **1014** is configured to absorb heat radiated from the pedestal system **1001**, and conduct the heat for removal from processing chamber **1000**. Radiation shield **1014** comprises one or more foot pads, including foot pad **1036**, to transfer heat to another structure in a processing chamber. The one or more foot pads extend through openings in bottom shield **1012**. For example, foot pad **1036** extends through opening **1034** and is in thermal communication with bottom surface **1040**. As depicted by arrow **1046**, foot pad **1036** may conduct heat to bottom surface **1040** to remove the heat from pedestal system **1001**. In some examples, bottom surface **1040** is actively cooled, e.g., by flowing a liquid through a channel beneath bottom surface **1040**. In some examples, a foot pad may conduct heat to another structure within processing chamber **1000**, such as a heat sink that is separate from a bottom surface of a process chamber.

[0161] As mentioned above, a pedestal shield system according to the present disclosure may be configured to facilitate adjustment of a side shield position and/or lift pin position relative to a position of a pedestal. FIGS. **11**A-**11**C schematically show adjustment of an example shield system **1100** within a processing chamber of a processing tool. Shield system **1100** comprises a side shield **1102**, a bottom shield **1104** supporting the side shield, and a radiation shield **1106**. The processing chamber comprises a processing chemical outlet **1108** that is tilted to a tilt angle **1110**, represented as angle θ. Such tilting may arise, for example, from bowing of top plate **922** (e.g., a processing chamber top plate) when a processing chamber is under reduced pressure. The depicted magnitude of the tilt of processing chemical outlet **1108** is exaggerated for clarity.

[0162] The processing tool comprises a pedestal **1112** supported by a pedestal support **1114**. The processing tool further comprises lift pin **1120**A and lift pin **1120**B that extend through corresponding lift pin hole **1122**A and lift pin hole **1122**B of pedestal **1112**.

[0163] Due to the tilt of processing chemical outlet **1108**, pedestal **1112** and processing chemical outlet **1108** are not parallel, which may affect film deposition.

[0164] Thus, as described above, a pedestal tilt may be adjusted to align with a processing chemical outlet tilt. As depicted in FIG. **11**B, pedestal support **1114** and pedestal **1112** are adjusted to tilt angle **1110**. As a result, pedestal **1112** is approximately parallel to processing chemical outlet **1108**.

[0165] Upon tilting pedestal **1112**, lift pin **1120**A and lift pin **1120**B are misaligned with pedestal **1112**. For example, as shown in FIG. **11**B, the upper ends of lift pins **1120**A, **1120**B are misaligned with the surface of pedestal **1112**. As such, lift pins **1120**A, **1120**B may become stuck and/or break during lowering of pedestal **1112**.

[0166] Also, side shield **1102** is misaligned with pedestal **1112**. As a result, gap **1124**A may become wider and allow processing chemicals to enter the space below pedestal **1112**. Additionally, gap **1124**B may become narrower. This may interrupt a flow of purge gas. As such, adjusting a tilt of a pedestal without adjusting a side shield may expose the pedestal system to processing conditions.

[0167] Accordingly, the position of bottom shield **1104** is adjusted using one or more adjustors of bottom shield **1104**. Example adjustors are shown at **1130**A and **1130**B. As shown in FIG. **11**C, adjustor **1130**A is adjusted to increase a gap **1132**A between a first location of bottom shield **1104** and a bottom surface **1134** of the processing chamber. Additionally, adjustor **1130**B is adjusted to decrease a gap **1132**B between a second location of bottom shield **1104** and bottom surface **1134**. Each adjustor **1130**A, **1130**B may use any suitable adjustment mechanism. Examples include a screw, a cam, a rack and pinion gear, a lever, a piston, a wedge, or any combination of any two or more thereof. While two adjustors are depicted in FIGS. **11**A-**11**C, bottom shield **1104** may comprise any suitable number of adjustors. For example, by using three adjustors, bottom shield **1104** may function as a tripod whereby the three adjustors can independently be adjusted to control a height and a tilt of the tripod. As a result of the adjustment, side shield **1102** is tilted to an angle that is approximately equal to tilt angle **1110**. In some examples, the position of shield system **1100** may also be adjusted in an X-Y plane on bottom surface **1134**, which may help achieve similarity between gap **1124**A and gap **1124**B.

[0168] The positions of lift pins **1120**A, **1120**B also are adjusted by adjustor **1130**A and adjustor **1130**B. As depicted in FIG. **11**C, increasing gap **1132**A by adjusting adjustor **1130**A while also decreasing gap **1132**B by adjusting adjustor **1130**B has the effect of raising a lift pin height of lift pin **1120**A, lowering a lift pin height of lift pin **1120**B, and adjusting an angle of both lift pins. In the example depicted in FIGS. **11**A-**11**C, lift pin height represents a distance from bottom surface **1134** to an upper end of a lift pin. Adjustment of the lift pin angle may help align lift pin **1120**A with lift pin hole **1122**A and align lift pin **1120**B with lift pin hole **1122**B. As such, this may help avoid the lift pins being damaged or stuck during pedestal raising/lowering.

[0169] Additionally, lift pin planarity may be adjusted relative to the surface of pedestal **1112** such that the upper ends of lift pins **1120**A, **1120**B are approximately planar with the surface of pedestal **1112**. Here, lift pin planarity represents a degree of planarity between a plane defined by upper ends of three or more lift pins, including lift pin **1120**A and lift pin **1120**B, and the surface of pedestal **1112**. As depicted in FIG. **11**C, when pedestal **1112** is lowered, lift pins **1120**A, **1120**B may contact a substrate disposed on top of pedestal **1112** together.

[0170] Adjusting lift pin height and lift pin planarity by adjusting adjustors **1130**A-B may be more convenient for a user compared to other methods such as adjustment of lift pin lengths or adjustment of shims. For example, it may be labor intensive to remove a shield to access shims and lift pins, adjust the shims and lift pins, and then replace the shield. In comparison, it may be relatively fast for a user to adjust adjustors **1130**A-B, for example, by twisting a screw. In other examples, shims may be used to adjust a height of a lift pin independently of adjustors **1130**A-B.

[0171] As shown in FIG. **11**C, foot pads **1140**A, **1140**B of radiation shield **1106** maintain contact with bottom surface **1134** when bottom shield **1104** is adjusted. Foot pads **1140**A, **1140**B extend through openings **1142**A, **1142**B in bottom shield **1104**. As such, radiation shield **1106** does not tilt with bottom shield **1104**. Thus, radiation shield **1106** can conduct heat through foot pads **1140**A, **1140**B for removal of the heat from the processing chamber when bottom shield **1104** is adjusted.

[0172] FIG. **12** schematically shows an example side shield **1200** configured for use in a pedestal shield system. Side shield **1200** is an example of side shield **1010** of FIG. **10** or side shield **1102** of FIGS. **11**A-**11**C. Side shield **1200** may be disposed around a pedestal support of a pedestal system to help protect the pedestal system from processing conditions. Side shield **1200** may be supported by a bottom shield. In some examples, a side shield may be integrated with a bottom shield.

[0173] Side shield **1200** comprises an approximately cylindrical shape. In other examples a side shield may comprise any other suitable shape. Side shield **1200** comprises a flange **1202** with fastener holes **1204**. Flange **1202** may help transfer heat from side shield **1200** to a bottom shield supporting side shield **1200**. Fasteners, such as screws, may be inserted through fastener holes **1204** to help secure side shield **1200** to a bottom shield.

[0174] In some examples, side shield **1200** comprises aluminum and/or an aluminum alloy. As discussed above, processing conditions comprising temperatures above 300° C. may lead to outgassing of metal alloys (e.g., aluminum **6061**) which may deform, damage, and/or weaken the metal alloy. However, the examples disclosed herein may provide for relatively lower temperatures of a side shield under processing conditions. For example, in one experiment, a substrate heater was heated to 500° C., and a side shield temperature was measured to be below 225° C. As such, the examples disclosed herein may provide for the use of side shields comprising metal alloys (e.g., aluminum alloys such as aluminum **6061**), which may be less expensive than ceramic. In other examples, side shield **1200** may comprise any other suitable material. Examples include corrosion-resistant steel or ceramic.

[0175] FIG. **13** schematically shows an example bottom shield **1300** configured for use in a pedestal shield system. Bottom shield **1300** is an example of bottom shield **1012** of FIG. **10** or bottom shield **1104** of FIGS. **11**A-**11**C. Bottom shield **1300** is configured to support a side shield, such as side shield **1010**, side shield **1102**, or side shield **1200**. As depicted in FIG. **13**, bottom shield **1300** comprises three adjustors **1302**A-C. In other examples, a bottom shield may comprise any other suitable number of adjustors. Example adjustors may include a screw, a cam, a rack and pinion gear, a lever, a piston, a wedge, or any combination of two or more of these structures. In some examples, an adjustor may comprise a locking mechanism to lock the adjustor and prevent movement. For example, an adjustor may comprise an adjustment screw and locking screw. In such an example, the locking screw may partially cover or otherwise block the adjustment screw when in a locked position. The adjustment screw can be adjusted when the locking screw is in an unlocked position, and not adjusted when the locking screw is in a locked position.

[0176] Bottom shield **1300** further comprises fastener holes **1304** that can be aligned with corresponding fastener holes of a side shield to facilitate an attachment of the side shield to bottom shield **1300**. Examples include fastener holes **1204** of side shield **1200**. For example, a screw threaded through fastener holes **1204** and fastener holes **1304** may be used to secure side shield **1200** to bottom shield **1300**. In other examples, any suitable fastener may be used. Examples include clamps and bolts. In further examples, a fastener may be omitted. For example, a bottom shield may comprise a groove configured to accommodate a side shield and hold the side shield by friction.

[0177] Bottom shield **1300** further comprises a plurality of features **1306**A-C configured to support a corresponding plurality of lift pins. In some examples, features **1306**A-C may be configured to prevent a lift pin from shifting. For example, features **1306**A-C may be recesses in which lift pins may rest. In some examples, features **1306**A-C may be configured to accommodate a weight and/or lift pin assembly. For example, a weight may at least partially rest within a recess. Further, in some examples, a shim may be placed in a feature such that the shim is disposed between a lift pin and bottom shield **1300**. Referring back to FIG. **10**, recess **1028** is an example of a feature that can accommodate a shim to support a lift pin.

[0178] As discussed above, adjustors **1302**A-C may be configured to adjust one or more of a lift pin height, a lift pin angle, a side shield height, and a side shield tilt. Adjustors **1302**A-C may be adjusted together to raise and lower bottom shield **1300**. Further, by tilting bottom shield **1300**, adjustors **1302**A-C can be used to adjust a side shield tilt and a lift pin angle relative to a pedestal.

[0179] Bottom shield **1300** further comprises a plurality of openings including opening **1308** and opening **1310**. Opening **1308** is located near the center of bottom shield **1300** and is configured to accommodate a pedestal support of a pedestal system. Opening **1308** also may be configured to allow a purge gas to flow around the pedestal support through opening **1308**. Opening **1310** is located near the edge of bottom shield **1300** and is configured to accommodate a foot pad of a radiation shield. Bottom shield **1300** comprises six openings configured to accommodate foot pads. However, in other examples, a bottom shield may comprise any suitable number of openings to accommodate any suitable number of foot pads. Openings may comprise any suitable shape and size. Further, an opening may be configured to accommodate two or more foot pads in some examples.

[0180] As described above, a side shield and a bottom shield may be integrated in some examples. FIG. **14** shows an example integrated bottom and side shield **1400** comprising a side shield portion **1402** and a bottom shield portion **1404**. Integrated bottom and side shield **1400** further comprises one or more adjustors, including adjustor **1406**, configured to adjust one or more of a side shield tilt and a side shield height. Integrated bottom and side shield **1400** further comprises one or more openings, including opening **1408**, configured to accommodate a foot pad of a radiation shield. Integrated bottom and side shield **1400** also comprises one or more features, including feature **1410**, configured to accommodate one or more lift pins. Side shield portion **1402** and bottom shield portion **1404** may be joined in any suitable manner, e.g., welding. In some examples, integrated bottom and side shield **1400** may be machined, cast or otherwise formed as a single part. Further, in some examples, integrated bottom and side shield **1400** comprises aluminum and/or an aluminum alloy.

[0181] FIG. **15** shows a schematic view of an example radiation shield **1500** from a top view. Radiation shield **1500** is an example of radiation shield **1014** of FIG. **10** or radiation shield **1106** of FIGS. **11**A-**11**C. Radiation shield **1500** comprises six foot pads **1502**A-F, indicated by dashed lines. FIG. **16** shows a perspective view of radiation shield **1500** that shows the bottom of radiation shield **1500**. As seen in FIG. **16**, the foot pads **1502**A-F of radiation shield **1500** extend downwardly. When used with a bottom shield, the foot pads **1502**A-F extend downwardly through openings in the bottom shield, such as through opening **1310** of bottom shield **1300**. Radiation shield **1500** is configured to absorb heat from a pedestal system. Further, the foot pads **1502**A-F are configured to conduct the heat for removal of the heat from the processing chamber. In some examples, the foot pads **1502**A-F may comprise a material comprising relatively high thermal conductivity, such as copper. In other examples, any other suitable material may be used. While the example depicted in FIGS. **15-16** comprises six foot pads, a radiation shield may comprise any suitable number of foot pads. Further, foot pads may comprise any suitable shape.

[0182] Radiation shield **1500** further comprises an opening **1504** configured to accommodate a pedestal support of a pedestal system. Opening **1504** also may be configured to allow purge gas to flow around a pedestal support through opening **1504**. Radiation shield **1500** further comprises a plurality of cutouts **1506**A-C configured to accommodate one or more lift pins. For example, cutout **1506**A may accommodate a first lift pin to extend through radiation shield **1500** to be supported by a bottom shield (e.g., at feature **1306**A of bottom shield **1300**). Likewise, cutout **1506**B may accommodate a second lift pin. Cutout **1506**C may accommodate a third lift pin.

[0183] As mentioned above, pedestal shield system may be adjusted to achieve and maintain suitable alignment with a pedestal system. For example, a pedestal shield system may be adjusted during manufacturing or maintenance of a processing tool.

[0184] FIG. **17** shows an example method **1700** of adjusting a pedestal shield system. The pedestal system of the substrate processing tool comprises a pedestal and a pedestal support. The pedestal shield system of the substrate processing tool comprises a side shield, a bottom shield, and a radiation shield. At **1702**, method **1700** comprises adjusting a tilt angle of the pedestal relative to the processing chemical outlet. As described above, application of a vacuum may cause bowing in a top plate of the processing chamber which leads to tilt of the processing chemical outlet. Thus, adjusting the tilt angle of the pedestal at **1704** may comprise applying a vacuum to a processing chamber of the processing tool before adjusting the tilt angle of the pedestal.

[0185] Method **1700** further comprises, at **1706**, adjusting one or more adjustors on the bottom shield of the pedestal shield system to adjust a position of the side shield relative to the pedestal. In some examples, at **1708**, adjusting the one or more adjustors comprises adjusting one or more of a screw, a cam, a rack and pinion gear, a lever, a piston, or a wedge. In some examples, at **1710**, adjusting the one or more adjustors may comprise adjusting a height of the side shield. In some examples, at **1712**, adjusting the one or more adjustors may comprise adjusting a tilt of the side shield. Further, in some examples, at **1714**, adjusting the one or more adjustors may comprise adjusting a lift pin height of one or more lift pins supported by the bottom shield. Also, in some examples, at **1716**, adjusting the one or more adjustors may comprise adjusting a lift pin planarity relative to a surface of the pedestal.

[0186] It will be understood that the disclosed examples of pedestal shield systems and purge plates can be used in a same processing station of a processing tool in some examples. The disclosed example pedestal shield systems can help protect a pedestal from conditions such as high temperatures and processing gases. Further, the disclosed example purge plates can help prevent cross-talk between stations of a multi-station tool.

[0187] In some examples, the methods and processes described herein may be tied to a computing system of one or more computing devices. In particular, such methods and processes may be implemented as a computer-application program or service, an application-programming interface (API), a library, and/or other computer-program product.

[0188] FIG. **18** schematically shows a non-limiting example of a computing system **1800** that can enact one or more of the methods and processes described above. Computing system **1800** is shown in simplified form. Computing system **1800** may take the form of one or more personal computers, workstations, computers integrated with wafer processing tools, and/or network accessible server computers.

[0189] Computing system **1800** includes a logic machine **1802** and a storage machine **1804**. Computing system **1800** may optionally include a display subsystem **1806**, input subsystem **1808**, communication subsystem **1810**, and/or other components not shown in FIG. **18**. Controllers **150** and **950** are examples of computing system **1800**.

[0190] Logic machine **1802** includes one or more physical devices configured to execute instructions. For example, the logic machine may be configured to execute instructions that are part of one or more applications, services, programs, routines, libraries, objects, components, data structures, or other logical constructs. Such instructions may be implemented to perform a task, implement a data type, transform the state of one or more components, achieve a technical effect, or otherwise arrive at a desired result.

[0191] The logic machine may include one or more processors configured to execute software instructions. Additionally or alternatively, the logic machine may include one or more hardware or firmware logic machines configured to execute hardware or firmware instructions. Processors of the logic machine may be single-core or multi-core, and the instructions executed thereon may be configured for sequential, parallel, and/or distributed processing. Individual components of the logic machine optionally may be distributed among two or more separate devices, which may be remotely located and/or configured for coordinated processing. Aspects of the logic machine may be virtualized and executed by remotely accessible, networked computing devices configured in a cloud-computing configuration.

[0192] Storage machine **1804** includes one or more physical devices configured to hold instructions **1812** executable by the logic machine to implement the methods and processes described herein. When such methods and processes are implemented, the state of storage machine **1804** may be transformed—e.g., to hold different data.

[0193] Storage machine **1804** may include removable and/or built-in devices. Storage machine **1804** may include optical memory (e.g., CD, DVD, HD-DVD, Blu-Ray Disc, etc.), semiconductor memory (e.g., RAM, EPROM, EEPROM, etc.), and/or magnetic memory (e.g., hard-disk drive, floppy-disk drive, tape drive, MRAM, etc.), among others. Storage machine **1804** may include volatile, nonvolatile, dynamic, static, read/write, read-only, random-access, sequential-access, location-addressable, file-addressable, and/or content-addressable devices.

[0194] It will be appreciated that storage machine **1804** includes one or more physical devices. However, aspects of the instructions described herein alternatively may be propagated by a communication medium (e.g., an electromagnetic signal, an optical signal, etc.) that is not held by a physical device for a finite duration.

[0195] Aspects of logic machine **1802** and storage machine **1804** may be integrated together into one or more hardware-logic components. Such hardware-logic components may include field-programmable gate arrays (FPGAs), program- and application-specific integrated circuits (PASIC/ASICs), program- and application-specific standard products (PSSP/ASSPs), system-on-a-chip (SOC), and complex programmable logic devices (CPLDs), for example.

[0196] When included, display subsystem **1806** may be used to present a visual representation of data held by storage machine **1804**. This visual representation may take the form of a graphical user interface (GUI). As the herein described methods and processes change the data held by the storage machine, and thus transform the state of the storage machine, the state of display subsystem **1806** may likewise be transformed to visually represent changes in the underlying data. Display subsystem **1806** may include one or more display devices utilizing virtually any type of technology. Such display devices may be combined with logic machine **1802** and/or storage machine **1804** in a shared enclosure, or such display devices may be peripheral display devices.

[0197] When included, input subsystem **1808** may comprise or interface with one or more user-input devices such as a keyboard, mouse, or touch screen. In some examples, the input subsystem may comprise or interface with selected natural user input (NUI) componentry. Such componentry may be integrated or peripheral, and the transduction and/or processing of input actions may be handled on- or off-board. Example NUI componentry may include a microphone for speech and/or voice recognition, and an infrared, color, stereoscopic, and/or depth camera for machine vision and/or gesture recognition.

[0198] When included, communication subsystem **1810** may be configured to communicatively couple computing system **1800** with one or more other computing devices. Communication subsystem **1810** may include wired and/or wireless communication devices compatible with one or more different communication protocols. As non-limiting examples, the communication subsystem may be configured for communication via a wireless telephone network, or a wired or wireless local- or wide-area network. In some examples, the communication subsystem may allow computing system **1800** to send and/or receive messages to and/or from other devices via a network such as the Internet.

[0199] It will be understood that the configurations and/or approaches described herein are exemplary in nature, and that these specific examples or examples are not to be considered in a limiting sense, because numerous variations are possible. The specific routines or methods described herein may represent one or more of any number of processing strategies. As such, various acts illustrated and/or described may be performed in the sequence illustrated and/or described, in other sequences, in parallel, or omitted. Likewise, the order of the above-described processes may be changed.

[0200] The subject matter of the present disclosure includes all novel and non-obvious combinations and subcombinations of the various processes, systems and configurations, and other features, functions, acts, and/or properties disclosed herein, as well as any and all equivalents thereof.

1. A processing tool comprising:
a processing chamber comprising
a plurality of stations, and
a purge plate comprising
a chamber-facing surface,
a plurality of cutouts configured to accommodate a process gas outlets of the plurality of stations,
a shroud arranged around at least a portion of a perimeter of a first cutout of the plurality of cutouts, the shroud extending away from the chamber-facing surface, and
a plurality of purge gas holes formed in the chamber-facing surface and the shroud.

2. The processing tool of claim **1**, wherein the shroud is a first shroud, and further comprising a second shroud arranged at least partially around the perimeter of a second cutout of the plurality of cutouts.

3. The processing tool of claim **1**, wherein the plurality of purge gas holes comprises a pattern, and wherein the pattern is interrupted at an edge of the shroud.

4. The processing tool of claim **1**, wherein the shroud is configured to accommodate one or more tabs of a transfer ring.

5. The processing tool of claim **1**, further comprising a pedestal located at a station of the plurality of stations, a pedestal support that supports the pedestal above a bottom surface of the processing chamber, and a pedestal shield system comprising:
a side shield disposed around the pedestal support,
a bottom shield that supports the side shield, the bottom shield comprising a plurality of adjustors configured to adjust one or more of a side shield tilt and a side shield height, the bottom shield further comprising one or more openings, and
a radiation shield configured to absorb heat radiated from the pedestal and transfer the heat for removal from the processing chamber, the radiation shield comprising one or more foot pads that extend through the one or more openings of the bottom shield.

6. The processing tool of claim **5**, wherein the side shield is disposed around the pedestal, and further comprising a purge gas outlet to flow purge gas into a space at least partially enclosed by the side shield.

7. The processing tool of claim 5, further comprising a plurality of lift pins supported by the bottom shield, and wherein the plurality of adjustors of the bottom shield are further configured to adjust one or more of lift pin height and lift pin angle relative to pedestal angle, wherein the radiation shield comprises a plurality of cutouts configured to accommodate the plurality of lift pins.

8. A purge plate for a processing chamber in a processing tool, the purge plate comprising:
a chamber-facing surface;
a cutout configured to accommodate a corresponding process gas outlet of the processing tool;
a shroud arranged around at least a portion of a perimeter of the cutout, the shroud extending from the chamber-facing surface; and
a plurality of purge gas holes formed in the chamber-facing surface and the shroud.

9. The purge plate of claim 8, wherein the purge plate comprises a unitary body.

10. The purge plate of claim 8, wherein the purge plate is formed from aluminum.

11. The purge plate of claim 8, wherein the shroud is a first shroud, and further comprising a second shroud arranged around a second cutout.

12. The purge plate of claim 8, wherein the plurality of purge gas holes comprises a pattern, the pattern being interrupted at an edge of the shroud.

13. The purge plate of claim 8, wherein the shroud extends away from the chamber-facing surface a distance within a range of between 0.10 inches and 0.25 inches.

14. The purge plate of claim 8, further comprising a second, third, and fourth cutout.

15. The purge plate of claim 8, wherein the shroud comprises one or more notches configured to accommodate one or more tabs of a transfer ring.

16. The purge plate of claim 8, wherein the purge plate is configured for a deposition chamber of a chemical vapor deposition tool.

17. A method of processing a plurality of substrates within a processing chamber of a processing tool, the processing chamber comprising a plurality of stations and a corresponding plurality of process gas outlets, the processing chamber further comprising a purge plate, the purge plate comprising a plurality of cutouts each configured to accommodate a process gas outlet of the plurality of process gas outlets, the method comprising:
flowing a first precursor gas over a first substrate at a first station;
flowing a second precursor gas over a second substrate at a second station;
flowing a purge gas through purge holes formed through a chamber-facing surface of the purge plate; and
flowing the purge gas through purge holes formed through a shroud of the purge plate, the shroud arranged around at least a portion of a perimeter of a first cutout of the plurality of cutouts.

18. The method of claim 17, wherein the shroud is a first shroud, and further comprising flowing the purge gas through purge holes formed in a second shroud of the purge plate, the second shroud arranged at least partially around a portion of a second cutout of the plurality of cutouts.

19. The method of claim 17, wherein the method of processing the plurality of substrates further comprises an additional method, the additional method comprising:
performing a chemical vapor deposition process.

20. The method of claim 17, further comprising, after flowing the first precursor gas, transferring the first substrate to the second station, and after flowing the second precursor gas, transferring the second substrate to a third station.

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