CLAIMS

What is claimed is:

1. A method comprising:

providing a substrate having carbon-based features thereon, the carbon-based features having exposed sidewall surfaces and being separated by gaps;

depositing a silicon oxide liner film in the gaps by a plasma enhanced atomic layer deposition (PEALD) process that comprises multiple cycles of (a) introducing a silicon-containing reactant into a reaction chamber having the substrate therein, and allowing the first reactant to adsorb onto substrate surfaces; (b) generating oxygen radicals from N_2O, and (c) exposing the adsorbed silicon-containing reactant to the oxygen radicals to form the silicon oxide liner film in the gaps,

wherein the substrate temperature during deposition is at least 100°C.

2. The method of claim 1, further comprising, after depositing the silicon oxide liner film in the gaps, depositing silicon oxide film in the gaps by PEALD using a reaction between the silicon-containing reactant and oxygen (O_2).

3. The method of claim 1, further comprising at least partially filling the gaps with silicon oxide by PEALD using a reaction between the silicon-containing reactant and N_2O.

4. The method of claim 1, wherein the substrate temperature during deposition is at least 150°C.

5. The method of claim 1, wherein the substrate temperature during deposition is at least 200°C.

6. The method of claim 1, further comprising, during PEALD deposition, periodically exposing the substrate to an inhibition plasma.

7. The method of claim 6, wherein the inhibition plasma is generated from an inhibition gas generated from one of a fluorine-containing compound, molecular nitrogen (N_2), argon (Ar), helium (He), molecular hydrogen (H_2), ammonia (NH_3), an amine, a diol, an aminoalcohol, a thiol or a combination thereof.

8. The method of claim 1, wherein the silicon-containing reactant is an aminosilane.

9. The method of claim 8, wherein the aminosilane has two or more amine groups attached to the central silicon atom.

10. A method comprising:

(a) providing a substrate having carbon-based features thereon, the carbon-based features having exposed sidewall surfaces and being separated by gaps;

(b) performing multiple cycles of a (i) introducing a silicon-containing reactant into a reaction chamber having the substrate therein and allowing the first reactant to adsorb onto substrate surfaces, (ii) generating oxygen radicals from N_2O, and (iii) exposing the adsorbed silicon-containing reactant to the oxygen radicals to form a silicon oxide liner film in the gaps;

(c) after (b) exposing the gaps to an inhibition plasma.

11. The method of claim 10, further comprising (d) after (c), filling the gap with a silicon oxide film.

12. The method of claim 11, wherein (d) comprises using a plasma generated from oxygen (O_2) as an oxidant.

13. The method of claim 12, wherein (d) comprises using a plasma generated from N_2O and O_2 as an oxidant.

14. The method of claim 11, wherein (d) is performed at a different substrate temperature than (b).

15. The method of claim 11, wherein (d) is performed at the same substrate temperature as (b).

16. The method of claim 10, further comprising after (c), repeating (b).

17. The method of claim 10, further comprising after (c), repeating (b) and (c) one or more times.

18. The method of claim 10, wherein the substrate temperature throughout the process is at least 100°C.

19. The method of claim 10, wherein the substrate temperature throughout the process is at least 150°C.

20. The method of claim 10, wherein the substrate temperature throughout the process is at least 200°C.