CLAIMS

1. A semiconductor processing method comprising:

providing a silicon-containing precursor and an oxygen-containing precursor to a processing region of a semiconductor processing chamber, wherein a substrate is disposed within the processing region of the semiconductor processing chamber;

providing a carbon-containing precursor to the processing region of the semiconductor processing chamber, wherein the carbon-containing precursor is characterized by a carbon-carbon double bond or a carbon-carbon triple bond;

thermally reacting the silicon-containing precursor, the oxygen-containing precursor, and the carbon-containing precursor at a temperature below 650° C; and

forming a silicon-and-oxygen-and-carbon-containing layer on the substrate.

2. The semiconductor processing method of claim 1, wherein the processing region of the semiconductor processing chamber is maintained plasma-free while forming the silicon-and-oxygen-and-carbon-containing layer on the substrate.

3. The semiconductor processing method of claim 1, wherein the silicon-and-oxygen-and-carbon-containing layer consists essentially of silicon, oxygen, carbon, and hydrogen.

4. The semiconductor processing method of claim 1, wherein the substrate is characterized by one or more features, and wherein the silicon-and-oxygen-and-carbon-containing layer is formed about the one or more features with a conformality of greater than or equal to 90%.

5. The semiconductor processing method of claim 1, wherein thermally reacting the silicon-containing precursor, the oxygen-containing precursor, and the carbon-containing precursor is performed at a temperature below or equal to 500° C.

6. The semiconductor processing method of claim 1, wherein the silicon-and-oxygen-and-carbon-containing layer is characterized by a carbon concentration of greater than or equal to 20%, and wherein the silicon-and-oxygen-and-carbon-containing layer is characterized by a root-mean-square roughness of less than or equal to 0.4 nm.

7. The semiconductor processing method of claim 6, wherein the silicon-and-oxygen-and-carbon-containing layer is characterized by a leakage current density at an electric field of 2 MV/cm of less than or equal to 5E-9 A/cm^2.

8. The semiconductor processing method of claim 1, further comprising:

exposing the silicon-and-oxygen-and-carbon-containing film to an anneal at a temperature of greater than or equal to 750° C.

9. The semiconductor processing method of claim 8, wherein, subsequent to the anneal, the silicon-and-oxygen-and-carbon-containing layer maintains a dielectric constant of less than or equal to 4.2.

10. The semiconductor processing method of claim 1, wherein the carbon-containing precursor is provided at a flow rate ratio to the silicon-containing precursor of greater than or equal to 2:1.

11. The semiconductor processing method of claim 10, wherein the oxygen-containing precursor is provided at a flow rate ratio to the carbon-containing precursor of greater than or equal to 10:1.

12. A semiconductor processing method comprising:

providing a silicon-containing precursor and an oxygen-containing precursor to a processing region of a semiconductor processing chamber, wherein a substrate is disposed within the processing region of the semiconductor processing chamber;

providing a hydrocarbon to the processing region of the semiconductor processing chamber, wherein the hydrocarbon is characterized by a carbon-carbon double bond or a carbon-carbon triple bond;

thermally reacting the silicon-containing precursor, the oxygen-containing precursor, and the hydrocarbon at a temperature between 400° C and 600° C; and

forming a silicon-and-oxygen-and-carbon-containing layer on the substrate.

13. The semiconductor processing method of claim 12, wherein the processing region of the semiconductor processing chamber is maintained plasma-free during the semiconductor processing method.

14. The semiconductor processing method of claim 12, further comprising:

exposing the silicon-and-oxygen-and-carbon-containing film to an anneal at a temperature of greater than or equal to 750° C.

15. The semiconductor processing method of claim 14, wherein, subsequent to the anneal, the silicon-and-oxygen-and-carbon-containing layer maintains a dielectric constant of less than or equal to 4.2.

16. The semiconductor processing method of claim 12, wherein the hydrocarbon is provided at a flow rate ratio to the silicon-containing precursor of greater than or equal to 2:1.

17. The semiconductor processing method of claim 12, wherein the substrate is characterized by one or more features, and wherein the silicon-and-oxygen-and-carbon-containing layer is formed about the one or more features with a conformality of greater than or equal to 90%.

18. A semiconductor processing method comprising:

providing a silicon-containing precursor and an oxygen-containing precursor to a processing region of a semiconductor processing chamber, wherein a substrate is disposed within the processing region of the semiconductor processing chamber, and wherein the oxygen-containing precursor is provided at a flow rate ratio to the silicon-containing precursor of greater than or equal to 10:1;

providing a carbon-containing precursor to the processing region of the semiconductor processing chamber, wherein the carbon-containing precursor is characterized by a carbon-carbon double bond or a carbon-carbon triple bond;

thermally reacting the silicon-containing precursor, the oxygen-containing precursor, and the carbon-containing precursor at a temperature below 600° C; and

forming a silicon-and-oxygen-and-carbon-containing layer on the substrate, wherein the silicon-and-oxygen-and-carbon-containing layer consists essentially of silicon, oxygen, carbon, and hydrogen.

19. The semiconductor processing method of claim 18, wherein the processing region of the semiconductor processing chamber is maintained plasma-free while forming the silicon-and-oxygen-and-carbon-containing layer on the substrate.

20. The semiconductor processing method of claim 18, wherein the silicon-and-oxygen-and-carbon-containing layer is characterized by a thickness conformality of greater than or equal to 90%.