CLAIMS

1. A method for depositing a silicon-containing film in a flowable chemical vapor deposition process, the method comprising:

placing a substrate comprising a surface feature into a reactor which is at one or more temperatures ranging from -20 ^{o}C to 200 °C;

introducing into the reactor a precursor compound having the formula R_nSiH_{4-n} wherein R is independently selected from a linear or branched C_2 to C_6 alkyl or a C_6-C_{10} aryl group and n is a number selected from 1, 2, and 3; and

providing a plasma source into the reactor to at least partially react the compound to form a flowable liquid or oligomer wherein the flowable liquid or oligomer at least partially fills a portion of the surface feature and forms a first film.

2. The method of claim 1 wherein the plasma source in the providing step comprises at least one plasma source selected from the group consisting of nitrogen plasma, a plasma comprising nitrogen and hydrogen, a plasma comprising nitrogen and helium, a plasma comprising nitrogen and argon, ammonia plasma, a plasma comprising ammonia and helium, a plasma comprising ammonia and argon, a plasma comprising ammonia and nitrogen, organic amine plasma, and mixtures thereof.

3. The method of claim 1 wherein the plasma source in the providing step comprises at least one plasma source selected from the group consisting of a carbon source plasma, a hydrocarbon plasma, a plasma comprising hydrocarbon and helium, a plasma comprising hydrocarbon and argon, carbon dioxide plasma, carbon monoxide plasma, a plasma comprising hydrocarbon and hydrogen, a plasma comprising hydrocarbon and a nitrogen source, a plasma comprising hydrocarbon and an oxygen source, and mixtures thereof.

4. The method of claim 1 wherein the plasma source in the providing step comprises at least one plasma source selected from the group consisting of hydrogen plasma, helium plasma, argon plasma, xenon plasma, and mixtures thereof.

5. The method of claim 1 wherein the plasma source in the providing step comprises at least one plasma source selected from the group consisting of water (H_2O) plasma, oxygen plasma, ozone (O_3) plasma, NO plasma, N_2O plasma, carbon monoxide (CO) plasma, carbon dioxide (CO_2) plasma and combinations thereof.

6. The method of claim 1 further comprising performing a thermal treatment at one or more temperatures ranging from 100 ^oC to 1000 ^oC to densify the first film.

7. The method of claim 6 further comprising exposing the densified first film to at least one further treatment selected from the group consisting of a plasma, infrared light, a chemical treatment, an electron beam, and UV light to further densify the densified first film.

8. The method of claim 1 wherein the plasma source is generated *in situ*.

9. The method of claim 1 wherein the plasma source is generated remotely.

10. The method of claim 1 wherein a pressure of the reactor is maintained at 100 torr or less.

11. The method of claim 1 wherein the silicon-containing film is selected from the group consisting of silicon carbide, silicon oxide, carbon doped silicon nitride, carbon doped silicon oxide, and carbon doped silicon oxynitride film.

12. The method of claim 1 where the precursor compound is select from the group consisting of ethylsilane, diethylsilane, triethylsilane, isopropyldimethylsilane, isopropyldiethylsilane, phenyldiethylsilane, and benzyldiethylsilane.

13. The method of claim 1 where the precursor compound is triethylsilane.

14. A chemical precursor for forming a silicon containing film having the formula R_nSiH_{4-n} wherein R is independently selected from a linear or branched C_2 to C_6 alkyl or a C_6-C_{10} aryl group and n is a number selected from 1, 2, 3, wherein any impurities of halide ions or metal ions, selected from the group consisting of Al^{3+} ions, Fe^{2+} ions, Fe^{3+} ions, Ni^{2+} ions, and Cr^{3+} ions, are present at a concentration of less than 5 ppm by weight.

15. A film obtained by the method of Claim 1.