~~**What is claimed is:**~~

Claims

1.~~-~~ A method, comprising:

~~positioning a substrate~~ disposing a silicon-and-oxygen-containing layer in ~~a chamber, the substrate having:~~

one or more trenches ~~comprising:~~on a ~~——~~substrate, the silicon-and-oxygen-containing layer having terminal silanol groups and the trench having:

a width of 10 nanometers (nm) or less; and

~~——~~an aspect ratio of 2:1 or greater, the aspect ratio defined by a ratio of a

depth to the width of the one or more trenches; ~~and a silicon-and-oxygen-containing layer disposed in~~ transferring the ~~one or more trenches,~~ substrate having the silicon-and-oxygen-containing layer ~~having terminal silanol groups~~thereon into a chamber;

heating the substrate in the chamber; and

exposing the silicon-and-oxygen-containing layer to an ammonia or amine group-containing ~~precursor~~catalyst distributed across a process volume~~.~~ of the chamber.

2. The method of claim 1, wherein positioning the substrate comprises:

transferring the substrate to a substrate support of the chamber; and

elevating the substrate support an elevated processing position to a process distance of about 0.25 inches to about 5 inches between the substrate support and a showerhead of the chamber.

3.~~-~~ The method of claim 1, wherein a pressure in the chamber is about 0.5 Torr to about 600 Torr.

4. The method of claim 1, wherein the ammonia or amine group-containing ~~precursor~~catalyst is introduced to the process volume at a flow rate of about 0.1 SLM to about 25 SLM.

5. The method of claim 1, wherein inert gas is introduced to the process volume at a flow rate of about 1 SLM to about 10 SLM~~, and wherein the ammonia or amine group-containing precursor comprises ammonia~~.

~~4~~6. The method of claim 1, wherein the ammonia or amine group-containing catalyst comprises ammonia.

7. The method of claim 1, further comprising transferring the substrate to an ultraviolet (UV) curing chamber and UV curing the silicon-and-oxygen-containing layer after exposing the silicon-and-oxygen-containing layer to the ammonia or amine group-containing ~~precursor.~~ catalyst.

~~5.~~

8. A method, comprising:

positioning a substrate on a substrate support in a chamber, the substrate having:

one or more trenches comprising:

a width of 10 nanometers (nm) or less; and

an aspect ratio of 2:1 or greater, the aspect ratio defined by a ratio of a depth to the width of the one or more trenches;

depositing a silicon-and-oxygen-containing layer in the one or more trenches, the silicon-and-oxygen-containing layer having terminal silanol groups;

heating the substrate support with the substrate thereon to a temperature of about ~~100~~ 10°C to about 1000 °C; and

exposing the silicon-and-oxygen-containing layer to an ammonia or amine group-containing ~~precursor~~catalyst distributed across a process volume~~.~~, the exposing comprising cross-linking adjacent terminal silanol groups to form a polymerized silicon-and-oxygen-containing layer.

~~6~~9. The method of claim ~~5~~8, wherein the depositing the silicon-and-oxygen-containing layer comprises:

introducing oxygen radicals and a silicon-containing precursor to the process volume of the chamber, the oxygen radicals polymerizing the silicon-containing precursor to deposit the silicon-and-oxygen-containing layer in the one or more trenches with the terminal silanol groups.

~~7~~10. The method of claim ~~6~~9, further comprising:

prior to the introducing the oxygen radicals and the silicon-containing precursor, elevating the substrate support a first process distance of about 0.5 inches to about 5 inches between the substrate support and a showerhead of the chamber; and

prior to the exposing the silicon-and-oxygen-containing layer to the ammonia or amine group-containing ~~precursor~~catalyst, elevating the substrate support a second process distance of about 0.25 inches to about 5 inches between the substrate support and the showerhead.

~~8~~11. The method of claim ~~7~~10, wherein the silicon-containing precursor comprises one or more of siloxanes, carbo-silanes, octamethylcyclotetrasiloxane (OMCTS), tetramethylcyclotetrasiloxane (TMCTS), octadecyltrichlorosilane (OTS), hexamethyldisiloxane (HMDSO), tetramethyldisiloxane (TMDSO), tetraethoxysilane (TEOS), bis(trimethylsilyl)methane (BTMSM), methylenebis(dimethylsilane), methylenebis(methylsilane), methylenedisilane, silane, disilane, trisilylamine, or any combination thereof.

~~9.~~ 12. The method of claim ~~5~~8, wherein a pressure in the chamber during the exposing the silicon-and-oxygen-containing layer to the ammonia or amine group-containing ~~precursor~~catalyst is about 0.5 Torr to about 50 Torr.

13. The method of claim 8, wherein the ammonia or amine group-containing ~~precursor~~catalyst is introduced to the process volume at a flow rate of about 0.1 SLM to about 25 SLM.

14. The method of claim 8, wherein inert gas is provided to the process volume at a flow rate of about 1 SLM to about 10 SLM.

~~10.~~ 15. The method of claim ~~5~~8, wherein the ammonia or amine group-containing ~~precursor~~catalyst comprises one or more of ammonia, methylamine, dimethylamine, trimethylamine, ethylamine, diethylamine, triethylamine, or any combination thereof.

~~11~~16. The method of claim ~~5~~8, wherein the one or more trenches comprise a silicon nitride layer and a titanium layer disposed therein, and wherein the silicon-and-oxygen-containing layer is formed over the silicon nitride layer and the titanium layer.

~~12~~17. The method of claim ~~5~~8, further comprising transferring the substrate to an ultraviolet (UV) curing chamber and UV curing the silicon-and-oxygen-containing layer after exposing the silicon-and-oxygen-containing layer to the ammonia or amine group-containing ~~precursor.~~ catalyst.

~~13.~~ 18. A method, comprising:

positioning a substrate on a substrate support in a first chamber, the substrate having:

one or more trenches comprising:

a width of 10 nanometers (nm) or less; and

an aspect ratio of ~~5~~2:1 or more, the aspect ratio defined by a ratio of a height to the width of the one or more trenches;

depositing a silicon-and-oxygen-containing layer, the depositing the silicon-and-oxygen-containing layer comprising:

introducing oxygen radicals and a silicon-containing precursor to a process volume of the first chamber, wherein the oxygen radicals ~~polymerizing~~and the silicon-containing precursor ~~to~~ deposit the silicon-and-oxygen-containing layer over the one or more trenches with terminal silanol groups;

removing the substrate from the first chamber and positioning the substrate in a second chamber;

heating the substrate support with the substrate thereon to a temperature of about ~~100~~ 10°C to about 1000 °C; ~~and~~

exposing the silicon-and-oxygen-containing layer to an ammonia or amine group-containing ~~precursor~~catalyst distributed across a process volume~~.~~, the exposing comprising cross-linking adjacent terminal silanol groups to form a polymerized silicon-and-oxygen-containing layer, the forming the polymerized silicon-and-oxygen-containing layer generating H_2O; and

exhausting the H_2O from the chamber.

19.

~~14.~~ The method of claim ~~13~~18, wherein the ammonia or amine group-containing ~~precursor~~catalyst comprises one or more of ammonia, methylamine, dimethylamine, trimethylamine, ethylamine, diethylamine, triethylamine, or any combination thereof.

~~15~~20. The method of claim ~~13~~18, further comprising transferring the substrate to an ultraviolet (UV) curing chamber and UV curing the silicon-and-oxygen-containing layer after exposing the silicon-and-oxygen-containing layer to the ammonia or amine group-containing ~~precursor.~~ catalyst.

21. The method of claim 1, wherein the exposing comprises cross-linking adjacent terminal silanol groups to form a polymerized silicon-and-oxygen-containing layer.