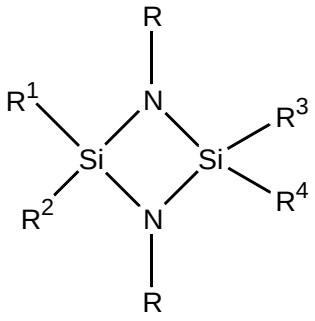
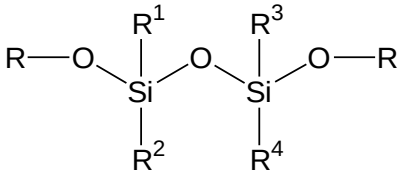
CLAIMS

1. A composition for depositing a silicon-containing film on at least a substrate comprising a surface feature using flowable chemical vapor deposition, the composition comprising:

a compound selected from Formulae I or II below:



I



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wherein R is selected from a branched C_4 to C_{10} alkyl group and R^1, R^2, R^3, R^4 are each independently selected from a hydrogen atom, a linear C_1 to C_{10} alkyl group, a branched C_3 to C_{10} alkyl group, a linear or branched C_2 to C_6 alkenyl group, a linear or branched C_2 to C_6 alkynyl group, a C_1 to C_6 dialkylamino group, a C_6 to C_{10} aryl group, an electron withdrawing group, a C_3 to C_{10} cyclic alkyl group, and a halide atom,

wherein the compound is substantially free of aluminum ion, iron ion, nickel ion and chromium ion.

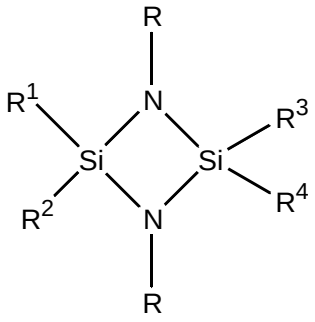
2. The composition of claim 1 which further comprises at least one solvent selected from the group consisting of ether, organic amine, alkyl hydrocarbon, aromatic hydrocarbon, and tertiary aminoether.

3. The composition of claim 1 which further comprises at least one solvent selected from the group consisting of octane, ethylcyclohexane, cyclooctane, and toluene.

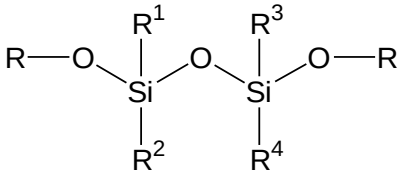
4. A method for depositing a film selected from a silicon oxide and a carbon doped silicon oxide film using flowable chemical vapor deposition, the method comprising:

placing a substrate comprising a surface feature into a reactor wherein the substrate is maintained at one or more temperatures ranging from about -20°C to about 400°C and a pressure of the reactor is maintained at 100 torr or less;

introducing at least one compound selected from the group consisting of Formulae I or II below:



I



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wherein R is selected from a branched C_4 to C_{10} alkyl group and R^1, R^2, R^3, R^4 are each independently selected from a hydrogen atom, a linear C_1 to C_{10} alkyl group, a branched C_3 to C_{10} alkyl group, a linear or branched C_2 to C_6 alkenyl group, a linear or branched C_2 to C_6 alkynyl group, a C_1 to C_6 dialkylamino group, a C_6 to C_{10} aryl group, an electron withdrawing

group, a C_3 to C_{10} cyclic alkyl group, and a halide atom and wherein the at least one compound forms a species that covers at least a portion of the surface feature; and

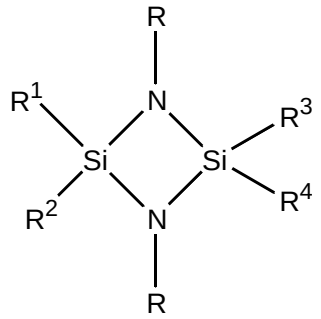
treating the species with an oxygen source at one or more temperatures ranging from about 500°C to about 1000°C to form the film on at least a portion of the surface feature.

5. The method of claim 4 wherein the oxygen source is selected from the group consisting of water (H_2O), oxygen (O_2), oxygen plasma, ozone (O_3), NO, N_2O, carbon monoxide (CO), carbon dioxide (CO_2), N_2O plasma, carbon monoxide (CO) plasma, carbon dioxide (CO_2) plasma, and combinations thereof.

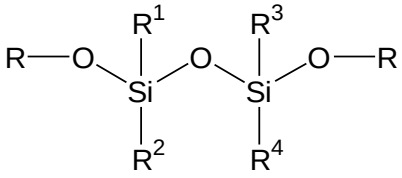
6. A method for depositing a film selected from a silicon oxide and a carbon doped silicon oxide film in a deposition process, the method comprising:

placing a substrate having a surface feature into a reactor which are maintained at one or more temperatures ranging from about -20°C to about 400°C;

introducing into the reactor at least one compound selected from the group consisting of Formulae I or II below:



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wherein R is selected from a branched C_4 to C_{10} alkyl group and R^1, R^2, R^3, R^4 are each independently selected from a hydrogen atom, a linear C_1 to C_{10} alkyl group, a branched C_3 to C_{10} alkyl group, a linear or branched C_2 to C_6 alkenyl group, a linear or branched C_2 to C_6 alkynyl group, a C_1 to C_6 dialkylamino group, a C_6 to C_{10} aryl group, an electron withdrawing group, a C_4 to C_{10} aryl group, and a halide atom and a nitrogen source wherein the at least one compound reacts with the nitrogen source to form a nitride containing film on at least a portion of the surface feature; and

treating the substrate with an oxygen source at one or more temperatures ranging from about 100°C to about 1000°C to form the silicon oxide film on at least a portion of the surface feature to provide the film.

7. The method of claim 6 wherein the nitrogen source is selected from the group consisting of ammonia, hydrazine, monoalkylhydrazine, dialkylhydrazine, nitrogen, 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, NF_3, NF_3 plasma, organic amine plasma, and mixtures thereof.

8. The method of claim 6 wherein the deposition process is a plasma enhanced chemical vapor deposition and the plasma is generated *in situ*.

9. The method of claim 8 wherein the deposition process is a plasma enhanced chemical vapor deposition and the plasma is generated remotely.

10. The method of claim 6 wherein the oxygen source is selected from the group consisting of water (H_2O), oxygen (O_2), oxygen plasma, ozone (O_3), NO, N_2O, carbon monoxide (CO), carbon dioxide (CO_2), N_2O plasma, carbon monoxide (CO) plasma, carbon dioxide (CO_2) plasma, and combinations thereof.

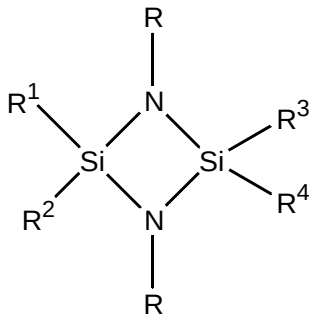
11. The method of claim 6 wherein the film has a wet etch rate and the wet etch rate is less than 2.2 times that of a thermal oxide film in dilute HF.

12. The method of claim 6 further comprising: treating the film with at least one selected from plasma, ultraviolet light, infrared light, or combinations thereof.

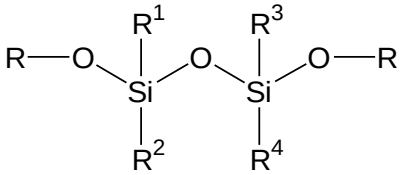
13. A method for depositing a silicon-containing film using flowable chemical vapor deposition, the method comprising:

placing a substrate comprising a surface feature into a reactor wherein the substrate is maintained at one or more temperatures ranging from about -20°C to about 400°C and a pressure of the reactor is maintained at 100 torr or less;

introducing at least one compound selected from the group consisting of Formulae I or II below:



I



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wherein R is selected from a branched C_4 to C_{10} alkyl group and R^1, R^2, R^3, R^4 are each independently selected from a hydrogen atom, a linear C_1 to C_{10} alkyl group, a branched C_3

to C_{10} alkyl group, a linear or branched C_2 to C_6 alkenyl group, a linear or branched C_2 to C_6 alkynyl group, a C_1 to C_6 dialkylamino group, a C_6 to C_{10} aryl group, an electron withdrawing group, a C_3 to C_{10} cyclic alkyl group, and a halide atom and wherein the at least one compound forms a species that covers at least a portion of the surface feature; and

treating the species with a plasma source at one or more temperatures ranging from about 100^{o}C to about 1000^{o}C to form the film on at least a portion of the surface feature.

14. The method of claim 13 wherein the plasma source is selected from the group consisting of a nitrogen plasma; plasma comprising nitrogen and helium; a plasma comprising nitrogen and argon; an ammonia plasma; a plasma comprising ammonia and helium; a plasma comprising ammonia and argon; helium plasma; argon plasma; hydrogen plasma; a plasma comprising hydrogen and helium; a plasma comprising hydrogen and argon; a plasma comprising ammonia and hydrogen; an organic amine plasma; and mixtures thereof.

15. The method of claim 13 wherein the silicon-containing film is selected from the group consisting of silicon nitride, carbon doped silicon nitride, silicon oxynitride, and carbon doped silicon oxynitride film.

16. The composition of claim 1 wherein the compound comprises 1,3-bis(tert-butyl)-2-methylcyclodisilazane.

17. The composition of claim 1 wherein the compound comprises 1,3-bis(tert-butoxy)-1,3-dimethyldisiloxane.

18. A silicon containing film formed by the method of claim 13 wherein the film has no voids in or on the surface feature, further wherein the film has a wet etch rate that is less than 2.2 times that of a thermal oxide film in dilute HF.