What is claimed is:

1. A method of conformally depositing a dielectric oxide in high aspect ratio gaps in a substrate, the method comprising:

(a) providing a substrate with one or more gaps into a reaction chamber, wherein each gap has a depth to width aspect ratio of greater than about 5:1;

(b) depositing a first dielectric oxide layer in the one or more gaps via conformal film deposition (CFD)~~,~~, wherein depositing the first dielectric oxide layer in the one or more gaps via CFD includes:

introducing a first reactant in vapor phase into the reaction chamber under conditions allowing the first reactant to adsorb onto the substrate surface;

introducing a second reactant in vapor phase into the reaction chamber while the first reactant is adsorbed on the substrate surface, wherein the second reactant is introduced without sweeping the first reactant out of the reaction chamber; and

exposing the substrate surface to plasma to drive a reaction between the first and the second reactants on the substrate surface to form the first dielectric oxide layer;

(c) etching a portion of the first dielectric oxide layer using a plasma etch, wherein etching the portion of the first dielectric oxide layer occurs at a faster rate near a top surface than near a bottom surface of each gap so that the first dielectric oxide layer has a tapered profile from the top surface to the bottom surface of each gap; and

(d) depositing a second dielectric oxide layer in the one or more gaps over the first dielectric oxide layer via CFD.

2. The method of claim 1, further comprising:

repeating steps (b) – (d) to substantially fill the one or more gaps.

3. The method of claim 1, wherein depositing the second dielectric oxide layer includes substantially filling the one or more gaps.

4. The method of claim 1, further comprising:

flowing a fluorine-containing species into a remote plasma to generate a plasma-activated etchant; and

flowing the plasma-activated etchant into the reaction chamber to react with the first dielectric oxide layer to perform the etch.

5. The method of claim 4, wherein the fluorine-containing species includes nitrogen trifluoride (NF_3).

6. The method of claim 4, further comprising:

flowing hydrogen (H_2) into the reaction chamber while etching the portion of the first dielectric oxide layer.

7. The method of claim 6, wherein a flow rate ratio of hydrogen to the fluorine-containing species is between about 1:1 and about 5:1.

8. The method of ~~any of claims~~claim 1~~-7~~, wherein the first dielectric oxide layer and the second dielectric oxide layer each include silicon dioxide (SiO_2).

9. The method of ~~any of claims~~claim 1~~-7~~, wherein a thickness of the first dielectric oxide layer is between about 100 Å and about 500 Å.

~~10. The method of any of claims 1-7, depositing the first dielectric oxide layer in the one or more gaps via CFD comprises:~~

~~introducing a first reactant in vapor phase into the reaction chamber under conditions allowing the first reactant to adsorb onto the substrate surface;~~

~~introducing a second reactant in vapor phase into the reaction chamber while the first reactant is adsorbed on the substrate surface, wherein the second reactant is introduced without sweeping the first reactant out of the reaction chamber; and~~

~~exposing the substrate surface to plasma to drive a reaction between the first and the second reactants on the substrate surface to form the first dielectric oxide layer.~~

~~11. A method of etching a conformally deposited layer of dielectric material in a substrate, the method comprising:~~

~~providing a substrate into a reaction chamber, wherein the substrate includes a gap lined with a conformal layer of dielectric material; and~~

~~exposing the substrate in the reaction chamber to a plasma generated from a process gas including a fluorine-containing species and hydrogen, wherein a flow rate ratio of the hydrogen to the fluorine-containing species is between about 1:1 and about 5:1.~~

~~12. The method of claim 11, wherein exposing the substrate in the reaction chamber to a plasma includes non-conformally etching the conformal layer of dielectric material.~~

~~13. The method of claim 11 or 12, wherein a temperature of the substrate in the reaction chamber is between about 400°C and about 500°C.~~

~~14. The method of claim 11 or 12, wherein a pressure in the reaction chamber is between about 5 mTorr and about 15 mTorr.~~

~~15. The method of claim 11 or 12, wherein the step coverage of the conformal layer of dielectric material is less than about 100%.~~

~~16.~~10. An apparatus for conformally depositing a dielectric oxide in high aspect ratio gaps in a substrate, the apparatus comprising:

a reaction chamber;

a plasma source coupled to the reaction chamber; and

a controller comprising instructions for performing the following operations:

(a) providing a substrate into the reaction chamber, wherein the substrate comprises one or more gaps, each gap having a depth to width aspect ratio of greater than about 5:1;

(b) depositing a first dielectric oxide layer in the one or more gaps via conformal film deposition (CFD~~);~~), wherein depositing the first dielectric oxide layer in the one or more gaps via CFD includes:

introducing a first reactant in vapor phase into the reaction chamber under conditions allowing the first reactant to adsorb onto the substrate surface;

introducing a second reactant in vapor phase into the reaction chamber while the first reactant is adsorbed on the substrate surface, wherein the second reactant is introduced without sweeping the first reactant out of the reaction chamber; and

exposing the substrate surface to plasma to drive a reaction between the first and the second reactants on the substrate surface to form the first dielectric oxide layer;

(c) etching a portion of the first dielectric oxide layer using a plasma etch, wherein etching the portion of the first dielectric oxide layer occurs at a faster rate near a top surface than near a bottom surface of each gap so that the first dielectric oxide layer has a tapered profile from the top surface to the bottom surface of each gap; and

(d) depositing a second dielectric oxide layer in the one or more gaps over the first dielectric oxide layer via CFD.

~~17.~~ 11. The apparatus of claim ~~16~~10, wherein the controller further comprises instructions to perform:

repeating steps (b) – (d) to substantially fill the one or more gaps.

~~18.~~ 12. The apparatus of claim ~~16~~10, wherein the controller comprising instructions for depositing the second dielectric oxide layer comprises instructions for substantially filling the one or more gaps.

~~19.~~ 13. The apparatus of ~~any one of claims 16-18~~ claim 10, wherein the controller further comprises instructions to perform:

flowing a fluorine-based species into the plasma source to generate a plasma-activated etchant; and

flowing the plasma-activated etchant into the reaction chamber to react with the first dielectric oxide layer to perform the etch.

~~20.~~ 14. The apparatus of claim ~~19~~13, wherein the controller further comprises instructions to perform:

flowing hydrogen (H_2) into the reaction chamber while etching the portion of the first dielectric oxide layer.