CLAIMS

1. A composition for depositing a film comprising silicon and oxide onto a substrate comprising at least one organoamino-polysiloxane compound selected from the group consisting of Formulae A, B, C, D, E, F, G, H, and Structure I:

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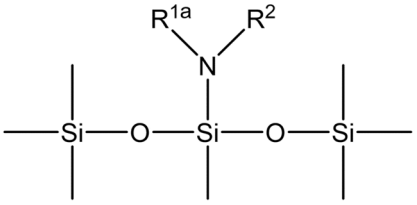
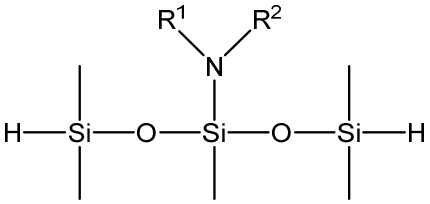


A



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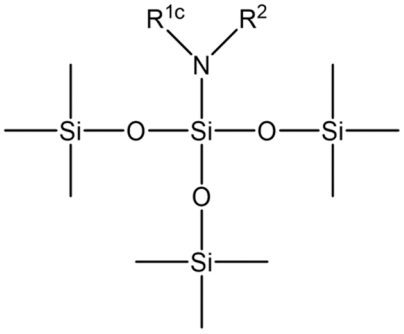

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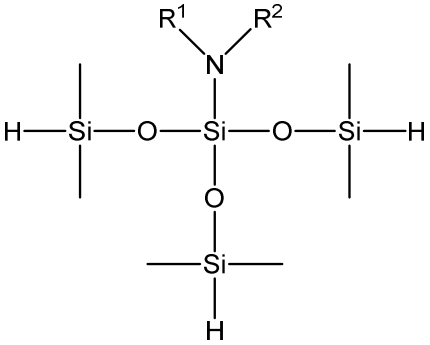

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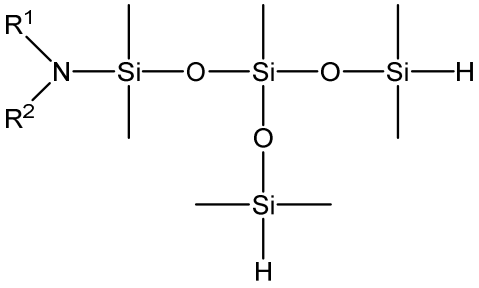

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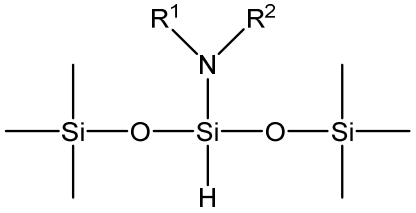

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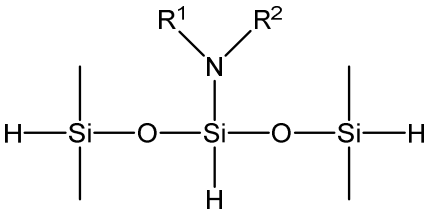

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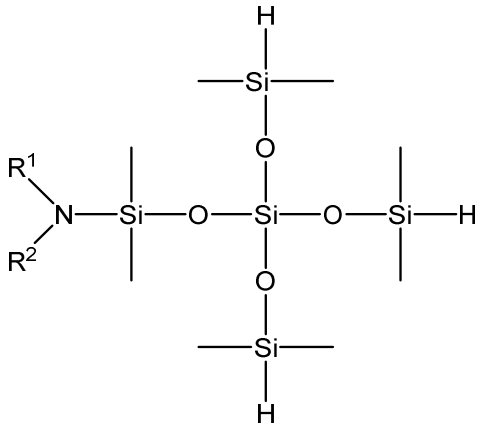

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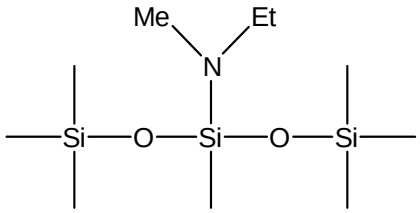


Structure I

wherein

R^1 is selected from a linear C_1 to C_{10} alkyl group, a branched C_3 to C_{10} alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_3 to C_{10} heterocyclic group, a C_3 to C_{10} alkenyl group, a C_3 to C_{10} alkynyl group, and a C_4 to C_{10} aryl group;

R^{1a} is selected from a linear C_3 alkyl group, a linear C_5 to C_{10} alkyl group, a branched C_3 to C_{10} alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_3 to C_{10} heterocyclic group, a C_3 to C_{10} alkenyl group, a C_3 to C_{10} alkynyl group, and a C_4 to C_{10} aryl group;

R^{1c} is selected from a linear C_1 to C_3 alkyl group, a linear C_5 to C_{10} alkyl group, a branched C_3 to C_{10} alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_3 to C_{10} heterocyclic group, a C_3 to C_{10} alkenyl group, a C_3 to C_{10} alkynyl group, and a C_4 to C_{10} aryl group; and

R^2 is selected from the group consisting of hydrogen, a C_1 to C_{10} linear alkyl group, a branched C_3 to C_{10} alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_3 to C_{10} heterocyclic group, a C_3 to C_{10} alkenyl group, a C_3 to C_{10} alkynyl group, and a C_4 to C_{10} aryl group,

wherein R^1 and R^2 in Formulae B, D-H are either linked to form a cyclic ring structure or are not linked to form a cyclic ring structure,

wherein R^{1a} and R^2 in Formula A are not linked to form a cyclic ring structure,

and wherein R^{1c} and R^2 in Formula C are either linked to form a cyclic ring structure or are not linked to form a cyclic ring structure.

2. The composition of claim 1 comprising at least one compound selected from the group consisting of Formula A and Formula C.

3. The composition of claim 1 further comprising at least one member selected from the group consisting of a solvent and a purge gas.

4. The composition of claim 3 wherein the solvent is selected from the group consisting of hexamethyldisiloxane and octamethyltrisiloxane.

5. The composition of claim 3 wherein the solvent is selected from the group consisting of hexane, heptane, octane, nonane, decane, dodecane, cyclooctane, cyclononane, cyclodecane, ethylcyclohexane, and ethylcyclooctane.

6. The composition of claim 1 wherein R^1 and R^2 are each a C_1 to C_4 alkyl group.

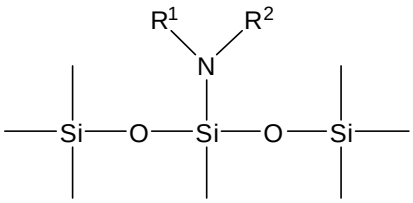
7. The composition of claim 1 wherein the composition is substantially free of one or more impurities selected from the group consisting of a halide, metal ions, metal, and combinations thereof.

8. The composition of claim 1 wherein the organoamino-polysiloxane compound is selected from the group consisting of 3-ethylmethylamino-1,1,1,3,5,5,5-heptamethyltrisiloxane, 3-di-iso-propylamino-1,1,1,3,5,5,5-heptamethyltrisiloxane, 3-dimethylamino-1,1,3,5,5-pentamethyltrisiloxane, 3-diethylamino-1,1,3,5,5-pentamethyltrisiloxane, 3-ethylmethylamino-1,1,3,5,5-pentamethyltrisiloxane, 3-di-iso-propylamino-1,1,3,5,5-pentamethyltrisiloxane, 3-dimethylamino-3-(trimethylsiloxy)-1,1,1,5,5,5-hexamethyltrisiloxane, 3-diethylamino-3-(trimethylsiloxy)-1,1,1,5,5,5-hexamethyltrisiloxane, 3-ethylmethylamino-3-(trimethylsiloxy)-1,1,1,5,5,5-heptamethyltrisiloxane, 3-di-iso-propylaminoo-3-(trimethylsiloxy)-1,1,1,5,5,5-hexamethyltrisiloxane, 3-dimethylamino-3-(dimethylsiloxy)-1,1,5,5-tetramethyltrisiloxane, 3-diethylamino-3-(dimethylsiloxy)-1,1,5,5-tetramethyltrisiloxane, 3-ethylmethylamino-3-(dimethylsiloxy)-1,1,5,5-tetramethyltrisiloxane, 3-di-iso-propylamino-3-(dimethylsiloxy)-1,1,5,5-tetramethyltrisiloxane, 1-dimethylamino-3-(dimethylsiloxy)-1,1,3,5,5-pentamethyltrisiloxane, 1-diethylamino-3-(dimethylsiloxy)-1,1,3,5,5-pentamethyltrisiloxane, 1-ethylmethylamino-3-(dimethylsiloxy)-1,1,3,5,5-pentamethyltrisiloxane, 1-di-iso-propylamino-3-(dimethylsiloxy)-1,1,3,5,5-pentamethyltrisiloxane, 3-dimethylamino-1,1,1,5,5,5-hexamethyltrisiloxane, 3-diethylamino-1,1,1,5,5,5-hexamethyltrisiloxane, 3-ethylmethylamino-1,1,1,5,5,5-hexamethyltrisiloxane, 3-di-iso-propylamino-1,1,1,3,5,5,5-hexamethyltrisiloxane, 3-dimethylamino-1,1,5,5-tetramethyltrisiloxane, 3-diethylamino-

1,1,5,5-tetramethyltrisiloxane, 3-ethylmethylamino-1,1,5,5-tetraamethyltrisiloxane, 3-di-iso-propylamino-1,1,5,5-tetramethyltrisiloxane, 1-dimethylamino-3,3-bis(dimethylsiloxy)-1,1,5,5-tetramethyltrisiloxane, 1-diethylamino-3,3-bis(dimethylsiloxy)-1,1,5,5-tetramethyltrisiloxane, 1-ethylmethylamino-3,3-bis(dimethylsiloxy)-1,1,5,5-tetramethyltrisiloxane, and 1-di-iso-propylamino-3,3-bis(dimethylsiloxy)-1,1,5,5-tetramethyltrisiloxane, 3-methylamino-1,1,1,3,5,5,5-heptamethyltrisiloxane, 3-ethylamino-1,1,1,3,5,5,5-heptamethyltrisiloxane, 3-iso-propylamino-1,1,1,3,5,5,5-heptamethyltrisiloxane, 3-tert-butylamino-1,1,1,3,5,5,5-heptamethyltrisiloxane, 3-methylamino-3-(trimethylsiloxy)-1,1,1,5,5,5-hexamethyltrisiloxane, 3-ethylamino-3-(trimethylsiloxy)-1,1,1,5,5,5-hexamethyltrisiloxane, 3-iso-propylamino-3-(trimethylsiloxy)-1,1,1,5,5,5-hexamethyltrisiloxane, 3-tert-butylmino-3-(trimethylsiloxy)-1,1,1,5,5,5-hexamethyltrisiloxane.

9. A method for depositing a film comprising silicon and oxide onto a substrate, the method comprising the steps of:

a) providing a substrate in a reactor;
b) introducing into the reactor a composition comprising at least one organoamino-polysiloxane compound selected from the group consisting of Formulae A, B, C, D, E, F, G, and H:



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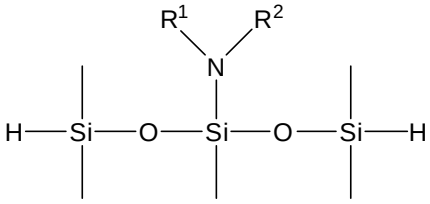

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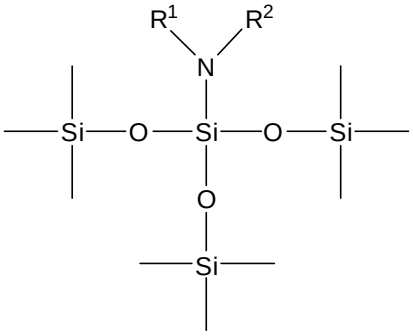

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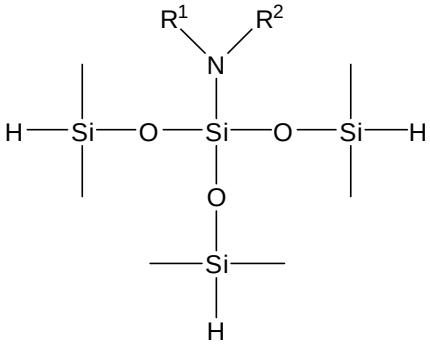

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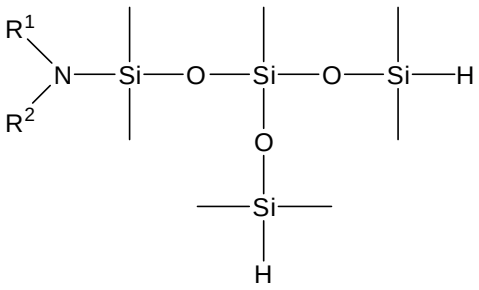

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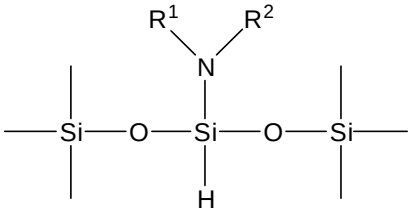

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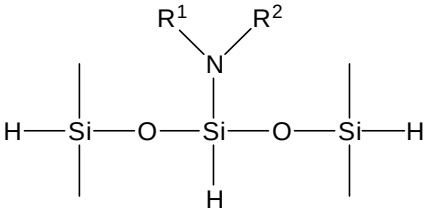

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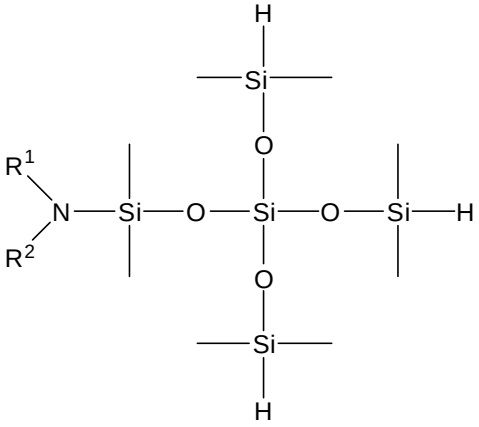

H

wherein

R^1 is selected from a linear C_1 to C_{10} alkyl group, a branched C_3 to C_{10} alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_3 to C_{10} heterocyclic group, a C_3 to C_{10} alkenyl group, a C_3 to C_{10} alkynyl group, and a C_4 to C_{10} aryl group; and

R^2 is selected from the group consisting of hydrogen, a C_1 to C_{10} linear alkyl group, a branched C_3 to C_{10} alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_3 to C_{10} heterocyclic group, a C_3 to C_{10} alkenyl group, a C_3 to C_{10} alkynyl group, and a C_4 to C_{10} aryl group,

wherein R^1 and R^2 in Formulae A-H are either linked to form a cyclic ring structure or are not linked to form a cyclic ring;

c) purging the reactor with a purge gas;

d) introducing at least one of an oxygen-containing source and a nitrogen-containing source into the reactor; and

e) purging the reactor with the purge gas,

wherein the steps b through e are repeated until a desired thickness of film is deposited; and wherein the method is conducted at one or more temperatures ranging from about 25°C to 600°C.

10. The method of claim 9 wherein the organoamino-polysiloxane compound is selected from the group consisting of 3-dimethylamino-1,1,1,3,5,5,5-heptamethyltrisiloxane, 3-diethylamino-1,1,1,3,5,5,5-heptamethyltrisiloxane, 3-ethylmethylamino-1,1,1,3,5,5,5-heptamethyltrisiloxane, 3-di-iso-propylamino-1,1,1,3,5,5,5-heptamethyltrisiloxane, 3-dimethylamino-1,1,3,5,5-pentamethyltrisiloxane, 3-diethylamino-1,1,3,5,5-pentamethyltrisiloxane, 3-ethylmethylamino-1,1,3,5,5-pentamethyltrisiloxane, 3-di-iso-propylamino-1,1,3,5,5-pentamethyltrisiloxane, 3-dimethylamino-3-(trimethylsiloxy)-1,1,1,5,5,5-hexamethyltrisiloxane, 3-diethylamino-3-(trimethylsiloxy)-1,1,1,5,5,5-hexamethyltrisiloxane, 3-ethylmethylamino-3-(trimethylsiloxy)-1,1,1,5,5,5-heptamethyltrisiloxane, 3-di-iso-propylaminoo-3-(trimethylsiloxy)-1,1,1,5,5,5-hexamethyltrisiloxane, 3-dimethylamino-3-(dimethylsiloxy)-1,1,5,5-tetramethyltrisiloxane, 3-diethylamino-3-(dimethylsiloxy)-1,1,5,5-tetramethyltrisiloxane, 3-ethylmethylamino-3-(dimethylsiloxy)-1,1,5,5-tetramethyltrisiloxane, 3-di-iso-propylamino-3-(dimethylsiloxy)-1,1,5,5-tetramethyltrisiloxane, 1-dimethylamino-3-(dimethylsiloxy)-1,1,3,5,5-pentamethyltrisiloxane, 1-diethylamino-3-(dimethylsiloxy)-1,1,3,5,5-pentamethyltrisiloxane,

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11. The method of claim 9 wherein the composition further comprises at least one member selected from the group consisting of a solvent and a purge gas.

12. The method of claim 11 wherein the solvent is selected from the group consisting of hexamethyldisiloxane and octamethyltrisiloxane.

13. The method of claim 11 wherein the solvent is selected from the group consisting of hexane, heptane, octane, nonane, decane, dodecane, cyclooctane, cyclononane, cyclodecane, ethylcyclohexane, and ethylcyclooctane.

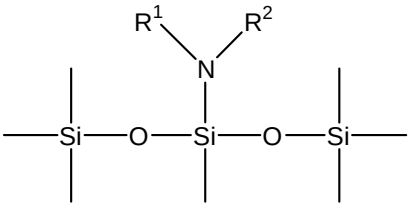
14. The method of claim 9 wherein R^1 and R^2 are each a C_1 to C_4 alkyl group.

15. The method of claim 8 wherein the composition is substantially free of one or more impurities selected from the group consisting of a halide, metal ions, metal, and combinations thereof.

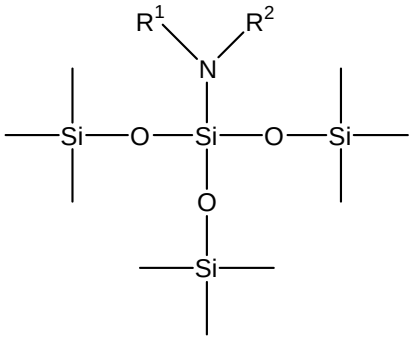
16. A method for depositing a film comprising silicon and oxide onto a substrate, the method comprises the steps of:

a) providing a substrate in a reactor;

b) introducing into the reactor a composition comprising at least one organoamino-polysiloxane compound selected from the group consisting of Formula A and Formula C:



A



C

wherein

R^1 is independently selected from a linear C_1 to C_{10} alkyl group, a branched C_3 to C_{10} alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_3 to C_{10} heterocyclic group, a C_3 to C_{10} alkenyl group, a C_3 to C_{10} alkynyl group, and a C_4 to C_{10} aryl group; and

R^2 is selected from the group consisting of hydrogen, a C_1 to C_{10} linear alkyl group, a branched C_3 to C_{10} alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_3 to C_{10} heterocyclic group, a C_3 to C_{10} alkenyl group, a C_3 to C_{10} alkynyl group, and a C_4 to C_{10} aryl group,

wherein R^1 and R^2 in Formula A and Formula C are either linked to form a cyclic ring structure or are not linked to form a cyclic ring;

c) purging the reactor with a purge gas;

d) introducing at least one of an oxygen-containing source and a nitrogen-containing source into the reactor; and

e) purging the reactor with the purge gas,

wherein the steps b through e are repeated until a desired thickness of film is deposited; and wherein the method is conducted at one or more temperatures ranging from about 600°C to 800°C.

17. The method of claim 16 wherein the organoamino-polysiloxane compound is selected from the group 3-dimethylamino-1,1,1,3,5,5,5-heptamethyltrisiloxane, 3-diethylamino-1,1,1,3,5,5,5-heptamethyltrisiloxane, 3-ethylmethylamino-1,1,1,3,5,5,5-heptamethyltrisiloxane, 3-di-iso-propylamino-1,1,1,3,5,5,5-heptamethyltrisiloxane, 3-dimethylamino-1,1,3,5,5-pentamethyltrisiloxane, 3-diethylamino-1,1,3,5,5-pentamethyltrisiloxane, 3-ethylmethylamino-1,1,3,5,5-pentamethyltrisiloxane, 3-di-iso-propylamino-1,1,3,5,5-pentamethyltrisiloxane, 3-dimethylamino-3-(trimethylsiloxy)-1,1,1,5,5,5-hexamethyltrisiloxane, 3-diethylamino-3-(trimethylsiloxy)-1,1,1,5,5,5-hexamethyltrisiloxane, 3-ethylmethylamino-3-(trimethylsiloxy)-1,1,1,5,5,5-heptamethyltrisiloxane, and 3-di-iso-propylaminoo-3-(trimethylsiloxy)-1,1,1,5,5,5-hexamethyltrisiloxane.

18. The method of claim 16 wherein the composition further comprises at least one member selected from the group consisting of a solvent and a purge gas.

19. The method of claim 18 wherein the solvent is selected from the group consisting of hexamethyldisiloxane and octamethyltrisiloxane.

20. The method of claim 18 wherein the solvent is selected from the group consisting of hexane, heptane, octane, nonane, decane, dodecane, cyclooctane, cyclononane, cyclodecane, ethylcyclohexane, and ethylcyclooctane.

21. The method of claim 16 wherein R^1 and R^2 are each a C_1 to C_4 alkyl group.

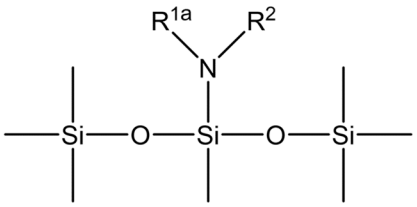
22. The method of claim 16 wherein the composition is substantially free of one or more impurities selected from the group consisting of a halide, metal ions, metal, and combinations thereof.

23. A silicon and oxygen containing film formed by the method of claim 9 comprising at least one of the following characteristics: a density of at least about 2.1 g/cc; a wet etch rate that is less than about 2.5 Å/s as measured in a solution of 1:100 of HF to water dilute HF (

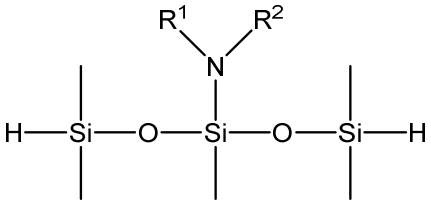
0.5 wt% dHF) acid; an electrical leakage of less than about 1 e-8 A/cm^2 up to 6 MV/cm; and a hydrogen impurity of less than about 5 e20 at/cc as measured by Secondary Ion Mass Spectrometry (SIMS), wherein the film comprises a reaction product of at least one organoamino-polysiloxane compound selected from the group consisting of Formulae A, B, C, D, E, F, G, and H; and at least one of an oxygen-containing source and a nitrogen-containing source.

24. A silicon and oxygen containing film formed by the method of claim 16 comprising at least one of the following characteristics: a density of at least about 2.1 g/cc; a wet etch rate that is less than about 2.5 Å/s as measured in a solution of 1:100 of HF to water dilute HF (0.5 wt% dHF) acid; an electrical leakage of less than about 1 e-8 A/cm^2 up to 6 MV/cm; and a hydrogen impurity of less than about 5 e20 at/cc as measured by Secondary Ion Mass Spectrometry (SIMS), wherein the film comprises a reaction product of at least one organoamino-polysiloxane compound selected from the group consisting of Formula A and Formula C; and at least one of an oxygen-containing source and a nitrogen-containing source.

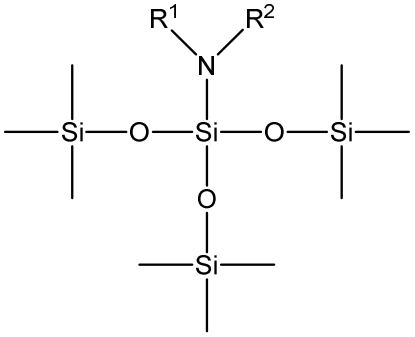
25. A method of preparing an organoamino-polysiloxane compound having a structure represented by Formulae A to H or Structure I:



A



B



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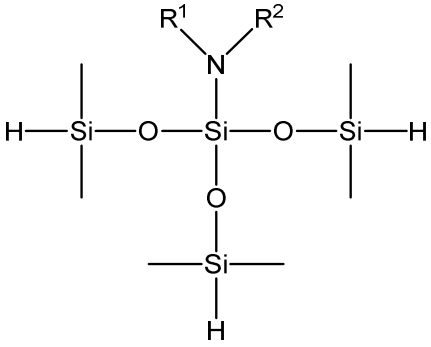

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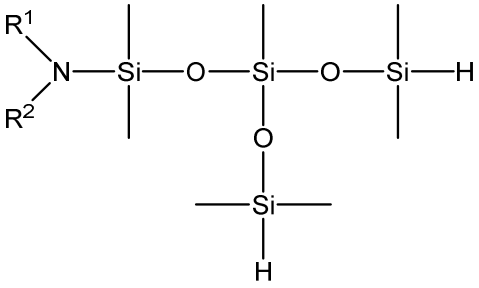

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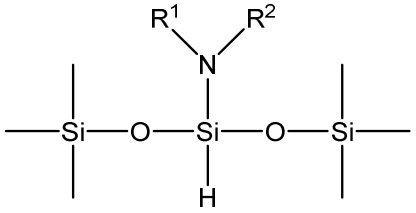

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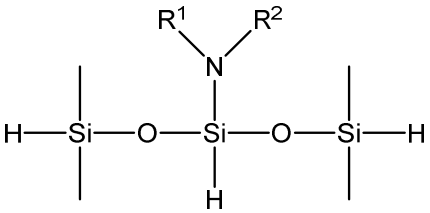

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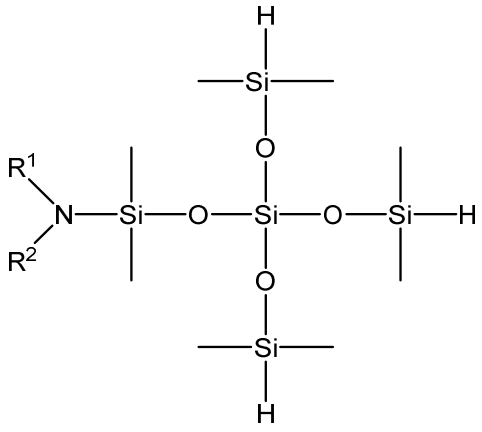

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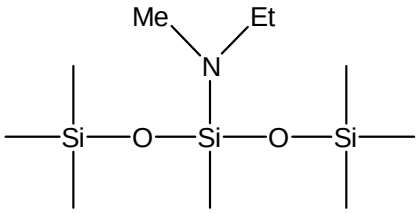

Structure I

wherein

R^1 is selected from a linear C_1 to C_{10} alkyl group, a branched C_3 to C_{10} alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_3 to C_{10} heterocyclic group, a C_3 to C_{10} alkenyl group, a C_3 to C_{10} alkynyl group, and a C_4 to C_{10} aryl group;

R^{1a} is selected from a linear C_3 to C_{10} alkyl group, a branched C_3 to C_{10} alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_3 to C_{10} heterocyclic group, a C_3 to C_{10} alkenyl group, a C_3 to C_{10} alkynyl group, and a C_4 to C_{10} aryl group; and

R^2 is selected from the group consisting of hydrogen, a C_1 to C_{10} linear alkyl group, a branched C_3 to C_{10} alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_3 to C_{10} heterocyclic group, a C_3 to C_{10} alkenyl group, a C_3 to C_{10} alkynyl group, and a C_4 to C_{10} aryl group,

wherein R^1 and R^2 in Formulae B-H are either linked to form a cyclic ring structure or are not linked to form a cyclic ring structure,

wherein R^{1a} and R^2 in Formula A are not linked to form a cyclic ring structure, and wherein the method comprises the steps of:

a) contacting the reactants R^1R^2NH or $R^{1a}R^2NH$ and a polysiloxane having at least one Si-H group in the presence of a catalyst, thus forming a reaction mixture, wherein R^1, R^{1a} and R^2 are as defined above;

b) optionally adding a solvent to the reaction mixture;

c) maintaining the reaction mixture at a temperature between about zero °C to about 300 ^oC; and

d) allowing the reaction to proceed to form the organoamino-polysiloxane compound from the reaction mixture.