CLAIMS

What is claimed is:

1. A device for coating an interior surface of a housing defining a volume, the device comprising:

a plurality of reactant gas sources including reactant gases for one or more surface coating processes;

a fluid flow conduit fluidically coupled to the plurality of reactant gas sources and extending from the plurality of gas sources to the volume~~;~~, wherein the fluid flow conduit is configured to deliver one or more of the reactant gases to the volume whereby the one or more surface coating processes produce one or more coating layers consisting of material deposited by chemical vapor deposition (CVD), atomic layer deposition (ALD), or both on all or a portion of an interior surface within the volume by reaction of the one or more reactant gases;

a first barrier disposed about the fluid flow conduit and dividing the fluid flow conduit into a first portion and a second portion within the volume; ~~and~~

first and second fluid flow ports disposed within the first and second portions, respectively, of the fluid flow conduit, wherein ~~the one or more of~~ the reactant gases are flowable to the interior surface proximate the first and second fluid flow ports~~.~~; and

a controller in electronic communication with the plurality of reactant gas sources and having a processor configured to control the plurality of reactant gas sources during the one or more surface coating processes such that one or more reactant gases, a plasma, or a combination thereof are introduced into the volume via the fluid flow conduit; and

the one or more coating layers are formed on all or a portion of the interior surface of the housing by reaction of the one or more reactant gases, the plasma, or the combination thereof.

2. The device of claim 1 further comprising:

a second barrier disposed about the fluid flow conduit and spaced a distance from the first barrier to form a first zone between the first and second barriers; and

a third barrier disposed about the fluid flow conduit and spaced a distance from the first barrier to form a second zone between the first and third barriers.

3. The device of claim 1 further comprising an actuator, wherein the actuator is coupled to the fluid conduit, the housing or both to translate and/or rotate the fluid conduit relative to the housing, the housing relative to the fluid conduit, or both.

4. The device of claim 1, wherein the volume has an aspect ratio that is less than or equal to about 0.5, the aspect ratio being an average width of the volume divided by an average length thereof.

5. The device of claim 2, wherein the first barrier is radially disposed about the fluid flow conduit such that the first zone and the second zone are axially spaced along fluid flow conduit, wherein the first barrier is axially disposed along a length of the fluid flow conduit such that the first zone and the second zone are radially spaced about the fluid flow conduit, or both.

6. The device of claim 2, wherein the first barrier, the second barrier, and/or the third barrier centralize the fluid flow conduit within the interior volume.

7. ~~The device of claim 1, wherein the one or more surface coating processes comprise chemical vapor deposition (CVD), atomic layer deposition (ALD), or both.~~ The device of claim 2 further comprising:

~~8. The device of claim 2 further comprising:~~

~~———~~a plasma source fluidically coupled to the fluid flow conduit to provide plasma for the one or more surface coating processes;

~~———~~an ion source fluidically coupled to the fluid flow conduit to provide ions for the one or more surface coating processes; and/or

~~———~~a heating unit in thermal communication with the housing to heat the housing for the one or more surface coating processes~~; and/or~~.

~~———a controller in electronic communication with the plurality of reactant gas sources, the plasma source, the ion source, and/or the heating unit to control the plurality of reactant gas sources, the plasma source, the ion source, and/or the heating unit during the one or more surface coating processes.~~

~~9.~~

8. The device of claim 1, wherein the device is coupled to an apparatus comprising the housing, and wherein the housing comprises production tubing, a pipeline, or a well tool.

~~10. A method of coating an interior surface of a housing defining a volume, the method comprising:~~

~~positioning the coating~~

9. The device of claim 8 ~~and the housing proximate each other;~~

~~placing the fluid flow conduit into the volume via an inlet in the housing, whereby the first barrier divides the volume into the first zone and the second zone;~~

~~introducing one or more reactant gases, a plasma, ions, or a combination thereof to the first zone and the second zone via the fluid flow conduit; and~~

~~forming one or more coating layers on all or a portion of the interior surface within the first zone and the second zone via reaction of the one or more reactant gases, the plasma, ions, or the combination thereof.~~

~~11. A method of coating an interior surface of a housing defining a volume, the method comprising:~~

~~partitioning the volume into a first zone and a second zone, the first zone isolated from fluid communication with the second zone;~~

~~introducing one or more reactant gases, plasma, ions, or a combination thereof to the first zone and the second zone; and~~

~~forming one or more coating layers on all or a portion of the interior surface within the first and second zones via reaction of the reactant gases, the plasma, or the combination thereof.~~

~~12. The method of claim 11~~, wherein the ~~reaction~~apparatus comprises a ~~chemical vapor deposition (CVD) reaction, an atomic layer deposition (ALD) reaction, or both, such that the one or more coating layers respectively comprise an ALD layer, a CVD layer, or both.~~ focused sampling well tool.

10.

~~13.~~ The ~~method~~device of claim 9, wherein the focused sampling well tool comprises a single pump, whereby fluid is pulled into the focused sampling well tool via the single pump and a common suction line.

11.~~12~~ The device of claim 1 further comprising~~:~~ a cover positioned over a part of the interior surface, wherein the cover is configured to prevent the one or more surface coating processes from being applied to the part.

~~(i) forming the ALD layer by:~~

~~introducing a first reactant gas into a reaction zone selected from the first zone and the second zone, such that at least a portion of the first reactant gas chemically bonds with the interior surface within the reaction zone to form a reactive layer; removing unreacted first reactant gas and/or gaseous byproducts from the reaction zone; and introducing a second reactant gas into the reaction zone, such that at least some of the second reactant gas bonds with the reactive layer to form the ALD layer;~~

~~(ii) forming the CVD layer by:~~

~~introducing at least a third reactant gas into the a reaction zone selected from the first zone and the second zone, such that the at least the third reactant gas chemically reacts with the interior surface within the reaction zone to form the CVD layer; or~~

~~(iii) both forming an ALD layer via (i) and a CVD layer via (ii), wherein forming both an ALD layer and a CVD layer comprises forming an ALD layer on the interior surface within the reaction zone and subsequently forming the CVD layer on the ALD layer or forming the CVD layer on the interior surface within the reaction zone and subsequently forming the ALD layer on the CVD layer.~~

~~14. The method of claim 13 further comprising performing an atomic layer etching (ALE) process to pre-treat the interior surface within the reaction zone prior to the forming of the one or more coating layers and/or to reduce a thickness of at least one of the one or more coating layers.~~

~~15. The method of claim 13 further comprising flowing a topical reagent to at least one of the one or more coating layers, wherein the topical reagent reacts with the coating layer to adjust a material characteristic of the coating layer.~~

~~16. The method of claim 11 further comprising:~~

~~introducing a first reactant gas and/or plasma into the first zone and a second reactant gas and/or plasma into the second zone; translating and/or rotating a fluid flow conduit within the volume and/or translating and/or rotating the housing about the fluid flow conduit; and introducing a third reactant gas and/or plasma into the first reaction zone and/or a fourth reactant gas and/or plasma into the second zone to form a coating layer on the interior surface within the first and second zones; and/or~~

~~subsequent to forming a coating layer, translating and/or rotating the fluid flow conduit within the volume and/or translating and/or rotating the housing about the fluid flow conduit to provide a third zone and/or a fourth zone; introducing one or more reactant gases, plasma, or a combination thereof to the third zone and/or the fourth zone; and forming one or more coating layers on all or a portion of the~~

~~interior surface within the third and/or fourth zone via reaction of the reactant gases, the plasma, or the combination thereof.~~

~~17. The method of claim 11, wherein the volume defines a fluid flow path through the housing.~~

~~18. The method of claim 11, wherein the housing comprises the well tool, wherein the well tool is a logging while drilling (LWD) tool, a measurements while drilling (MWD) tool, or a sampling while drilling (SWD) tool, and wherein the volume of the well tool define a fluid flow path for flow of a formation fluid from an exterior of the well tool through an interior of the well tool.~~

~~19. The method of claim 18 further comprising placing the well tool in a wellbore and contacting the formation fluid with the coated surface.~~

~~20. The method of claim 19, wherein the well tool is a formation sampling tool, and wherein contacting the formation fluid with the coated surface further comprises taking a formation fluid sample with the well tool.~~