temperature ranging from approximately 20°C to approximately 250°C.

[0011a] In one aspect there is provided a method for depositing a silicon-containing film on a substrate, the method comprising the steps of a) introducing a vapor of trisilylamine into a reactor having a substrate disposed therein; b) introducing a co-reactant gas N_2 plasma into the reactor; and c) repeating the steps of a) and b) until a desired thickness of the silicon-containing film is deposited on the substrate using a vapor deposition method at a deposition temperature ranging from 20°C to 250°C, wherein a density of the deposited silicon-containing film is around 2.98 g/cm^3.

[0012] The disclosed method may include one or more of the following aspects:

- further comprising the steps of:
  purging the reactor with a first purging gas following the step of a); and
  purging the reactor with a second purging gas following the step of b);
- the first purging gas and the second purging gas being an inert gas selected from N_2, Ar, Kr or Xe;
- The vapor deposition method being an ALD;
- The vapor deposition method being a PEALD;
- The vapor deposition method being a spatial ALD;
- The vapor deposition method being a spatial PEALD;
- the deposition temperature being below approximately 250°C;
- the deposition temperature being below approximately 150°C;
- the deposition temperature being below approximately 110°C;
- the deposition temperature ranging from approximately room temperature to approximately 250°C;
- the deposition temperature ranging from approximately 20°C to approximately 150°C;
- the deposition temperature ranging from approximately 20°C to approximately 110°C;
- the deposition temperature ranging from approximately 20°C to approximately 50°C;
- the substrates having a temperature below approximately 250°C;
- the substrates having a temperature below approximately 150°C;
- the substrates having a temperature below approximately 110°C;
- the substrates having a temperature range from approximately room temperature to approximately 250°C;
- the substrates having a temperature range from approximately 20°C to approximately 150°C;
- the substrates having a temperature range from approximately 20°C to approximately

110°C;

- the substrates having a temperature range from approximately 20°C to approximately 50°C;
- the reactor wall being heated to approximately 300°C or lower;
- the reactor wall being heated to a temperature range from approximately 20°C to approximately 250°C;

What is claimed is:

1. A method for depositing a silicon-containing film on a substrate, the method comprising the steps of:

a) introducing a vapor of trisilylamine into a reactor having a substrate disposed therein;

b) introducing a co-reactant gas N_2 plasma into the reactor; and

c) repeating the steps of a) and b) until a desired thickness of the silicon-containing film is deposited on the substrate using a vapor deposition method at a deposition temperature ranging from 20°C to 250°C,

wherein a density of the deposited silicon-containing film is around 2.98 g/cm^3.

2. The method of claim 1, further comprising the steps of:

purging the vapor of trisilylamine from the reactor with a first purging gas following the step of a); and

purging the co-reactant gas from the reactor with a second purging gas following the step of b).

3. The method of claim 2, wherein the first purging gas and the second purging gas are an inert gas selected from N_2, Ar, Kr or Xe.

4. The method of claim 1, wherein the deposition temperature ranges from 20°C to 150°C.

5. The method of claim 1, wherein the deposition temperature ranges from 20°C to 110°C.

6. The method of claim 1, wherein the substrate has a trench or hole having an aspect ratio of 1:1 to 40:1.

7. The method of claim 6, wherein the silicon-containing film covers at least a part of the trench or hole.

8. The method of claim 6, wherein a step coverage of the side wall of the trench or hole is in a range of around 0.6 to around 1.2, and a step coverage of the bottom of the trench or

hole is in a range of around 0.6 to around 1.5.

9. The method of claim 1, wherein the vapor deposition method is an ALD process.

10. The method of claim 9, wherein the ALD process is a PEALD process or a spatial ALD process.

11. The method of any one of claims 1 to 10, wherein the substrate is a heat sensitive substrate containing organic materials selected from photo resist, a-C, plastics, polyimides, or chalcogenide, and heat sensitive features including extremely fine metal lines in the substrate.

12. The method of any one of claims 1 to 10, wherein the silicon-containing film is SiN or SiON.

13. The method of any one of claims 1 to 10, wherein the silicon-containing film is carbon free.

14. The method of any one of claims 1 to 10, wherein a GPC of the silicon-containing film is in the range of 0.015 nm/cycle to 0.15 nm/cycle.

15. The method of any one of claims 1 to 10, wherein a RI of the silicon-containing film is around 1.96.