CLAIMS

1. A method of depositing a film on a substrate surface, comprising:

providing a substrate in a reaction chamber;

selecting a silicon-containing reactant from a precursor group consisting of di-tert-butyl diazidosilane, tris(dimethylamido)silylazide, and bis(tert-butylhydrazido)diethylsilane;

introducing the silicon-containing reactant in vapor phase into the reaction chamber; and

introducing a second reactant in vapor phase into the reaction chamber.

2. The method of claim 1, further comprising:

introducing the silicon-containing reactant under conditions allowing the silicon-containing reactant to adsorb onto the substrate surface; and

exposing the substrate surface to plasma to drive a reaction between the silicon-containing reactant and the second reactant on the substrate surface to form the film.

3. The method of claim 1, further comprising introducing the second reactant into the reaction chamber while the silicon-containing reactant is adsorbed on the substrate surface and without first sweeping the silicon-containing reactant out of the reaction chamber.

4. The method of claim 1, further comprising flowing the second reactant to the substrate surface at one of a constant flow rate, a non-constant flow rate and an intermittent flow rate.

5. The method of claim 1, wherein:

the film comprises SiN;

the film forms a conformal structure; and

deposition of the film is performed at a temperature less than or equal to 400°C.

6. A method of depositing a film on a substrate surface, comprising:

(a) providing a substrate in a reaction chamber;

(b) selecting a silicon-containing reactant from a precursor group consisting of di-tert-butyl diazidosilane, bis(ethylmethylamido)silane, bis(diisopropylamino)silane, bis(tert-butylhydrazido)diethylsilane, tris(dimethylamido)silylazide, tris(dimethylamido)silylamide, ethylsilicon triazide, diisopropylaminosilane, and hexakis(dimethylamido)disilazane;

(c) introducing the silicon-containing reactant in vapor phase into the reaction chamber under conditions allowing the silicon-containing reactant to adsorb onto the substrate surface;

(d) introducing a second reactant in vapor phase into the reaction chamber while the silicon-containing reactant is adsorbed on the substrate surface, wherein the second reactant is introduced without first sweeping the silicon-containing reactant out of the reaction chamber;

(e) exposing the substrate surface to plasma to drive a reaction between the silicon-containing reactant and the second reactant on the substrate surface to form the film; and

(f) sweeping out the second reactant in vapor phase prior to (e).

7. The method of claim 6, wherein the plasma is ignited while at least one of the silicon-containing reactant and the second reactant is in a gas phase while being exposed to the substrate.

8. The method of claim 6, wherein the silicon-containing reactant and the second reactant do not react with one another in the vapor phase.

9. The method of claim 6, wherein:

the film comprises SiN film; and

deposition of the film is performed at a temperature less than or equal to 400°C.

10. The method of claim 6, further comprising flowing the second reactant to the substrate surface at a non-constant flow rate during (d).

11. The method of claim 6, wherein the silicon-containing reactant and the second reactant co-exist in vapor phase, and wherein the silicon-containing reactant and the second reactant do not appreciably react with one another until exposure to plasma in (e).

12. The method of claim 6, wherein the film formed in (e) forms a conformal structure.

13. The method of claim 6, further comprising, after (e), depositing additional film directly on a portion of the film by chemical vapor deposition.

14. The method of claim 6, further comprising flowing the second reactant to the substrate surface at one of a constant flow rate, a non-constant flow rate and an intermittent flow rate.

15. A method of depositing a film on a substrate surface, comprising:

(a) providing a substrate in a reaction chamber;

(b) selecting a silicon-containing reactant from a precursor group consisting of di-tert-butyl diazidosilane, bis(ethylmethylamido)silane, bis(diisopropylamino)silane, bis(tert-butylhydrazido)diethylsilane, tris(dimethylamido)silylazide, tris(dimethylamido)silylamide, ethylsilicon triazide, diisopropylaminosilane, and hexakis(dimethylamido)disilazane;

(c) introducing the silicon-containing reactant in vapor phase into the reaction chamber under conditions allowing the silicon-containing reactant to adsorb onto the substrate surface;

(d) introducing a second reactant in vapor phase into the reaction chamber while the silicon-containing reactant is adsorbed on the substrate surface;

(e) exposing the substrate surface to plasma to drive a reaction between the silicon-containing reactant and the second reactant on the substrate surface to form the film; and

(f) exposing the substrate surface to the second reactant after sweeping the silicon–containing reactant out of the reaction chamber but prior to (e).

CLAIMS

What is claimed is:

1. A method of depositing a film on a substrate surface, comprising:

providing a substrate in a reaction chamber;

selecting a silicon-containing reactant from a precursor group consisting of di-tert-butyl diazidosilane, tris(dimethylamido)silylazide, and bis(tert-butylhydrazido)diethylsilane;

introducing the silicon-containing reactant in vapor phase into the reaction chamber; and

introducing a second reactant in vapor phase into the reaction chamber.

2. The method of claim 1, further comprising:

introducing the silicon-containing reactant under conditions allowing the silicon-containing reactant to adsorb onto the substrate surface; and

exposing the substrate surface to plasma to drive a reaction between the silicon-containing reactant and the second reactant on the substrate surface to form the film.

3. The method of claim 1, further comprising introducing the second reactant is introduced into the reaction chamber while the silicon-containing reactant is adsorbed on the substrate surface and without first sweeping the silicon-containing reactant out of the reaction chamber.

4. The method of claim 1, further comprising flowing the second reactant to the substrate surface at one of a constant flow rate, a non-constant flow rate and an intermittent flow rate.

5. The method of claim 1, wherein:

the film comprises SiN;

the film forms a conformal structure; and

deposition of the film is performed at a temperature less than or equal to 400°C.

6. A method of depositing a film on a substrate surface, comprising:

(a) providing a substrate in a reaction chamber;

(b) selecting a silicon-containing reactant from a precursor group consisting of di-tert-butyl diazidosilane, bis(ethylmethylamido)silane, bis(diisopropylamino)silane, bis(tert-butylhydrazido)diethylsilane, tris(dimethylamido)silylazide, tris(dimethylamido)silylamide, ethylsilicon triazide, diisopropylaminosilane, and hexakis(dimethylamido)disilazane;

(c) introducing the silicon-containing reactant in vapor phase into the reaction chamber under conditions allowing the silicon-containing reactant to adsorb onto the substrate surface;

(d) introducing a second reactant in vapor phase into the reaction chamber while the silicon-containing reactant is adsorbed on the substrate surface, wherein the second reactant is introduced without first sweeping the silicon-containing reactant out of the reaction chamber; and

(e) exposing the substrate surface to plasma to drive a reaction between the silicon-containing reactant and the second reactant on the substrate surface to form the film.

7. The method of claim 6, wherein the plasma is ignited while at least one of the silicon-containing reactant and the second reactant is in a gas phase while being exposed to the substrate.

8. The method of claim 6, wherein the silicon-containing reactant and the second reactant do not react with one another in the vapor phase.

9. The method of claim 6, wherein:

the film comprises SiN film; and

deposition of the film is performed at a temperature less than or equal to 400°C.

10. The method of claim 6, further comprising flowing the second reactant to the substrate surface at a non-constant flow rate during (d).

11. The method of claim 6, further comprising sweeping out the second reactant in vapor phase prior to (e).

12. The method of claim 6, further comprising exposing the substrate surface to the second reactant after the sweep phase but prior to (e).

13. The method of claim 6, wherein the silicon-containing reactant and the second reactant co-exist in vapor phase, and wherein the silicon-containing reactant and the second reactant do not appreciably react with one another until exposure to plasma in (e).

14. The method of claim 6, wherein the film formed in (e) forms a conformal structure.

15. The method of claim 6, further comprising, after (e), depositing additional film directly on a portion of the film by chemical vapor deposition.

16. The method of claim 6, further comprising flowing the second reactant flows to the substrate surface at one of a constant flow rate, a non-constant flow rate and an intermittent flow rate.

17. An apparatus for depositing a film on a substrate, comprising:

a reaction chamber;

an inlet port that delivers gas phase reactants to the reaction chamber;

a plasma generator that provides plasma to the reaction chamber; and

a controller that initiates:

flowing a silicon-containing reactant in vapor phase into the reaction chamber under conditions allowing the silicon-containing reactant to adsorb onto a substrate surface,

wherein the silicon containing reactant is selected from a precursor group consisting of di-tert-butyl diazidosilane, bis(ethylmethylamido)silane, bis(diisopropylamino)silane, bis(tert-butylhydrazido)diethylsilane, tris(dimethylamido)silylazide, tris(dimethylamido)silylamide, ethylsilicon triazide, diisopropylaminosilane, and hexakis(dimethylamido)disilazane;

flowing a second reactant in vapor phase into the reaction chamber while the silicon-containing reactant is adsorbed on the substrate surface, wherein the second reactant is introduced without first sweeping the silicon-containing reactant out of the reaction chamber; and

providing the plasma in the reaction chamber to drive a reaction between the silicon-containing reactant and the second reactant to form the film.

18. The apparatus of claim 17, wherein the controller initiates chemical vapor deposition directly on a portion of the film.

19. The apparatus of claim 17, wherein the controller initates:

etching the film; and

depositing additional film on the etched film.

20. The apparatus of claim 17, wherein:

the film comprises SiN film;

the film forms a conformal structure; and

deposition of the film is performed at a temperature less than or equal to 400°C.