

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 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 approximately 20°C to approximately 250°C.
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 N₂, Ar, Kr or Xe.
4. The method of claim 1, wherein the deposition temperature ranges from approximately 20°C to approximately 150°C.
5. The method of claim 1, wherein the deposition temperature ranges from approximately 20°C to approximately 110°C.
6. The method of claim 1, wherein the co-reactant is a plasma source containing at least one of hydrogen, nitrogen, and oxygen.
7. The method of claim 6, wherein the plasma source is selected from N₂ plasma, N₂/He plasma, N₂/Ar plasma, NH₃ plasma, NH₃/He plasma, NH₃/Ar plasma, H₂/organic amine plasma, or mixtures thereof.
8. The method of claim 6, wherein the plasma source is selected from O₃, O₂, H₂O, NO, N₂O, H₂O₂, O radicals or combinations thereof.

9. The method of claim 1, wherein the co-reactant is N₂, O₃ or O₂ plasma.
10. The method of claim 1, wherein the substrate has a trench or hole having an aspect ratio of around 1:1 to around 40:1.
11. The method of claim 10, wherein the silicon-containing film covers at least a part of the trench or hole.
12. The method of claim 10, wherein a step coverage of the side wall of the aperture is in a range of around 0.6 to around 1.2, and a step coverage of the bottom of the aperture is in a range of around 0.6 to around 1.5.
13. The method of claim 1, wherein the vapor deposition process is an ALD process.
14. The method of claim 13, wherein the ALD process is a PEALD process or a spatial ALD process.
15. The method of any one of claims 1 to 14, 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.
16. The method of any one of claims 1 to 14, wherein the Si-containing film is SiN or SiON.
17. The method of any one of claims 1 to 14, wherein the silicon-containing film is carbon free.
18. The method of any one of claims 1 to 14, wherein a GPC of the Si containing film is in the range of approximately 0.015 nm/cycle to approximately 0.15 nm/cycle.
19. The method of any one of claims 1 to 14, wherein a RI of the silicon-containing film is around 1.96.
20. The method of any one of claims 1 to 14, wherein a density of the silicon-containing film is around 2.98 g/cm³.