CLAIMS

1. A thermal atomic layer deposition method for selectively depositing a silicon and oxygen containing film into surface features on a substrate, the method comprising:

a) providing at least one substrate having both a dielectric surface and a metal surface in a reactor,

b) heating the reactor to at least one temperature ranging from ambient temperature to about 350°C and optionally maintaining the reactor at a pressure of 100 torr or less,

c) introducing into the reactor at least one self-assembled monolayer (SAM) volatile precursor selected from the group consisting of organic thiol compounds to anchor more abundantly on the metal surface than on the dielectric surface,

d) purging the reactor using inert gas,

e) introducing into the reactor a silicon compound selected from the group consisting of tetraisocyanatosilane (TICS), triisocyanatosilane, and triisocyanatomethylsilane, to anchor the silicon compound more abundantly on the dielectric surface than on metal surface;

f) purging the reactor using inert gas,

g) providing an oxygen source and a catalyst into the reactor, wherein the catalyst comprises a Lewis base, to form a silicon and oxygen containing dielectric film on the dielectric surface; and

h) purging the reactor using inert gas.

2. The method of claim 1, wherein the dielectric surface is selected from the group consisting of silicon oxide, carbon doped silicon oxide, silicon oxynitride, carbon doped oxynitride, silicon nitride, and metal oxide.

3. The method of claim 1, wherein the metal surface includes at least one metal selected from the group consisting of cobalt, aluminum, copper, tantalum, ruthenium, manganese, molybdenum, tungsten and combination thereof.

4. The method of claim 1, wherein the organic thiol compound is selected from the group consisting of methanethiol, ethanethiol, propanethiol, butanethiol, pentanethiol, hexanethiol, octanethiol, nonanethiol, decanethiol, undecanethiol, 1-dodecanethiol, 1-dodecanethiol, 1-nonanethiol, 1-decanethiol, 1-octanethiol, 1-heptanethiol, 1-hexanethiol, 1-pentanethiol, perfluorodecanethiol, di-tert-butyl disulfide, di-heptane disulfide, 2-Propene-1-thiol, tetrahydro-2H-pyran-4-thiol, 4-methyl-6-trifluoromethyl-pyrimidine-2-thiol, ara-xylene-alpha-thiol, 4-trifluoromethylbenzyl mercaptan, 4-(trifluoromethoxy)benzyl mercaptan, 4-fluorobenzyl mercaptan, 3,5-bis(trifluoromethyl)benzenethiol, 2-(trifluoromethyl)benzenethiol, 4-trifluoromethyl-2,3,5,6-tetrafluorothiophenol, 3,5-difluorobenzyl mercaptan, 4-trifluoromethyl-2,3,5,6-tetrafluorothiopheno, and thiophenol.

5. The method of claim 1, wherein the oxygen source comprises water.

6. The method of claim 1, wherein the catalyst is selected from the group consisting of trimethylamine, triethylamine, tri-n-propylamine, tri-iso-propylamine, tri-n-butylamine, phenyldimethylamine, tri-iso-butylamine, pyridine, and piperazine.

7. The method of claim 1, wherein the oxygen source and the catalyst are mixed prior to be provided into the reactor in step g).

8. The method of claim 1, wherein the silicon and oxygen containing film is selected from the group consisting of silicon oxide film, silicon oxynitride film, carbon doped silicon oxide film, and carbon doped silicon oxynitride film.

9. The method of claim 2, wherein the metal oxide is selected from the group consisting of zirconium oxide, hafnium oxide, silicon doped zirconium oxide, and silicon doped hafnium oxide.