to deliver one or more gases for distribution. In some embodiments, the one or more gas inlets are provided in a coaxial, multi-feed gas delivery stem connected to the second surface. Gas within the one or more volumes exits the gas distributor by flowing out of the plurality of gas distribution ports. Some example architectures of a gas distributor are described in association with FIGS. 7–26 in the context of various showerhead pedestal implementations. As previously mentioned, a showerhead pedestal is a showerhead configured to deliver gas(es) to a backside of a substrate.

[0117] FIG. 7 schematically illustrates a perspective view of a gas distributor (e.g., a showerhead pedestal) according to some embodiments. FIG. 8 schematically illustrates an orthographic view of a portion of a surface (e.g., a lower surface) of the gas distributor of FIG. 7 according to some embodiments.

[0118] Referring to FIGS. 7 and 8, showerhead pedestal **700** includes main body **701** and stem **703**. Main body 701 has first surface **705** and second surface **707** opposing first surface **705** in a first direction, such as a direction extending parallel to the z-axis direction. Longitudinal axis **708** of showerhead pedestal **700** may also extend parallel or substantially parallel to the z-axis direction. Accordingly, a thickness of main body **701** is defined along longitudinal axis **708** in the first direction. First surface **705** includes a plurality of gas distribution ports (e.g., gas distribution ports **709**), which may be arranged in a gas distribution area (or area) **711** and may be divided into a plurality of zones (or groups), such as zones **713**. Zones **713** may longitudinally extend in a second direction transverse to the first direction (e.g., the second direction may extend parallel to the y-axis direction), and may be adjacent to one another along a third direction transverse to both the first direction and the second direction (e.g., the third direction may extend parallel or substantially parallel to the x-axis direction). Although four zones are shown, embodiments are not limited thereto. For example, the gas distribution ports of area **711** may be divided into three or less zones or divided into five or more zones. It is also contemplated that the gas distribution ports of at least one zone may be divided into one or more sub-zones and/or sub-portions.

[0119] According to various embodiments, the gas distribution ports of area **711** may distribute one or more gases, such as one or more process (or reactant) gases and/or one or more dilution gases, in an area adjacent to a backside of a substrate in a process chamber. For instance, one or more first gases may be flowed from the gas distribution ports of a first zone among zones **713**, and one or more first gases and one or more second gases may be flowed from the gas distribution ports of at least one second zone among zones **713**. In some cases, the output of the one or more first gases from a second zone may be interlaced, alternated, or otherwise

be spaced apart from internal surface **2311**, but embodiments are not limited thereto. It is noted, however, that core **903** may be joined with extension **905** prior to sleeve **901** being joined with extension **905**.

[0131] Referring to FIGS. 11–13 and 24–26, core **903** may be a generally cylindrical body extending along longitudinal axis **2401** and having first end portion **2501** connected to second end portion **2503** via intermediate portion **2505**. First end portion **2501** of core **903** may terminate at proximal end **2507** having first opening **2509** and second end portion **2503** of core **903** may terminate at distal end **2511** having second opening **2513**. In this manner, core **903** may have one or more exterior lateral surfaces, which are collectively represented in FIG. 25 via dashed line **903s** that at least partially bounds the body defining core **903**. Hereinafter, the exterior lateral surface(s) of core **903** will be referred to, either individually or collectively, as exterior **903s**. At least one internal passageway (e.g., internal passageway **2515**) may be formed through the body of core **903**, and thereby, fluidically connect first opening **2509** with second opening **2513** in an interior of core **903**. In some cases, internal passageway **2515** may be formed by the joining of bore **2517** extending from first opening **2509** in proximal end **2507** of core **903** along central axis **2521** and bore **2519** extending from second opening **2513** in distal end **2511** of core **903** along central axis **2523**. Central axis **2521** may be offset from longitudinal axis **2401** of core **903** in a direction transverse to a direction of extension of longitudinal axis **2401**. In some cases, central axis **2523** may be coincident with longitudinal axis **2401** of core **903**. It is also noted that bore **2517** may include one or more sections of different cross-sectional areas in corresponding planes perpendicular to central axis **2521**. For example, section **2517**_1 of bore **2517** may have a greater cross-sectional area than section **2517**_2 of bore **2517**. As will become more apparent below, section **2517**_1 of bore 2517 may be sized relative to third body portion **2017** of extension **905** so that section **2517**_1 can accommodate at least some of third body portion **2017** therein when core **903** and extension **905** are incorporated as part of stem **703**. Similar to the physical and fluidic connection of bores **2117** and **2119** respectively with bores **2101** and **2103** of extension **905**, bore **2517** may be gun-drilled from proximal end **2507** of core **903** towards distal end **2511** of core **903** to a first depth, and bore **2519** may be gun-drilled from distal end **2511** towards proximal end **2507** to a second depth such that bores **2517** and **2519** at least partially coincide and, thereby, become physically and fluidically connected within a central region of core **903**. In some cases, bores **2517** and **2519** may be physically and fluidically connected in a region of first end portion **2501**.

[0132] According to some embodiments, first end portion **2501** of core **903** may include a

inlets of the second channels.

[0193] Embodiment 19: The apparatus of embodiment 17 or embodiment 18, wherein at least one of a central axis of the first interior supply path and a central axis of the second interior supply path is offset from the longitudinal axis of the stem body.

[0194] Embodiment 20: The apparatus of embodiment 19, wherein each of the central axis of the first interior supply path and the central axis of the second interior supply path is offset from the longitudinal axis of the stem body.

[0195] Embodiment 21: The apparatus of embodiment 18, wherein a proximal end of the core is welded to the third body portion; and a proximal end of the sleeve is welded to the first body portion.

[0196] Embodiment 22: The apparatus of any one of embodiments 1-21, wherein the interior flows paths are fluidically isolated from one another within the stem body.

[0197] Embodiment 23: The apparatus of any one of embodiments 1-22, wherein the interior flows paths are fluidically isolated from one another within the stem body, further comprising: a gas distributor comprising: a first surface comprising a plurality of inlets; and a second surface opposing the first surface, the second surface comprising a plurality of gas distribution ports; wherein: the stem body is coupled to the first surface of the gas distributor; the first interior flow path is fluidically connected with a first group of the gas distribution ports by way of a first outlet among the outlets of the stem body and a first inlet among the inlets of the gas distributor; and the second interior flow path is fluidically connected with a second group of the gas distribution ports by way of a second outlet among the outlets of the stem body and a second inlet among the inlets of the gas distributor, the gas distribution ports of the second group being distinct from the gas distribution ports of the first group.

[0198] Embodiment 24: The apparatus of embodiment 23, wherein the gas distributor is a showerhead pedestal of the semiconductor processing apparatus, the showerhead pedestal being configured to support a substrate at or near its periphery such that a backside of the substrate is substantially exposed to the gas distribution ports.

[0199] Embodiment 25: The apparatus of embodiment 23 or embodiment 24, further comprising: a process chamber configured to support a first portion of the stem body and the gas distributor therein, the process chamber comprising an opening through which a second portion of the stem body extends to expose the proximal end portion.

[0200] Embodiment 26: The apparatus of embodiment 25, further comprising: a pedestal configured to support a substrate within the process chamber, wherein the process chamber is configured to support the gas distributor over the pedestal such that the gas distribution ports

face the pedestal.

[0201] Unless otherwise specified, the illustrated embodiments are to be understood as providing example features of varying detail of some embodiments. Thus, unless otherwise specified, the features, components, modules, layers, films, regions, aspects, structures, etc. (hereinafter individually or collectively referred to as an "element" or "elements"), of the various illustrations may be otherwise combined, separated, interchanged, and/or rearranged without departing from the teachings of the disclosure.

[0202] The terminology used herein is for the purpose of describing some embodiments and is not intended to be limiting. As used herein, the singular forms, "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It is to be understood that the phrases "for each <item> of the one or more <items>," "each <item> of the one or more <items>," and/or the like, if used herein, are inclusive of both a single-item group and multiple-item groups, i.e., the phrase "for . . . each" is used in the sense that it is used in programming languages to refer to each item of whatever population of items is referenced. For example, if the population of items referenced is a single item, then "each" would refer to only that single item (despite dictionary definitions of "each" frequently defining the term to refer to "every one of two or more things") and would not imply that there must be at least two of those items. Similarly, the term "set" or "subset" should not be viewed, in itself, as necessarily encompassing a plurality of items—it is to be understood that a set or a subset can encompass only one member or multiple members (unless the context indicates otherwise). The terms "comprises," "comprising," "includes," and/or "including," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, components, and/or groups thereof, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. It is also noted that, as used herein, the terms "substantially," "about," and other similar terms, are used as terms of approximation and not as terms of degree, and, as such, are utilized to account for inherent deviations in measured, calculated, and/or provided values that would be recognized by one of ordinary skill in the art. Accordingly, the term "substantially" as used herein, unless otherwise specified, means within 5% of a referenced value. For example, substantially perpendicular means within ±5% of perpendicular.

[0203] The use of cross-hatching and/or shading in the accompanying drawings is generally provided to clarify boundaries between adjacent elements. As such, neither the presence nor the absence of cross-hatching or shading conveys or indicates any preference or requirement for particular materials, material properties, dimensions, proportions, commonalities between