

Tower for substrate carrier

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Claims (26)

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translated from Chinese

A porous tower diffuser assembly for use in a front opening wafer container, the diffuser assembly comprising: an inlet fitting having a base portion and an integral partial bias a unitary offset portion, and an integral nipple; and a perforated tower configured to be a sintered polymer tubular portion and a flared lower portion Portion, the flared lower portion is

engageable or engaged with the upwardly facing nozzle. The perforated diffuser assembly of claim 1, further comprising an elastic gasket (elastomeric grommet) and a check valve for engaging a purge nozzle, the size of the check valve suitably fit in one of the through holes of the gasket. The perforated diffuser assembly of claim 2 further comprising another porous column and another inlet joint. The perforated diffuser assembly of claim 1 configured as a retrofit kit and further comprising a package containing the inlet fitting and the perforated tray. The perforated diffuser assembly of claim 1 further includes a written instruction. A front opening wafer container comprising a container portion having a front opening and a door for sealingly closing the front opening, the container portion having a bottom wall, the front opening wafer container further comprising: An inlet joint having a base portion, an integral biasing portion, and an integral upwardly facing nozzle, the inlet joint being disposed at an opening in the bottom wall; A perforated column is configured as a sintered polymer tubular portion and a flared lower portion that is engaged with the upwardly facing nozzle. The prior open wafer container of claim 6 further comprising another inlet joint having a base portion, an integral biasing portion, and an integral upward nozzle. Another inlet joint is disposed at another opening in the bottom wall; another porous column is configured as another sintered polymer tubular portion and another flared lower portion, the other flared lower portion being engaged On the upward nozzle of the other inlet joint. A purge refurbishing tool set for a front opening wafer container, the tool set comprising: a porous media diffuser having a flared end; and an inlet joint having a nozzle for receiving the flared end; And a packaging container, the porous media diffuser and the inlet joint. The tool set of claim 8 further comprising a resilient washer and a check valve. An inlet joint for a perforated tower diffuser assembly for use in a substrate container, the inlet joint comprising: a base portion defining an axial direction through the base portion a nozzle extending from a first side of the base portion and defining a central passageway in fluid communication with the axial opening of the base portion, the nozzle including a wall portion and a defined portion a structure of one of the lateral openings, the transverse opening passing through the wall; a porous media diffuser operatively coupling the nozzle, the porous media diffuser comprising an open porous sidewall portion And defining a diffuser passage extending into the porous media diffuser along a diffuser axis, the diffuser passage defining an opening at a proximal end of the porous media diffuser and associated with the nozzle The The central passage is concentric, wherein the nozzle extends into the opening of the diffuser passage such that the porous media diffuser subtends the transverse opening. The inlet joint of claim 10, further comprising a tubular portion depending from a second side of the base portion, the second face being opposite the first face of the base portion. The inlet joint of claim 10, wherein: the base portion is centered on a first axis that is perpendicular to the first side of the base portion; the central passage of the nozzle defines a a second axis, the second axis being substantially parallel to the first axis; and the second axis being radially offset relative to the first axis. The inlet joint of claim 12, wherein: the axial opening of the base portion defines a third axis, the third axis being substantially parallel to the first axis; and the third axis is relative to the first The axis and the second axis are radially offset. The inlet joint of claim 10, wherein the nozzle is a barbed nipple comprising a barb portion and a tapered portion on the wall portion, the barb portion defining a major outer diameter of the barbed nozzle, the tapered portion defining a reduced outer diameter adjacent the barb portion; the transverse opening passing through the tapered portion of the wall portion And an annular plenum defined between the tapered portion and a boundary of the diffuser passage of the porous media diffuser, the annular plenum via the transverse The opening is in fluid communication with the central passage of the barbed nozzle. The inlet joint of claim 10, wherein the wall portion of the nozzle includes an external thread formed on an outer surface thereof. The inlet fitting of claim 15 wherein the proximal end of the porous media diffuser comprises internal threads formed on an inner surface thereof, the internal threads being compatible with the external threads of the nozzle. The inlet fitting of claim 10, wherein the porous media diffuser includes a flared portion at the proximal end. An inlet joint for a porous tower diffuser assembly for use in a substrate container, the inlet joint comprising: a purge module for mounting to a bottom plate of the substrate container The floor module includes a casing having a tubular portion and a top portion, the top portion including a structure defining an opening through which the opening defines a central axis and concentric about a central axis; a coupling disposed in the housing, the coupler defining a through passage substantially concentric with the central axis of the opening of the top And a porous media diffuser having a proximal end operatively coupled to the coupler and extending through the opening of the top of the purge module, the porous media diffuser comprising an open a porous sidewall portion defining a diffuser passage extending into the porous media diffuser, the diffuser passage defining an opening at the proximal end of the porous media diffuser, the opening being substantially open to

the opening Central axis Concentric with a center, wherein a portion of the porous medium with the diffuser opening Kongqi Ping and extends just above the opening, the line portion is a porous material. The inlet joint of claim 18, wherein the coupler is a female coupling. The inlet joint of claim 19, wherein the female coupler is a threaded female coupler. The inlet fitting of claim 20, wherein the proximal end of the porous media diffuser includes an external thread on an outer surface thereof, the outer threads being compatible with the threaded female coupler. The inlet joint of claim 18, wherein the coupler depends from the top of the housing. A system for transporting a substrate, comprising: a substrate container comprising an opening for inserting/removing a plurality of substrates; and a door adapted to sealingly cover the opening, the opening being substantially parallel to a vertical direction a diffuser assembly disposed within the substrate container and adapted to receive a gaseous working fluid into the interior of the container, the diffuser assembly being oriented to direct the gaseous working fluid toward the opening for use The gaseous working fluid purges the substrate container, the diffuser assembly being configured to direct one of the gaseous working fluids toward a lower half of the opening at a higher velocity than to direct one of the gaseous working fluids toward an upper half of the opening speed. The system of claim 23, wherein the diffuser assembly is disposed adjacent to a back of one of the substrate containers, the back portion being opposite the opening. The system of claim 23, wherein the diffuser assembly comprises an inlet tower adapted to be mounted to the substrate container to receive the gaseous working fluid to the interior of the vessel, the inlet tower comprising a One end and a blind end opposite the first end, the first end defining a flow inlet defining an internal flow channel and including a porous outer sleeve, the interior a flow channel extending from the flow inlet to the blind end, The porous outer sleeve is in fluid communication with the internal flow passage. The system of claim 25, wherein the inlet tower comprises at least one flow obstruction along which the at least one flow block is disposed between the flow inlet and the blind end.

Description

translated from Chinese

Tower for substrate carrier

The present invention relates to a transportable substrate container suitable for storing or transporting an object (eg, a semiconductor wafer) in a clean environment, and more particularly to purging the container during exposure of the container to the surrounding environment Environmental systems and methods.

During insertion of the substrate into a substrate container (eg, a front open wafer container) or removal of the substrate from the substrate container, a little dust, gaseous impurities, or increased humidity may be introduced into the substrate container, thereby remaining resident. The product yield of the wafer has an adverse effect. Therefore, there is a greater need to control the environment within such shipping containers during substrate handling to achieve or maintain high cleanliness.

A microenvironment in the substrate container is typically blown by injecting an inert gas into the interior of a substrate container via an inlet port to expel air in the container through an outlet port. Systems and methods for delivering purge gas into a container have been devised to improve the environment within the container. No. 6,221,163 to Roberson et al. ("Roberson"), which discloses a system and method for molecular contamination control that allows for relative humidity, oxygen, or particulates in a container. (particulate) purging to the desired level. See also, for example, U.S. Patent Application Publication No. 2012/0297981, issued to, the entire entire entire entire entire entire- The towers in which the gas flows vertically are coordinated to uniformly distribute the purge gas in the microenvironment.

The foregoing references are designed to control an enclosed microenvironment. That is, the conventional apparatus and method for solving the microenvironment control of the substrate container assumes that one of the openings through the loading and unloading of the substrate is sealed by an access door. These systems do not address the problem of ambient air invading the substrate container during insertion or removal of the substrate (ie, when the access door is removed and the opening is exposed). This intrusion of

ambient air can adversely affect the yield of the resident substrate even when the surrounding environment is a clean room.

Moreover, these references do not address the problem of the connection between a diffuser tube and an upward facing fitting of a purge cartridge assembly. The connections need to be strong and the outer shape of the assembly should be low to avoid interference with the wafer slots. Accordingly, there is a need for an improved purge apparatus and method that solves the problem of encroaching of the surrounding environment when the substrate container is opened to the surrounding environment.

Various embodiments of the present invention produce a non-uniform flow distribution to make the flow distribution at the openings non-uniform. The flow distribution at the opening is tailored to intrude against ambient air that may otherwise occur. In one embodiment, when the opening defines a plane in a substantially vertical orientation, the uneven flow distribution is tailored such that the flow rate delivered to the bottom half of the opening is higher than the flow rate delivered to the top of the opening. It has been demonstrated that implementing the flow rate and velocity profile disclosed herein maintains the relative humidity within the substrate container at substantially less than one percent even when the door to the substrate container is opened or removed from the opening. Target value.

Structurally, in one embodiment, a system for transporting a substrate is disclosed, the system comprising a substrate container including a substrate for inserting/removing a plurality of substrates And an opening adapted to sealingly cover the opening, the opening being located in a plane substantially parallel to a vertical direction. A diffuser assembly is disposed within the substrate container and adapted to receive a gaseous working fluid into the interior of the container, the diffuser being oriented to direct the gaseous working fluid toward the opening for purging with the gaseous working fluid The substrate container. In one embodiment, the diffuser assembly is configured to direct one of the gaseous working fluids toward a lower half of the opening to be faster than to direct one of the gaseous working fluids toward an upper half of the opening. The diffuser can be disposed adjacent to a back of one of the substrate containers, the back being opposite the opening.

The diffuser includes an inlet tower adapted to be mounted to the substrate container to receive the gaseous working fluid into the interior of the container. The inlet tower can include a first end and a blind end opposite the first end, the first end defining a flow inlet defining an internal flow passage and including a porous outer casing (A porous outer sleeve extends from the flow inlet to the blind end, the porous outer sleeve being in fluid communication with the inner flow passage. The inlet tower may further include at least one flow obstruction along which the at least one flow blocking portion is disposed between the flow inlet and the blind end. In one embodiment, the at least one flow blocking portion is a flow orifice.

An embodiment of the present invention provides a porous tower diffuser assembly, the porous tower diffuser assembly comprising: a joint having a biasing portion and an upwardly extending nipple; And a diffuser tower connected to the nozzle. The diffuser tower can have a flared fitting extending above the upwardly facing nozzle. In an embodiment, the perforated diffuser assembly can be configured as a kit to refurbish the front open wafer container to improve purge performance.

Various embodiments of the present invention produce a flow distribution that is closely removed along the floor of a substrate container when the access door is removed. Cleaning the bottom plate will often Resist the influx of ambient air that may have occurred.

When a substrate container is purged prior to a microenvironment, the door of the container is removed and wet air flows downwardly in front of the open housing. This downward flowing air tends to enter the substrate container at the lower wafer slot, making it more difficult to purge. In addition, existing inlet fittings that are coupled to the tower diffuser often minimize or prevent flow at the joint. If the purge flow enters the bottom of

the diffuser (most often), this low flow or no flow at the junction will pose a challenge to the underfill wafer slot due to the lower wafer slot. The air entering the substrate container is not subject to confrontation.

Accordingly, various embodiments of the present invention disclose structures and methods for purging a substrate container using enhanced flow at a lower wafer slot to effectively purge high air flow into the substrate container at the locations .

Structurally, various embodiments of the present invention disclose an inlet joint for a perforated tower diffuser assembly for use in a substrate container, the inlet joint comprising: a base portion, Defining an axial opening through the base portion; a nozzle extending from a first side of the base portion and defining a central passage, the central passage and the axially opening fluid of the base portion In communication, the nozzle includes a wall portion and a structure defining a transverse opening through the wall portion; and a porous media diffuser operatively coupling the nozzle. The porous media diffuser includes an open porous sidewall portion and defines a diffuser passage that extends into the porous media diffuser along a diffuser axis. The diffuser passage defines an opening at a proximal end of the porous media diffuser and is concentric with the central passage of the nozzle. In one embodiment, the nozzle extends into the opening of the diffuser passage such that the porous media diffuser faces the lateral opening.

In one embodiment, the base portion is centered on a first axis, the first An axis is perpendicular to the first face of the base portion, the central passage of the nozzle defining a second axis, the second axis being substantially parallel to the first axis, and the second axis being along the first axis Radial offset. The axial opening of the base portion may also define a third axis, the third axis being substantially parallel to the first axis, and the third axis being radially relative to the first axis and the second axis Offset.

In various embodiments, the nozzle is a barbed nipple comprising a barb portion and a tapered portion of the wall portion, the barb portion defining the barbed nozzle A major outer diameter defining a reduced outer diameter adjacent one of the barbs. The transverse opening can pass through the tapered portion of the wall portion. In one embodiment, an annular plenum is defined between the tapered portion of the barb portion and a boundary of the diffuser passage of the porous media diffuser, the annular plenum opening through the lateral direction The aperture is in fluid communication with the central passage of the barbed nozzle.

In some embodiments, the wall portion of the nozzle includes an external thread formed on an outer surface thereof. The proximal end of the porous media diffuser can include internal threads formed on an inner surface thereof that are compatible with the external threads of the nozzle.

In various embodiments of the invention, an inlet joint for a perforated diffuser assembly includes a purge module for mounting in a bottom plate of the substrate container, wherein the perforated column The diffuser assembly is used in a substrate container, the purge module includes a housing having a tubular portion and a top portion, the top portion including a structure defining an opening, the opening passing through the structure The opening defines a central axis and is concentric about a central axis. A coupling may be disposed in the housing, the coupler defining a through passage substantially concentric with the central axis of the opening of the top. The coupler can depending from the top of the housing of the joint. The embodiments further comprise a porous media diffuser, the porous medium The diffuser has a proximal end operatively coupled to the coupler and extending through the opening of the top of the purge module, the porous media diffuser including an open porous sidewall portion defining a diffuser A channel extending into the porous media diffuser, the diffuser channel defining an opening at the proximal end of the porous media diffuser, the opening being substantially concentric about the central axis of the opening. A portion of the porous media diffuser is flush with the opening and extends directly above the opening, the portion being a porous material. The coupler can be a female coupling and can be a threaded female coupler. In one embodiment, the proximal end of the porous media diffuser includes external threads on an outer surface thereof that are compatible with the threaded female coupler.

30...Substrate container

30a...Substrate container

30b...Substrate container

32...Diffuser assembly

34... side

36... top

38... bottom

42... Back

44... front

46... door frame

48... openings

52...

54...Vertical direction

56... Lower half

58... upper half

64...Microenvironment

66...Slotted side wall

68... slot position

70...Diffuser assembly

70b...Diffuser assembly

72...Mobile view

74...Mobile view

76... Ambient air

78...Smog media

82...Clean dry air purge gas

84...Nitrogen purge gas

90...Graph

92...Graph

94a... disc

94b... disc

94c... disc

94d... disc

94e... disc

94f... disc

100...Diffuser assembly

102...Flower cross section

104...Export flow structure

106...Flow length

108...Blind

112... purge gas

114...Speed distribution

140...Diffuser assembly

142...Speed distribution

160...Diffuser assembly

162...Internal flow limiter

164...

166...

168...Diffuser body

172... wall

174...Export flow structure

175... flow cross section

176... distal

178... blind end

182... flow orifice

190...Diffuser assembly

192...Diffuser body

194... centering disc

196...Inlet rod assembly

202...Graph

204...Graph

220...Reverse flow diffuser assembly

222...Diffuser body

224... proximal end

226... distal

228... wall

232...Export flow structure

234...feed line

236... proximal end

238... distal

240...current flow

242...U-joint

244...Inlet joint

246... purge gas

260...Reverse flow diffuser assembly

262... center axis

264...Circular flow channel

266... plug

268... blind end

280... tower diffuser assembly

282...Inflatable chamber diffuser body

2821...Export flow structure

284... flow cross section

288... blind end

292...Export speed distribution

300...Segmented plenum diffuser assembly

302... Near end

304...Blind far end

306a...

306b...

306c...

308...Central passage

312... center axis

314a...Export flow structure

314b...Export flow structure

314c...Export flow structure

316...Export flow velocity distribution

320...Inflatable chamber diffuser assembly

322... length

324... flow cross section

326... thickness

328... proximal end

332... distal

334...Export speed distribution

340...Inflatable chamber diffuser assembly

342... length

344...Flow cross section

346... thickness

348... proximal end

352... distal

354...Export speed distribution

360...Inflatable chamber diffuser assembly

362... length

364...Flow cross section

368... Near end

372...Remote

374...Export speed distribution

380...Multiple diffuser assembly

382a...Diffuser body

382b...Diffuser body

382c...Diffuser body

384a... proximal end
384b... proximal end
384c... proximal end
386a... entrance tube
386b... entrance tube
386c... entrance tube
399...Perforated tower diffuser assembly
400...inlet joint
402...Porous Media Diffuser
402A...Porous Media Diffuser
404...Base section
406... nozzle
406a... nozzle
406b... nozzle
406c... nozzle
406d... nozzle
406e... nozzle
408...Axial opening
410... first side
411... proximal end
412...Central passage
413...Remote
414... wall
416...Horizontal opening
417...Upper socket
418...Connecting Department
419...Bumps
420... slot
421...Flexible components
422... wall

423... lower socket

424...Open porous structure

425... check valve

425.2...through holes

426...Diffuser channel

427... flare

427.1...Inner diameter

427.2... outside diameter

428...Diffuser axis

431...Tube

432... openings

433... second side

434... proximal end

436...first axis

438...second axis

442...barb

443... distal

444...Cone

446...Main outer diameter

448... outside diameter

452...Circular plenum

454... border

456...elastic band

462... external thread

466...Channel

472... slot

474...adhesive joints or welded joints

476...O-ring

478... convex

482... internal thread

486...inlet joint

488...Chapter

490...near

492... 远

494... openings

495... openings

496...O-ring

497...Gland

498... inner surface

499...shims

500...Perforated tower diffuser assembly

502...Blowing module

504...Inlet joint

506...shell

508...Tube

512... top

514...Opening

516... center axis

518... check valve

520...Filter assembly

521...Flexible components

521.2...Flexible tubular part

521.4...Integrated diaphragm

521.7... center opening

522... Coupler

524...through passage

526...Porous Media Diffuser

528... proximal end

532...Diffuser channel

534... openings

536...Open porous side wall

538... internal thread

542... external thread

544... outer surface

600...Diffuser Tower

604... Container Department

608... bracket

612...Bumps or bosses

614...Clamping Department

700...Renovation Tool Set

702...Diffuser connector

704...Connector

706... written instructions

712...Package

P1... Static pressure

P2... Static pressure

V1... internal flow speed

V2... internal flow speed

V1'...export speed

V2'...export speed

1 is a perspective view of a substrate container in an embodiment of the present invention; FIGS. 2A and 2B are ambient air entering an (A) open substrate container having no substrate and (B) having five substrates distributed thereon A view of the open substrate container; FIGS. 3A and 3B are schematic cross-sectional views showing the interaction of ambient air with the interior of an open substrate container having a conventional diffuser, respectively (A) a clean dry air purge gas and (B) a nitrogen purge gas; Figure 4 shows the relative humidity obtained at different locations on the substrate loaded in a substrate purge using a conventional diffuser for a nitrogen purge 5 is a schematic diagram of a first tower diffuser assembly of the prior art; FIG. 6 is a schematic diagram of a tower diffuser assembly according to an embodiment of the present invention, the tower diffuser assembly forms a Flow velocity distribution, the flow velocity distribution in the lower region is higher than The flow velocity in the upper region; FIG. 7 is a cross-sectional perspective view of a diffuser including a flow orifice as an internal flow restrictor in an embodiment of the present invention; FIGS. 8A and 8B are drawings In the embodiment of the invention, the humidity decreases with time in an open substrate container for (A) nitrogen gas purge and (B) clean dry air purge; FIG. 9A is an embodiment of the present invention. A cross-sectional perspective view of a diffuser including a center disk as an internal flow restrictor; and FIG. 9B is a perspective view of a support structure of a center disk of FIG. 9A in an embodiment of the present invention; A perspective view of a reverse flow diffuser utilizing an

external feed line in accordance with an embodiment of the present invention; and FIG. 11A is a cross-sectional perspective view of a reverse flow diffuser utilizing an internal feed line in accordance with an embodiment of the present invention; 11B is a partial enlarged view of the distal end of the reverse flow diffuser of FIG. 11A in an embodiment of the present invention; and FIG. 12 is a schematic view of a tower diffuser assembly using a plenum type diffuser body; Figure 13 is an implementation of the present invention FIG. 14A to FIG. 14C are cross-sectional views of a plurality of diffusers according to an embodiment of the present invention; and FIG. 15A is a perspective view of a plurality of diffusers operating in parallel according to an embodiment of the present invention; 15B is a partial front view of a plurality of diffusers according to FIG. 15A in an embodiment of the present invention; FIG. 16A is a perspective view of an inlet connector according to an embodiment of the present invention; FIG. 16B is a cross-sectional view of the inlet connector of FIG. 16A; A cross-sectional view of a perforated diffuser assembly in an embodiment of the invention; 17A through 17D are front views of various nozzle configurations in accordance with an embodiment of the present invention; and FIG. 18A is an embodiment of the present invention. FIG. 18B is an assembled view of the inlet joint of FIG. 18A in a substrate carrier; FIG. 19 is a cross-sectional view of an inlet joint according to an embodiment of the present invention; and FIG. 20A is a front opening a perspective view of a container portion of a wafer container having a portion of the wafer wafer container removed and having a diffuser tower mounted to the front open wafer container by a bracket attached to the tray a plurality of bumps on the inner wall surface of the container portion; FIG. 20B is a bracket suitable for attaching a diffuser tower to a container portion; and FIG. 20C is a detailed view of the inner wall surface, the inner wall The surface has bumps or bosses and is used to fix a diffuser tower Frame; FIG. 21A and second 21B of FIG embodiment of the present invention, a line cross-sectional view of the porous diffuser of the exemplary embodiment having a size; and a legend 22 shows a diffuser having a refurbished tower tool group.

Referring to Figure 1, a substrate container 30 for storing a plurality of substrates 32 in accordance with one embodiment of the present invention is illustrated. The substrate container 30 includes two opposite side portions 34, a top portion 36, and a bottom portion. Part 38 and a back 42. The bottom portion 38 defines an inner surface or a bottom plate 40. One of the front portions 44 of the substrate container 30 includes a door frame 46 that defines an opening 48. A door 52 is adapted to sealingly cover the opening 48. The opening 48 of the substrate container 30 lies in a plane substantially parallel to a vertical direction 54. The substrate container 30 is also characterized by receiving a microenvironment 64.

A pair of slotted sidewalls 66 are disposed within the substrate container 30, each of the slotted sidewalls 66 being adjacent one of the sides 34, respectively. The slotted sidewalls 66 are aligned such that the slots are opposite each other to define a plurality of slot locations 68 and are spaced apart to support the substrate 32 therebetween. For the purposes of the present invention, the lowermost portion of the slot locations 68 (i.e., the slot closest to the bottom portion 38) is identified as the "first" slot and the slot number is increased in the upward direction (See Figure 15B).

The substrate container 30 further includes at least one diffuser assembly 70 disposed within the substrate container 30 and operatively coupled to a source of gas (not shown) for introducing a gaseous working fluid into the substrate. In the container 30. In certain embodiments, one or more of the diffuser assemblies 70 are oriented to direct the gaseous working fluid toward the opening 48 to purge the substrate container 30.

Referring to Figures 2A and 2B, flow views 72 and 74 are shown in which ambient air 76 is introduced into a substrate container 30a after the door 52 is removed. The substrate container 30a has many of the same features as the substrate container 30, but the diffuser 70 is not activated when the flow views 72 and 74 are obtained. For the flow view 72, the substrate container 30a is empty (ie, the substrate is not mounted therein); for the flow view 74, the substrate container 30a includes a uniform distribution from the lowermost (first) slot to the uppermost slot Five substrates. The flow views 72 and 74 are created by introducing a smoke medium 78 into the closed transparent substrate container 30a and distributing the smoke medium

substantially uniformly throughout the substrate container 30a. The aerosol medium 78 is then illuminated through the transparent walls of the substrate container 30a. When the door 52 is removed from the substrate container 30a, the influx of ambient air may be replaced by the replacement of the smoke medium 78. have been seen. Thus, the smoke medium 78 represents a regulated (e.g., clean, inert, and/or low humidity) gas in the microenvironment 64, and the area in which the smoke medium 78 is absent represents a gradual intrusion of unregulated ambient air 76. .

Flow views 72 and 74 indicate ambient air 76 entering a substrate container 30a near a bottom portion 38. This tendency can be observed in both the empty substrate container and the substrate container on which the substrate is mounted.

Referring to Figures 3A and 3B, it is schematically illustrated that two different purge gases (clean dry air purge gas 82 (Fig. 3A) and nitrogen purge gas 84 (Fig. 3B)) are used. The open substrate container 30b performs a qualitative result of a purge experiment. The substrate container 30b has many of the same aspects as the substrate container 30, which are denoted by the same reference numerals and employ a diffuser assembly 70b which produces a vertical flow distribution which is vertical. The velocity of the gas delivered to the distal or upper portion of the diffuser assembly 70b is higher than the velocity of the gas delivered towards its proximal or lower portion (see, for example, Figure 5). The depictions of Figures 3A and 3B are observed by visualization by smoke/fog (similar to Figures 2A and 2B), but are shown schematically for clarity. In these experiments, the relative humidity of ambient air 76 was approximately 45%, while the relative humidity of clean dry air 82 and nitrogen gas 84 was approximately 0%. The temperatures of gases 76, 82 and 84 are approximately 22 °C. For example, as depicted in Figure 1, two tower diffusers 70b are utilized and the flow rate through each diffuser set is 100 liters per minute (lpm).

The drawing of Fig. 3A exemplifies that the ambient air 76 is substantially discharged when the substrate container 30b is purged with the clean dry air 82 under the conditions described. The density of the clean dry air 82 is substantially the same as the density of the ambient air 76, or generally slightly greater than the density of the ambient air 76, due to the absence of water vapor (the molecular weight of the water vapor is less than the molecular weight of the standard air composition). . Therefore, it is believed that the clean dry air 82 introduced along the bottom 38 of the substrate container 30b will remain close to the bottom. The surface of the portion 38, in turn, floods into the ambient air 76 where the antigen may have occurred.

In contrast, the depiction of FIG. 3B illustrates that the nitrogen gas 84 introduced via the diffuser assembly 70b and adjacent the bottom 38 has a tendency to rise above the gradual intrusion of ambient air 76 as the nitrogen gas 84 approaches the opening 48, thus to ambient air 76. The barrier is local rather than substantially complete. Ambient air 76 contains components having a molecular mass greater than nitrogen (eg, oxygen). Therefore, it is believed that the denser ambient air 76 introduced along the bottom 38 of the substrate container 30b will remain close to the surface of the bottom portion 38 and thus will not effectively block the influx of ambient air 76 under the experimental conditions of Figure 3B. .

Referring to Fig. 4, the graphs 90 and 92 are shown to quantify the humidity intruding into the substrate container 30b when the nitrogen gas 84 is used as the gaseous working fluid. Each of the plurality of blank discs 94a-94f is sized to represent a substrate and is provided with a plurality of relative humidity indicators at the center, front edge, rear edge, and side edges, respectively. Then, the substrates 94a-94f are mounted in the slot 1 to the slot 3 (the slot 1 is the lowermost slot, and the slot 2 and the slot 3 are the two slots immediately above the lowermost slot), The slot 6 (located at approximately 1/4 of the height of the slotted side wall 66), the slot 13 (located approximately 1/2 of the height of the slotted side wall 66), and the slot 25 (the uppermost slot of the substrate container 30b) in. An experiment was then carried out with a disk in place and with nitrogen gas 84 as the gaseous working fluid (i.e., repeating the experimental conditions described in the discussion of Figure 3B). This experiment was repeated to demonstrate the reproducibility of the results. The two sets of data are presented in Figure 4

The results presented in Figure 4 show that the relative humidity levels detected by the discs 94a-94d located in the slots 1 - slots 3 and slots 6 are substantially higher than those in the slots 13 and slots 25. Relative humidity level. Discs 94a-94d consistently have a relative humidity indicator reading of greater than 20% and in some instances greater than 30%. In contrast, disks 94e and 94f have consistently lower than 20% relative humidity indicator readings, and are less than 15% except one reading.

Therefore, it is believed that the traditional diffuser and other results that produce the results shown in Figure 4. The speed distribution obtained by the purge operation conditions is not sufficient to maintain the humidity level of the substrate container 30b below the relative humidity of 15%.

Referring to Figure 5, it illustrates the dynamics of one of the prior art standard tower diffuser assemblies 100. The diffuser assembly 100 is characterized by a uniform internal flow cross section 102, a uniform outlet flow structure 104 along the flow length 106 of the diffuser assembly 100 (e.g., uniform porosity and thickness), and a flow The blind end 108 terminates in cross section 102. It is assumed that one of the purge gas 112 entering and passing through the diffuser assembly 100 is incompressible (i.e., the total pressure is relatively low) and is adiabatic, and thus the flow can be characterized by the Bernoulli equation: $P_{total} = P_1 + \frac{1}{2} \rho V_1^2$ Equation (1)

$P_{total} = P_2 + \frac{1}{2} \rho V_2^2$ Equation (2) where P_{total} is the total pressure (substantially constant throughout the diffuser assembly 100) and P_1 is the static pressure at a position 1 in the diffuser assembly 100. Q_1 is the dynamic pressure at position 1, which is the density of the resident gas (substantially constant throughout the diffuser assembly), V_1 is the internal flow velocity at position 1, and P_2 is the static pressure at position 2. Q_2 is the dynamic pressure at position 2, V_2 is the internal flow velocity at position 2, and position 2 is downstream of position 1. The graph of Fig. 5 also shows the exit speeds V_1' and V_2' (i.e., the speed at which the diffuser gases are discharged at positions 1 and 2, respectively) and the ambient pressure P_o around the diffuser assembly 100.

Another feature of the diffuser assembly 100 is that the outlet flow structure 104 is configured such that one of the pressure drops across the outlet flow structure 104 is not significant relative to the static pressures P_1 and P_2 .

It has been observed that for the diffuser assembly 100, the exit velocity V_2' is greater than the exit velocity V_1' . It is believed that as the flow of purge gas 112 approaches the blind end 108, the internal flow velocity slows down, the internal flow velocity V_1 is greater than the internal flow velocity V_2 , which in turn causes the dynamic pressure Q_1 to be greater than the dynamic pressure Q_2 . Since the P_{total} system is constant, the dynamic pressure Q_1 is higher relative to the dynamic pressure Q_2 , which causes the static pressure P_1 to decrease relative to the static pressure P_2 . Since the exit speeds V_1' and V_2' are driven by the static pressures P_1 and P_2 , respectively, the exit speed V_1' will be smaller than the exit speed V_2' . Thus, the velocity profile of the conventional diffuser assembly 100 produces a non-uniform exit velocity profile 114 that increases along the flow length 106 (i.e., occurs near the upper or distal end of the blank end of the substrate container 30). The speed is higher than the speed generated near the lower or proximal end of the bottom 38 of the substrate container 30).

Referring to Figure 6, a diffuser assembly 140 is shown to include features of certain embodiments of the present invention. The guiding principle of the diffuser assembly 140 reverses the internal flow characteristics such that V_2 is greater than V_1 , thereby forming a velocity profile 142 in which V_1' is greater than V_2' . As such, the force and momentum of the gaseous working fluid passing through the bottom 38 and passing through the lower portion 56 of the opening 48 of the substrate container 30 is greater than the force and momentum of the cleaning through the upper portion 58 of the opening 48. The following are various embodiments that are configured to achieve such dynamics.

Referring to Figure 7, a diffuser assembly 160 including an internal flow restrictor 162 is illustrated in accordance with one embodiment of the present invention. The diffuser assembly 160 includes a segment 164 and a distal segment 166 separated by an internal flow restrictor 162. Each segment includes a diffuser body 168 having a plurality of walls 172 that define an outlet flow structure 174 (eg, an open porous structure or a plurality of openings) that allows the gaseous working fluid to pass via a gaseous working fluid. The diffuser body 168 is discharged in the radial direction.

In one embodiment, the diffuser body 168 is formed from a POREX porous polyethylene material of the name TUB-5361, which is manufactured by Porex Cooperation of Fariburn, Georgia, USA. Supplied. This product features a nominal outer diameter of 1/2 inch, a nominal inside diameter of 0.29 inches, and an outlet flow knot. Structure 174, outlet flow structure 174 comprises an average pore size of 15 to 30 mm and a porosity in the range of 30% to 40% (including 30% and 40%). It should be understood that although various studies have been conducted using this diffuser body and the experimental results presented herein have been obtained, the specific structure of the POREX tube utilized is merely representative and not limiting.

The outlet flow structure 174 can be uniform throughout the length of the segments 164 or 166, respectively, or uniform in both segments 164 and 166. The diffuser body 168 can further define a flow cross-section 175 that is uniform throughout the length of the segment 164 or 166 and/or uniform in both segments 164 and 166. The distal section 166 is covered by a blind end 178 at a distal end 176. Blind end 178 can be, but is not required to be, solid and impermeable. In one embodiment, internal flow restrictor 162 includes a flow orifice 182, as depicted in FIG.

Functionally, the flow orifice 182 causes a head loss between the proximal section 164 and the distal section 166 of the diffuser assembly 160. The head loss causes a total pressure PT_2 in the distal section 166 to decrease relative to a total pressure PT_1 in the proximal section 164. Along with the decrease in total pressure PT_2 , one of the static pressures PS_2 in the distal section 166 will decrease relative to one of the static pressures PS_1 in the proximal section 164. Thus, as discussed above, the reduction in the static pressure of the distal section 166 will concomitantly decrease the exit velocity V_2' of the flow exiting the distal section 166 relative to the exit velocity V_1' of the proximal section 164. As a result, the exit velocity V_1' of the bottom portion 38 of the adjacent substrate container 30 is greater than the exit velocity V_2' flowing in the upper portion of the substrate container 30.

Referring to Figures 8A and 8B, experimental data plots 202 and 204 for demonstrating the efficacy of the diffuser assembly 160 are shown in an embodiment of the invention. The two graphs 202 and 204 exhibit a relationship to the relative humidity in a substrate container similar to substrate container 30, which is removed and utilizes diffuser assembly 160 to purge the substrate container and phase. The humidity is maintained below 15%. The results shown in graph 202 are based on a nitrogen gas purge; the results in graph 204 are based on a clean dry air purge. The experiment that produced the two sets of data utilized two diffusers (as depicted in Figure 1), each of which delivered 100 liters per minute of gaseous working fluid to the substrate container. The two graphs 202 and 204 also show information from the locations of the front of the discs in the slots 3 and slots 6 of the wafer container. The position of the discs and the position of the slot of the substrate container are selected because various other tests performed in support of this work prove that in the fog visualization and relative humidity test, the front position in the slot position of each lower wafer is purged. The most challenging.

In each experiment, the door 52 of the wafer carrier 30 was open and allowed the microenvironment to be filled with ambient air 76 having a relative humidity of 45% (this is a typical feature of a clean room for substrate handling). In the two graphs 202 and 204, the gaseous working fluid is introduced into the graph via the diffuser 160 at approximately 300 seconds. Regardless of which gaseous working fluid is employed, the disc at the slot 6 will exhibit a substantially stable, monotonous relative humidity reduction. When using clean dry air as the gaseous working fluid, the disc at the slot 3 will also monotonically decrease (see Figure 8B).

These data are all close to 0% relative humidity at the 600 second time mark (i.e., after about 300 seconds of introduction of the gaseous working fluid).

For nitrogen gas purge, the disc at slot 3 is not monotonically reduced and the relative humidity is not close to 0%. Conversely, the relative humidity level at the front of the slot 3 is somewhat unstable, indicating that ambient air is intermittently intruding into the open substrate container.

However, these results indicate that the diffuser assembly 160 performs a satisfactory function. The relative humidity will be below the target relative humidity threshold of 15% when entering the purge cycle less than 10 seconds and will not exceed the 15% relative humidity mark thereafter. Thus, graphs 202 and 204 demonstrate the efficacy of diffuser assembly 160 when using nitrogen or clean dry air as the gaseous working fluid.

Referring to Figures 9A and 9B, a diffuser assembly 190 employing the flow restrictor principle is illustrated in an embodiment of the invention. The diffuser assembly 190 includes a single diffuser body 192 into which a centered disk 194 supported by an inlet stem assembly 196 is inserted. The diffuser body 192 can include a number of properties that are identical to the proximal section 164 and the distal section 166 of the diffuser assembly 160 (eg, walls defining an outlet flow structure; internal flow channels having a uniform flow cross section; and blind ends). Centering disk 194 and inlet rod assembly 196 cooperate with diffuser body 192 to define a plurality of semi-annular passages 198 to limit flow and cause a head loss. Thus, the diffuser assembly 190 operates on the same principle as the diffuser assembly 160 and can form the same "step" in the distribution of the exit velocity.

It should be noted that both the diffuser assembly 160 and the diffuser assembly 190 are not limited to a single internal flow restrictor. That is, a plurality of flow restrictors (not shown) may be employed to form a series of reduced pressures along the length of the diffuser assemblies 160 and 190 to create a multi-step exterior. speed distribution.

Referring to Figure 10, a reverse flow diffuser assembly 220 is illustrated in an embodiment of the invention. The reverse flow diffuser assembly 220 includes a diffuser body 222 having a proximal end 224 and a distal end 226 and including an outlet flow structure 232 (eg, an open porous structure or a plurality of openings) A wall 228 that causes the gaseous working fluid to exit radially through the diffuser body 222. In an exemplary, non-limiting embodiment, the diffuser body 222 is formed from or has similar properties to the POREX porous polyethylene material described above.

A feed line 234 having a proximal end 236 and a distal end 238 is adjacent and substantially parallel to the diffuser body 222. Unlike the diffuser body 222, the structure of the feed line 234 is not conducive to a radial flow therethrough; moreover, the wall of the feed line 234 is solid, causing access to the proximal end One of the flow streams 240 is exhausted from the distal end 238.

The distal end 226 of the diffuser body 222 is in fluid communication with the distal end 238 of the feed line 234, such as by a U-shaped joint 242. An inlet joint 244 can be coupled to the proximal end 224 of the diffuser body 222 and the proximal end 236 of the feed line 234. In the illustrated embodiment, the inlet fitting 244 is in fluid communication with the proximal end 236 of the feed line 234 and provides a blind end 246 at the proximal end 224 of the diffuser body 222. The joint 244 can also be adapted to be coupled within a crucible (not shown) formed at the bottom 38 of the substrate container 30.

In operation, a purge gas 246 is introduced into the inlet fitting 244, which feeds the purge gas 246 into the feed line 234. The purge gas passes through feed line 234 and U-shaped joint 242 where it flows back and enters distal end 226 of diffuser body 222. Purge gas 246 then passes radially through wall 228 and exits diffuser body 222 via outlet flow structure 232.

Functionally, for a diffuser body 222 having characteristics similar to the POREX porous polyethylene material described above, the velocity profile of the exhaust diffuser body 222 relative to the blind end 246 can be similar to the fifth with respect to the blind end 108. The velocity distribution 114 is shown. However, the reverse flow of the flow stream 240 reverses the velocity profile relative to the inlet of the diffuser body 220. That is, for the reverse flow diffuser assembly 220, the high velocity adjacent the blind end 246 (ie, the proximal end 224) of the diffuser body 222 is at the bottom 38 adjacent the substrate container 30, more adjacent the velocity at the top 36 is high and the force and momentum of the gaseous working fluid exiting the lower half 56 of the opening 48 of the substrate container 30 is greater than the force and momentum of the upper half 58 of the discharge opening 48.

Referring to Figures 11A and 11B, a reverse flow diffuser assembly 260 is illustrated in an embodiment of the invention. The reverse flow diffuser assembly 260 includes a number of the same attributes as the reverse flow diffuser assembly 220, which are denoted by reference numerals numbered the same. Structurally, the reverse flow diffuser assembly 260 is different from the reverse flow diffuser assembly 220 in that the feed tube Line 234 is located within diffuser body 222 and is concentric with diffuser body 222 centered on a central axis 262 to define an annular flow passage 264 between feed line 234 and diffuser body 222. In addition, the proximal end 224 of the diffuser body 222 includes a plug 266 that terminates the annular flow passage 264, and the distal end 226 of the diffuser body 222 includes a blind end 268, wherein the distal end 238 of the feed line 234 is opposite The blind end 266 is axially offset.

Functionally, the blind end 268 acts to reverse the flow stream 240 exiting the feed line 234 and redirect it axially into the annular flow channel 264 (see Figure 11B). The plug 266 is in fact a blind end of the annular flow passage 264 that causes the purge gas entering the annular flow passage 264 to exit the diffuser body 222 radially through the outlet flow structure 232. The reversal of the flow stream 240 and the barrier provided by the plug 266 at the proximal end 224 of the diffuser body 222 creates a velocity profile of the exhaust diffuser body 222 having a flow with the reverse flow diffuser assembly 220. The velocity distribution is similar in characteristics.

The embodiments disclosed above form a non-uniform velocity profile based on the principle that static pressure varies along the length of the diffuser body. However, by modifying this dynamics, the diffuser assembly can be customized to provide a desired flow distribution based on a different principle (referred to herein as the "plenum charge effect"), as follows Said.

Referring to Fig. 12, a tower diffuser assembly 280 employing a plenum diffuser body 282 is illustrated. The diffuser body 282 is different from the diffuser bodies 168, 192, and 222 in that one of the outlet flow structures 2821 of the plenum diffuser body 282 is configured such that the pressure drop ΔP at both ends thereof is substantially greater than the static pressure P_1 and P_2 . Therefore, the diffuser body 120 functions as a plenum in which the axial velocities V_1 and V_2 are small, so that the total pressure P_{total} is substantially the same as the static pressures P_1 and P_2 . Therefore, the "filling chamber filling effect" is promoted when the static pressure change along the internal flow flow is not significant.

One way to utilize the plenum filling effect is to utilize a plenum-type diffuser body 282 in which the porosity of the plenum diffuser body 282 is reduced relative to the porosity of the diffuser bodies 168, 192, and 222, thereby The resistance of the radial outflow increases. Another way is to increase the thickness of the wall of the plenum diffuser body 282 relative to the thickness of the walls of the diffuser bodies 168, 192 and 222, which also increases the resistance to radial outflow. The size of the opening diameter can be reduced to the same effect. Yet another approach increases the internal flow cross-section of the plenum diffuser body 282 relative to the internal flow cross-section of the diffuser bodies 168, 192, and 222, thereby reducing at a given volumetric flow rate. The speed of the flow. The parameters can be varied individually or in combination to form the desired plenum filling effect.

The plenum diffuser body 282 is considered to have a constant internal flow cross section 284, an outlet flow structure 284 (eg, uniform porosity and thickness) that is uniform along its length, and a flow cross section 284 The blind end of termination 288. For a tower diffuser assembly 280 that facilitates the plenum filling effect, one of the outlet velocity profiles 292 exiting the plenum diffuser body 282 in the radial direction will be substantially uniform. Therefore, other customizations are needed to influence a non-uniform velocity distribution. Embodiments of implementing such other customized plenum filling types are set forth below.

Referring to Figure 13, a segmented plenum diffuser assembly 300 is illustrated in an embodiment of the invention. The segmented plenum diffuser assembly 300 includes 13 a proximal end 302, a blind distal end 304, and three segments 306a, 306b, and 306c as shown, along which the three segments 306a, 306b, and 306c are A central passage 308 of one of the central axes 312 is in fluid communication. The central passage 308 can define the same flow cross section along the length of the assembly 300. However, in one embodiment, each of the segments 306a, 306b, and 306c produces a plenum fill effect, and is configured to have a unique outlet flow structure 314a, 314b, and 314c, respectively; that is, each segment 306a, 306b, and 306c have an opening size, a pore geometry, and One of the unique combinations of porosity is such that the resistance of each of the segments 306a, 306b, and 306c to the radial outflow is different.

To effect an outlet flow velocity profile 316 that is delivered at the proximal end 302 (i.e., at a location closest to the bottom 38 of the substrate container 30) that is faster than the velocity delivered at the distal end 304, the outlet flow structure 314a, 314b and 314c are customized such that the resistance of segment 306c to radial outflow is maximized and the resistance of segment 306a to radial outflow is minimized, and the resistance of segment 306b to radial outflow is intermediate.

It should be noted that the depiction of the three segments 306a, 306b, and 306c is non-limiting and represents only a plurality of segments. More or fewer segments may be used in other embodiments.

Referring to Figures 14A, 14B, and 14C, the plenum diffuser assemblies 320, 340, and 360 are depicted in the embodiments of the present invention, respectively. The aperture size, aperture geometry, and porosity of the plenum diffuser assemblies 320, 340, and 360 can be constant along their respective flow lengths 322, 342, and 362. On the other hand, assemblies 320, 340, and 360 utilize flow cross sections 324, 344, and 364 that vary along their respective lengths 322, 342, and 362, respectively. The plenum diffuser assemblies 320 and 340 further utilize thicknesses 326 and 346 that vary along their respective lengths 322 and 342.

Functionally, the plenum diffuser assembly 320 has a larger flow cross section 324 and a thinner wall at a proximal end 328 than at a distal end 332. With this geometry, an exit velocity profile 334 can have a higher velocity at the proximal end 328 than at the distal end 332. The plenum diffuser assembly 340 has a proximal end 348 and a distal end 352 and defines an outlet velocity profile 354 that operates on the same principle, but the flow cross section 344 is discrete. The form of the step is not in the form of a tapered geometry of the flow cross section 324. For a plenum diffuser assembly 360 having a proximal end 368, a distal end 372 and forming an exit velocity profile 374, the wall thickness is substantially constant and thus radial flow along its length The change in resistance is primarily dependent on the change in flow cross section 364.

Referring to Figures 15A and 15B, a multiple diffuser assembly 380 is illustrated in an embodiment of the invention. The multi-diffuser assembly 380 includes three separate diffuser bodies 382a, 382b, and 382c having operatively coupled to one of the inlet tubes 386a, 386b, and 386c, respectively. Terminals 384a, 384b, and 384c have a blind distal end 388a, 388b, and 388c, respectively.

In one embodiment, each of the diffuser bodies 382a, 382b, and 382c is configured as a plenum-type diffuser body that produces a uniform velocity flow distribution as depicted in FIG. 12, respectively. However, each diffuser has a different resistance to radial outflow. In one embodiment, the diffuser body 382c exhibits a higher resistance to the radial outflow, the diffuser body 382a exhibits a lower resistance to the radial outflow,

and the diffuser body 382b presents a radial outflow therebetween. Resistance. Since the diffuser body 382a is closest to the lower portion 38 of the substrate container 30, the force and momentum of the gaseous working fluid passing through the bottom portion 38 and passing through the lower portion 56 of the opening 48 of the substrate container 30 is higher than the upper portion 58 of the through opening 48. The power and momentum of the sweep (see Figure 1).

In another embodiment, the diffuser bodies 382a, 382b, and 382c are each configured to form a non-uniform velocity flow distribution, as depicted in FIG. While such an arrangement does not necessarily provide the highest speed immediately adjacent the bottom 38, the diffuser body 382a can still be customized such that one of the nominal speeds formed is greater than the nominal speed output by the diffuser bodies 382b and 382c. As such, the force and momentum of the gaseous working fluid passing through the bottom 38 and passing through the lower portion 56 of the opening 48 of the substrate container 30 is greater than the force and momentum of the cleaning through the upper portion 58 of the opening 48.

In other embodiments, each of the diffuser bodies 382a, 382b, and 382c is configured as a reverse flow diffuser assembly, as depicted in FIG. 10 or FIG. The diffuser body 382a can be customized such that one of the nominal speeds formed is greater than the output by the diffuser bodies 382b and 382c. Weigh the speed. As such, the force and momentum of the gaseous working fluid passing through the bottom 38 and passing through the lower portion 56 of the opening 48 of the substrate container 30 is greater than the force and momentum of the cleaning through the upper portion 58 of the opening 48. This arrangement also provides the highest speed immediately adjacent the bottom 38, which in turn enhances the sweeping action.

In certain embodiments, the inlets 386a, 386b, and 386c can be in fluid communication with respective flow valves (not shown) that can be adjusted to increase or decrease through the respective diffuser body 382a. The relative flow rates of 382b, and 382c. Even in configurations where each of the diffuser bodies 382a, 382b, and 382c have the same outlet flow characteristics, the regulated flow rate can be varied along the length of the multi-diffuser assembly 380 to form a varying outlet velocity profile.

The depiction of Figure 15B also shows the sequence of slot positions relative to the top 36 and bottom 38 of the substrate container 30.

It should be noted that the depictions of the three diffuser bodies 382a, 382b, and 382c are non-limiting and represent only a plurality of diffuser bodies. More or fewer diffuser bodies may be utilized in other embodiments.

The diffuser assemblies disclosed above are all "tower type" diffusers. Other types of diffusers can also be used. For example, a plenum-type diffuser compartment (not shown) may be disposed along the back 42 of the substrate container 30, for example, in the form of a double wall having an adjacent substrate. The inner wall. The inner wall may be porous or comprise a plurality of openings or venting slots. The porosity/opening density can vary along the height of the inner wall such that the resistance to flow near the bottom 38 of the substrate container 30 is less than the resistance to flow near the top 36. The filling of the plenum diffuser compartments is facilitated by a plurality of turns passing through the bottom 38 of the substrate container 30, which are in fluid communication with the diffuser compartment.

16A, 16B and 16C depict one embodiment of a perforated diffuser assembly 399 and various components. In an embodiment of the invention, an inlet joint 400 is illustrated for coupling a porous media diffuser 402 configured as a tubular tower. The inlet fitting 400 includes a base portion 404 that defines an axial opening 408 through the base portion 404 that is centered about an opening axis 409. A nozzle 406 extends from a first side 410 of the base portion 404. The nozzle 406 includes a proximal end 411 and a distal end 413 and defines a central passage 412, a central passage 412 and a base portion 404. The axial bore 408 is in fluid communication. In one embodiment, the nozzle 406 includes a wall portion 414 having a structure defining a

transverse opening 416 through which the lateral opening 416 passes. The inlet connector can be connected to an upper socket 417 in a connection portion 418 by a "bayonet" type connection. In the "bayonet" type connection, the projection 419 engages the slot in the socket. 420. An elastic member 421 is fixed in the lower socket 423 to engage the purge nozzle. The resilient member can be configured as a grommet and can position a check valve 425 in one of the through-holes 425.2 of the resilient member. The connecting portion may be a unitary portion of the container portion of one of the front open wafer containers.

In various embodiments, the porous media diffuser 402 is operatively coupled to the nozzle 406. The porous media diffuser 402 can include a wall 422 that defines an open porous structure 424 to enable gaseous working fluid to be expelled radially through the porous media diffuser 402. The porous media diffuser 402 can be formed of or have similar properties to a POREX porous polyethylene material.

The porous media diffuser 402 can define a diffuser passage 426 that extends into the porous media diffuser 402 along a diffuser axis 428. The diffuser passage 426 can define an opening 432 at a proximal end 434 of the porous media diffuser 402 that is concentric with the central passage 412 of the nozzle 406. The porous media diffuser 402 can include a flared portion 427 at the proximal end 434, one of the inner diameters and/or an outer diameter of the flared portion being greater than one of the distal ends of the porous media diffuser 402 Inner diameter and / or outer diameter. The nozzle 406 extends into the opening 432 of the diffuser passage 426 such that the porous media diffuser 402 faces the lateral opening 416.

In some embodiments, a tubular portion 431 depends from a second side 433 of the base portion 404, and the second surface 433 is opposite the first side 410 of the base portion 404. In various embodiments, the base portion 404 is centered about a first axis 436 that is perpendicular to the first face 410 of the base portion 404. The tubular portion can define an inlet port 437 that is also centered about the first axis 436. The central passage 412 of the nozzle 406 can define a second axis 438 that is substantially parallel to the first axis 436. In one embodiment, the second axis 438 is radially offset relative to the first axis 436.

In one embodiment, the nozzle 406 is a barbed nozzle 406a, including a barb portion 442 at one of the distal ends 413 of the nozzle 406a and a tapered portion 444 of the wall portion 414, the barb portion 442 A major outer diameter 446 defining a barbed nozzle 406a is defined, and a tapered portion 444 defines a partially smallest outer diameter 448 adjacent the barb portion 442. The transverse opening 416 passes through the tapered portion 444 of the wall portion 414. An annular plenum 452 is defined between the tapered portion 444 of the barb portion 442 and a boundary 454 of the diffuser passage 426 of the porous media diffuser 402. The annular plenum 452 is connected to the barbed tube via the transverse opening 416. The central passage 412 of the mouth 406a is in fluid communication. In various embodiments, an elastic band 456 (eg, an O-ring) is coupled adjacent the proximal end 434 of the porous media diffuser 402 to assist in securing the porous media diffuser 402 to the nozzle 406.

Referring to FIGS. 17A through 17D, there are shown other disclosed embodiments having a nozzle 406 that extends from a first face 410 of the base portion 404. Herein, reference numeral 406 refers generally or generally to the nozzle, and reference numeral 406 (e.g., 406a) followed by a letter suffix refers to a particular nozzle of the present invention. The aspects common to the nozzles 406 are denoted by reference numerals numbered the same. In one embodiment, a nozzle 406b includes external threads 462 formed on an outer surface 464 of the wall portion 416 of the nozzle 406b, and at least one lateral opening 416 passes through the external thread. 462 (see Figure 17A). In another embodiment, a nozzle 406c also includes an external thread 462 and at least one lateral opening 416, and has a channel 466 extending from the at least one lateral opening 416, the at least one lateral opening 416 traverses the external thread 462 via the channel 466 to the distal end 443 of the nozzle 406c (see Figure 17B). In another embodiment, a nozzle 406d includes a structure defining a slot 472 that extends from the at least one lateral opening 416 via a distal end 443 of the nozzle (see Figure 17C). In one embodiment, one nozzle 406e is shortened relative to the other nozzles 406

and a glue joint or weld joint 474 is disposed at the proximal end 434 of the porous media diffuser 402 and the inlet joint 400. Between (17D).

In various embodiments, as a non-limiting example, the lateral opening 416 can have a diameter in the range of 3 mm to 12 mm and the center can be located at a distance perpendicular to the first face 410 of the base portion 404, which The distance is between 3 mm and 15 mm (including 3 mm and 15 mm). For the nozzle 406e of Figure 17D, the distal end 413 can be located at a distance perpendicular to the first face 410 of the base portion 404, which is between 3 mm and 15 mm (including 3 mm and 15 mm). Inside).

In various embodiments, an O-ring 476 is disposed at the proximal end 411 of the nozzle 406. O-ring 476 can contact both outer surface 464 and first side 410 of base portion 404, as depicted in Figure 16B. In some embodiments, a raised face 478 is formed or disposed at the proximal end 411 of the nozzle 406, as depicted in Figures 17C and 17D. In certain embodiments, the boundary 454 of the diffuser passage 426 of the porous media diffuser 402 includes a structure defining an internal thread 482 that is configured to mate with the external thread 462.

Referring to Figures 18A and 18B, an inlet joint 486 is illustrated in an embodiment of the invention. The inlet joint 486 contains many of the same aspects as the inlet joint 400, which are designated by the same reference numerals. The inlet joint 486 includes a collar portion Instead of a nozzle, the collar portion 488 extends axially and extends axially from the first face 410 of the base portion 404. The collar portion 488 includes a proximal portion 490 and a distal portion 492, the distal portion 492 defines an opening 494 that receives the porous media diffuser 402. In one embodiment, collar portion 488 includes one or more apertures 495. In one embodiment, an O-ring 496 is disposed in one of the glands 497 on one of the inner surfaces 498 of the collar portion 488. A gasket 499 can also be used to provide a seal between the inlet joint 486 and the bottom 38 of the substrate container 30.

Functionally, various embodiments of the conventional purge towers that do not include laterally open or shortened nozzles, Figures 16A through 16C, 17A through 17C, and 18A through 18B For example, the openings 416 and 495 and the shortened nozzle 406e of FIG. 17D will bring air closer to the surface 40 of the bottom 38 of the wafer container 30 into the porous media diffuser 402.

The nozzles 406a-406d and the collar portion 488 can provide a sufficient bearing surface 484 for the boundary 454 of the diffuser passage 426 to be aligned against the support surface 484 for securely securing the porous media diffuser 402. It will not loose or dump. The glue joint or weld joint 474 of the nozzle 406e can compensate for the reduced bearing surface of the nozzle 406e relative to the other nozzles 406a-406d. Of course, certain embodiments (not shown) may include a combination of a longer and open-ended nozzle and a glued joint.

O-ring 476 mounted at the base of nozzle 406b can function to align proximal end 434 of porous media diffuser 402. O-ring 476 can also be compressed between proximal end 434 of porous media diffuser 402 and inlet fitting 400, thereby providing a biasing force between internal thread 482 and external thread 462, which can be The rotation of the porous media diffuser 402 on the threaded nozzles 406 (i.e., the nozzles 406b, 406c, and 406d) is reduced during operation. The compressed O-ring 476 can also provide a seal to prevent gas flow axially out of the proximal end 434 and the opening 432 of the porous media diffuser 402.

Referring to Figure 19, a perforated diffuser assembly 500 is illustrated in an embodiment of the present invention. The perforated diffuser assembly 500 includes a purge module 502 having an inlet joint 504. The purge module 502 can include a housing 506 having a tubular portion 508 and a top portion 512. The top portion 512 includes a structure defining an opening 514 through which the opening 514 extends. The purge module 502 can be configured to be mounted in the bottom 38 of the substrate container 30 such that the top portion 512 is substantially flush with the inner surface 40 of the bottom portion 38. The aperture 514 defines

a central axis 516 and is concentric about a central axis 516. In one embodiment, the housing 506 is also concentric about a central axis 516 of the opening 514. The purge module 502 can include a check valve 518 that allows flow into the substrate container 30 while inhibiting or preventing the substrate container 30 from flowing out. The purge module 502 can also include a filter assembly 520 to filter gases passing therethrough. In addition, an elastic member 521 is engaged with the purge nozzle, and the elastic member 521 can be configured as an elastic tubular portion 521.2 and a unitary diaphragm portion 521.4 having an attachment to the center of the tubular portion 521.2. Hole 521.7. The tubular portion is sealingly clamped within the assembly and the diaphragm portion extends inwardly therefrom to provide a resilient seating surface for a purge nozzle. A purge nozzle that engages the diaphragm portion having the opening is located between the opening and the tubular portion.

A coupling 522 is disposed in the housing 506 and the coupler 522 defines a through passage 524. In one embodiment, the through passage 524 is substantially concentric with the central axis 516 of the opening 514 of the top portion 512. A porous media diffuser 526 has a proximal end 528 operatively coupled to the coupler 522 and extending through an opening 514 of the top 508 of the purge module 502, the porous media diffuser 526 defining a diffuser passageway 532, the diffuser channel 532 extends into the porous media diffuser 526. The diffuser passage 532 defines an opening 534 at the proximal end 528 of the porous media diffuser 526. In one embodiment, the opening 534 is substantially concentric about the central axis 516 of the opening 514.

The porous media diffuser 526 includes an open porous sidewall portion 536 ("porous" is defined as an opening that allows the gaseous working fluid to exit radially through the porous media diffuser 526. Porous structure). In one embodiment, the porous sidewall portion 536 of the porous media diffuser 526 extends through the opening 514 and/or extends directly above the opening 514 such that the porous sidewall portion 536 abuts the inner surface of the bottom portion 38 of the substrate container 30. 40.

In some embodiments, coupler 522 is a female coupling and can include internal threads 538 (as shown). In one embodiment, the proximal end 528 of the porous media diffuser 526 can include external threads 542 on an outer surface 544 thereof. External thread 542 is compatible with internal thread 538. In one embodiment, the coupler 522 can depending from the top 512 of the housing 506; in other embodiments, the coupler 522 can be suspended from the tubular portion 508 and/or from the filter assembly 520.

Functionally, positioning the porous sidewall portion 536 proximate the inner surface 40 of the bottom portion 38 of the substrate container 30 causes the air exiting the porous sidewall portion 536 to sweep the inner surface 40 more than the upper portion of the inner surface 40. One of the effects of purging the stream. In certain embodiments, the bottom portion 38 is of sufficient thickness to define the housing 506 such that the height of the inlet joint 504 can be integrated without the need to replace or redesign the check valve 518.

The tubular portion 508 can be configured to couple with the bottom portion 38 of the substrate container 30 and can house a check valve to allow flow to proceed in only one direction (ie, into or out of the substrate container 30).

20A, 20B, and 20C illustrate a diffuser tower 600 that is mounted to a container portion 604 of a front opening wafer container by a bracket 608 that is secured to a container Structure (such as bumps or bosses 612). The tower bracket has a clamping portion 614 that is sized to resiliently secure the tubular diffuser therein.

Referring to Figures 21A and 21B, in one embodiment of the invention, a porous media diffuser 402A having a non-limiting size is illustrated. These non-limiting dimensions are presented in inches and the values in parentheses are in millimeters. The flared portion 427 is depicted as having a nominal number of 9.27 millimeters The inner diameter of the rice is 427.1 and the outer diameter of the nominal outer diameter is 42. In various non-limiting embodiments, the inner diameter 427.1 can be between 9 mm and 10 mm, and the outer diameter 427.2 can be between 14 mm and 16 mm. In various non-limiting embodiments, the inner

diameter 427.1 can be between 5 mm and 15 mm, and the outer diameter 427.2 can be between 7 mm and 20 mm. In a non-limiting embodiment, the wall thickness of the diffuser can be between 2 mm and 4 mm. The diffuser may be formed of a sintered polymer or a sintered ceramic.

In various non-limiting embodiments, the inner diameter 427.1 can be between 5 mm and 15 mm, and the outer diameter 427.2 can be between 10 mm and 20 mm.

Referring to Fig. 22, which illustrates a retrofit kit 700, the retrofit kit 700 provides a diffuser 702, a connector 704, and a package 712. A written instruction 706 for guiding the installation may also be provided.

The diffuser assemblies disclosed above are all "tower" diffusers. Other types of diffusers can also be used. For example, a plenum-type diffuser compartment (not shown) may be disposed along the back 42 of the substrate container 30, for example, in the form of a double wall having an inner wall portion adjacent the substrate. The inner wall can be porous or comprise a plurality of openings or venting slots. The porosity/opening density can vary along the height of the inner wall such that the resistance to flow near the bottom 38 of the substrate container 30 is less than the resistance to flow near the top 36. By filling the bottom 38 of the substrate container 30, the filling of the plenum diffuser compartments can be facilitated, the lanthanides being in fluid communication with the diffuser compartment.

The following references, which are hereby incorporated by reference in their entirety by reference in their entirety, in their entireties in the the the the the the the the the the U.S. Patent Application Publication No. 2012/0297981.

In addition, the terms "embodiment", "the embodiment of the invention" and "the disclosed embodiment" are used herein to mean the specification of the patent application, which is not considered to be the prior art (the text includes the scope of the patent application) And the drawings).

30...Substrate container

32...Diffuser assembly

34... side

36... top

38... bottom

42... Back

44... front

46... door frame

48... openings

52...

54...Vertical direction

56... Lower half

58... upper half

64...Microenvironment

66...Slotted side wall

68... slot position

70...Diffuser assembly

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US5879458A	1996-09-13	1999-03-09	Semifab Incorporated	Molecular contamination control system
JP2002170876A *	2000-12-04	2002-06-14	Ebara Corp	Substrate transport container
JP4374133B2	2000-12-05	2009-12-02	株式会社日立国際電気	Substrate processing apparatus and substrate processing method
US20030035713A1 *	2001-08-20	2003-02-20	Taiwan Semiconductor Manufacturing Co., Ltd.	Moisture-controlled wafer storage container and method of using
JP4204302B2 *	2002-10-25	2009-01-07	信越ポリマー株式会社	Storage container
US7201276B2 *	2003-11-07	2007-04-10	Entegris, Inc.	Front opening substrate container with bottom plate
JP4921367B2	2004-06-07	2012-04-25	インテグリス・インコーポレーテッド	System and method for removing contaminants
KR100706250B1 *	2005-07-07	2007-04-12	삼성전자주식회사	Semiconductor device manufacturing apparatus and method
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WO2009114798A2 *	2008-03-13	2009-09-17	Entegris, Inc.	Wafer container with tubular environmental control components

JP5241607B2 *	2009-05-21	2013-07-17	信越ポリマー株式会社	Substrate storage container
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CN108028217B *	2015-09-04	2022-04-22	恩特格里斯公司	Internal wash sprayer with offset manifold
TWI709441B *	2016-09-05	2020-11-11	美商恩特葛瑞斯股份有限公司	Substrate container and purge tower assembly for the substrate container
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CN113396113B *	2018-12-12	2023-03-28	未来儿股份有限公司	Substrate storage container

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Priority And Related Applications

Applications Claiming Priority (2)

Application	Filing date	Title
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