CLAIMS

1. A method for forming a carbon doped silicon oxide film having carbon content ranging from 15 at. % to 30 at. % via a thermal ALD process, the method comprising:

a) placing one or more substrates comprising a surface feature into a reactor;

b) heating the reactor to one or more temperatures ranging from ambient temperature to about 550° C. and optionally maintaining the reactor at a pressure of 100 torr or less;

c) introducing into the reactor at least one silicon precursor having two Si—C—Si linkages selected from the group consisting of 1-chloro-1,3-disilacyclobutane, 1-bromo-1,3-disilacyclobutane, 1,3-dichloro-1,3-1,3-disilacyclobutane, 1,3-dibromo-1,3-disilacyclobutane, 1,1,3-trichloro-1,3-disilacyclobutane, 1,1,3-tribromo-1,3-disilacyclobutane, 1,1,3,3-tetrachloro-1,3-disilacyclobutane, 1,1,3,3-tetrabromo-1,3-disilacyclobutane, 1,3-dichloro-1,3-dimethyl-1,3-disilacyclobutane, 1,3-bromo-1,3-dimethyl-1,3-disilacyclobutane, 1,1,1,3,3,5,5,5-octachloro-1,3,5-trisilapentane, 1,1,3,3,5,5-hexachloro-1,5-dimethyl-1,3,5-trisilapentane, 1,1,1,5,5,5-hexachloro-3,3-dimethyl-1,3,5-trisilapentane, 1,1,3,5,5-pentachloro-1,3,5-trimethyl-1,3,5-trisilapentane, 1,1,1,5,5,5-hexachloro-1,3,5-trisilapentane, 1,1,5,5-tetraachloro-1,3,5-trisilapentane;

d) purging with an inert gas;

e) providing a nitrogen source into the reactor to react with the surface to form a carbon doped silicon nitride film;

f) purging with inert gas to remove reaction by-products;

g) repeating steps c to f to provide a desired thickness of a resulting carbon doped silicon nitride;

h) treating the resulting carbon doped silicon nitride film with an oxygen source at one or more temperatures ranging from about ambient temperature to 1000° C. to convert the carbon doped silicon nitride film into a carbon doped silicon oxide film; and

i) providing post-deposition exposing the carbon doped silicon oxide film to a plasma comprising hydrogen.

2. The method according to claim 1 wherein the step h) of treating the resulting carbon doped silicon nitride film with an oxygen source is performed at one or more temperatures ranging from or from about 100° C. to 400° C.