CLAIMS

What is claimed is:

1. A method for depositing silicon oxide on a substrate using thermal atomic layer deposition or thermal chemical vapor deposition, the method comprising:

a. receiving the substrate in a reaction chamber;

b. introducing a first flow of a first reactant into the reaction chamber and exposing the substrate to the first reactant, wherein the first reactant comprises a silicon-containing reactant;

c. introducing a second flow of a second reactant into the reaction chamber to cause a reaction between the first reactant and the second reactant,

i. wherein the second reactant comprises hydrogen (H_2) and an oxygen-containing reactant,

ii. wherein the reaction deposits silicon oxide on the substrate, and

iii. wherein the reaction is initiated when a pressure in the reaction chamber is greater than 10 Torr and equal to or less than about 40 Torr.

2. The method of claim 1, wherein (b) and (c) occur at different times, and the silicon oxide is deposited through thermal atomic layer deposition.

3. The method of claim 1, wherein (b) and (c) occur simultaneously, and the silicon oxide is deposited through thermal chemical vapor deposition.

4. The method of claim 1, wherein the reaction is initiated when the pressure in the reaction chamber is greater than 10 Torr and equal to or less than about 20 Torr.

5. The method of claim 1, wherein the reaction is initiated when the pressure in the reaction chamber is greater than 10 Torr and equal to or less than about 30 Torr.

6. The method of any of claim 1, wherein the hydrogen and oxygen-containing reactant flow into the reaction chamber simultaneously.

7. The method of any of claims 1-6, wherein a high-pressure limit switch is in fluidic communication with the reaction chamber, and wherein the high-pressure limit switch

is configured to trip at a maximum pressure.

8. The method of claim 7, wherein the maximum pressure is equal to or less than about 40 Torr.

9. The method of claim 7, wherein the maximum pressure is equal to or less than about 30 Torr.

10. The method of claim 7, wherein the maximum pressure is equal to or less than about 20 Torr.

11. The method of claim 7, wherein after the reaction is initiated, the pressure in the reaction chamber increases to at least the maximum pressure, thereby causing the high-pressure limit switch to trip, the method further comprising:

d. stopping or reducing the second flow of the second reactant as a result of tripping the high-pressure limit switch.

12. The method of any of claims 1-6, wherein the oxygen-containing reactant comprises a reactant selected from the group consisting of: oxygen (O_2), ozone (O_3), hydrogen peroxide (H_2O_2), water (H_2O), and combinations thereof.

13. The method of claim 12, wherein the oxygen-containing reactant comprises oxygen (O_2).

14. An apparatus for depositing silicon oxide on a substrate using thermal atomic layer deposition or thermal chemical vapor deposition, the apparatus comprising:

a. a reaction chamber;

b. an inlet configured to introduce reactants to the reaction chamber;

c. an outlet configured to remove materials from the reaction chamber;

d. a substrate support configured to support the substrate during deposition;

e. a high-pressure limit switch in fluidic communication with the reaction chamber, wherein the high-pressure limit switch is configured to trip if a pressure in the reaction chamber exceeds a maximum pressure, the maximum pressure being at least 10 Torr and equal to or less than about 40 Torr; and

f. a controller having at least one processor and a memory, wherein the at least one processor and the memory are communicatively connected with one another, and the memory stores computer-executable instructions for controlling the at least one processor to cause any of the methods of claims 1-13.

15. An apparatus for depositing silicon oxide on a substrate using thermal atomic layer deposition or thermal chemical vapor deposition, the apparatus comprising:

a. a reaction chamber;

b. an inlet configured to introduce reactants to the reaction chamber;

c. an outlet configured to remove materials from the reaction chamber;

d. a substrate support configured to support the substrate during deposition;

e. a high-pressure limit switch in fluidic communication with the reaction chamber, wherein the high-pressure limit switch is configured to trip if a pressure in the reaction chamber exceeds a maximum pressure, the maximum pressure being at least 10 Torr and equal to or less than about 40 Torr; and

f. a controller having at least one processor and a memory, wherein the at least one processor and the memory are communicatively connected with one another, and the memory stores computer-executable instructions for controlling the at least one processor to cause:

i. receiving the substrate in the reaction chamber;

ii. introducing a first flow of a first reactant into the reaction chamber and exposing the substrate to the first reactant, wherein the first reactant comprises a silicon-containing reactant;

iii. introducing a second flow of a second reactant into the reaction chamber to cause a reaction between the first reactant and the second reactant,

1. wherein the second reactant comprises hydrogen (H_2) and an oxygen-containing reactant,

2. wherein the reaction deposits silicon oxide on the substrate, and

3. wherein the reaction is initiated when a pressure in the reaction chamber is greater than 10 Torr and equal to or less than about 40 Torr.

16. The apparatus of claim 15, wherein the maximum pressure of the high-pressure limit switch is equal to or less than about 30 Torr.

17. The apparatus of claim 16, wherein the maximum pressure of the high-pressure limit switch is equal to or less than about 20 Torr.

18. The apparatus of any of claims 15-17, wherein the apparatus is configured to flow the second reactant such that the hydrogen and oxygen-containing reactant are introduced to the reaction chamber simultaneously.

19. The apparatus of any of claims 15-17, wherein the controller is configured to cause stopping or reducing the second flow of the second reactant as a result of tripping the high-pressure limit switch.