CLAIMS

1. A method for making an organosilica film with improved mechanical properties, the method comprising:

providing a substrate within a reaction chamber; introducing into the reaction chamber a gaseous composition comprising a monoalkoxysilane having the structure given in Formulae (1) or (2):

(1) $R^1R^2MeSiOR^3$

wherein R^1 and R^2 are selected independently from a linear or branched C_2 to C_5 alkyl, preferably ethyl, propyl, iso-propyl, butyl, sec-butyl, or tert-butyl and R^3 is selected from a linear or branched C_1 to C_5 alkyl, preferably methyl, ethyl, propyl, iso-propyl, butyl, sec-butyl, iso-butyl, or tert-butyl.

(2) $R^4(Me)_2SiOR^5$

wherein R^4 is selected from a linear or branched C_2 to C_5 alkyl, preferably ethyl, propyl, iso-propyl, butyl, sec-butyl, or tert-butyl and R^5 is selected from a linear or branched C_2 to C_5 alkyl, preferably ethyl, propyl, iso-propyl, n-butyl, sec-butyl, iso-butyl, or tert-butyl and wherein the monoalkoxysilane of Formulae (1) or (2) is substantially free of one or more impurities selected from the group consisting of a halide, water, metals, and combinations thereof; and

applying energy to the gaseous composition comprising monoalkoxysilane in the reaction chamber to induce reaction of the gaseous composition comprising monoalkoxysilane to deposit an organosilica film on the substrate, wherein the organosilica film has a dielectric constant of from 2.8 to 3.30 and an elastic modulus of from 9 to 32 GPa.

2. The method of claim 1 wherein the gaseous composition comprising monoalkoxysilane is free of a hardening additive.

3. The method of claim 1 which is a chemical vapor deposition method.

4. The method of claim 1 which is a plasma enhanced chemical vapor deposition method.

5. The method of claim 1 wherein the gaseous composition comprising monoalkoxysilane further comprises the at least one oxidant selected from the group consisting of O_2, N_2O, NO, NO_2, CO_2, CO, water, H_2O_2, ozone, and combinations thereof.

6. The method of claim 1 wherein the gaseous composition comprising monoalkoxysilane does not comprise an oxidant.

7. The method of claim 1 wherein the reaction chamber in the applying step comprises at least one gas selected from the group consisting of He, Ar, N_2, Kr, Xe, CO_2, and CO.

8. The method of claim 1 wherein the organosilica film has a refractive index (RI) of from 1.3 to 1.6 at 632 nm and carbon content as measured by XPS of from 10 at. % to 30 at. %.

9. The method of claim 1 wherein the organosilica film is deposited at a rate of from 5 nm/min to 700 nm/min.

10. The method of claim 8 wherein the organosilica film has a $SiCH_2Si/SiO_x$*1E4 IR ratio of from 8 to 30.

11. A composition for a vapor deposition of a dielectric film comprising a monoalkoxysilane having the structure given in Formulae (1) or (2):

(1) $R^1R^2MeSiOR^3$

where R^1 and R^2 are selected independently from a linear or branched C_2 to C_5 alkyl, preferably ethyl, propyl, iso-propyl, butyl, sec-butyl, or tert-butyl and R^3 is selected from a linear or branched C_1 to C_5 alkyl, preferably methyl, ethyl, propyl, iso-propyl, butyl, sec-butyl, iso-butyl, or tert-butyl.

(2) $R^4(Me)_2SiOR^5$

where R^4 is selected from a linear or branched C_2 to C_5 alkyl, preferably ethyl, propyl, iso-propyl, butyl, sec-butyl, or tert-butyl and R^5 is selected from a linear or branched C_2 to C_5 alkyl, preferably ethyl, propyl, iso-propyl, n-butyl, sec-butyl, iso-butyl, or tert-butyl and wherein the monoalkoxysilane is substantially free of one or more impurities selected from the group consisting of a halide, water, and metals.

12. The composition of claim 11 wherein the monoalkoxysilane comprises at least one selected from the group consisting of di(ethyl)-methyl-methoxysilane, di(ethyl)-methyl-ethoxysilane, di(ethyl)-methyl-n-propoxysilane, di(ethyl)-methyl-iso-propoxysilane, di(ethyl)methyl(n-butoxy)silane, di(ethyl)methyl(sec-butoxy)silane, di(ethyl)methyl(tert-butoxy)silane, di(propyl)methyl(methoxy)silane, di(propyl)methyl(ethoxy)silane, di(propyl)methyl(propoxy)silane, di(propyl)methyl(iso-propoxy)silane, di(n-propyl)methyl(butoxy)silane, di(n-propyl)methyl(sec-butoxy)silane, di(n-propyl)methyl(tert-butoxy)silane, di(n-propyl)methyl(iso-butoxy)silane, di(iso-propyl)methyl(methoxy)silane, di(iso-propyl)methyl(ethoxy)silane, di(iso-propyl)methyl(propoxy)silane, di(iso-propyl)methyl(iso-propoxy)silane, di(iso-propyl)methyl(n-butoxy)silane, di(iso-propyl)methyl(sec-butoxy)silane, di(iso-propyl)methyl(tert-butoxy)silane, di(iso-propyl)methyl(iso-butoxy)silane, di(methyl)ethyl(ethoxy)silane, di(methyl)ethyl(n-propoxy)silane, di(methyl)ethyl(iso-propoxy)silane, di(methyl)ethyl(n-butoxy)silane, di(methyl)ethyl(sec-butoxy)silane, di(methyl)-ethyl-tert-butoxysilane, di(methyl)ethyl(iso-butoxy)silane, di(methyl)n-propyl(ethoxy)silane, di(methyl)n-propyl(n-propoxy)silane, di(methyl)n-propyl(iso-propoxy)silane, di(methyl)n-propyl(butoxy)silane, di(methyl)n-propyl(sec-butoxy)silane, di(methyl)n-propyl(tert-butoxy)silane, di(methyl)n-propyl(iso-butoxy)silane, di(methyl)iso-propyl(ethoxy)silane, di(methyl)iso-propyl(n-propoxy)silane, di(methyl)iso-propyl(iso-propoxy)silane, di(methyl)iso-propyl(n-butoxy)silane, di(methyl)iso-propyl(sec-butoxy)silane, di(methyl)iso-propyl(tert-butoxy)silane, di(methyl)iso-propyl(iso-butoxy)silane, di(methyl)n-butyl(ethoxy)silane, di(methyl)n-butyl(propoxy)silane, di(methyl)n-butyl(iso-propoxy)silane, di(methyl)n-butyl(n-butoxy)silane, di(methyl)-n-butyl(sec-butoxy)silane, di(methyl)n-butyl(tert-butoxy)silane, di(methyl)-n-butyl(iso-butoxy)silane, di(methyl)sec-butyl(ethoxy)silane, di(methyl)sec-butyl(n-propoxy)silane, di(methyl)sec-butyl(iso-propoxy)silane, di(methyl)sec-butyl(n-butoxy)silane, di(methyl)sec-butyl(sec-butoxy)silane, di(methyl)sec-butyl(tert-butoxy)silane, di(methyl)sec-butyl(iso-butoxy)silane, di(methyl)tert-butyl(ethoxy)silane, di(methyl)tert-butyl(propoxy)silane, di(methyl)tert-butyl(iso-propoxy)silane, di(methyl)tert-butyl(n-butoxy)silane, di(methyl)tert-butyl(sec-butoxy)silane, di(methyl)tert-butyl(tert-butoxy)silane, di(methyl)tert-butyl(iso-butoxy)silane, and combinations thereof.

13. The composition of claim 11, wherein the halides comprise chloride ions.

14. The composition of claim 13, wherein the chloride ions, if present, are present at a concentration of 50 ppm or less as measured by IC.

15. The composition of claim 13, wherein the chloride ions, if present, are present at a concentration of 10 ppm or less as measured by IC.

16. The composition of claim 13, wherein the chloride ions, if present, are present at a concentration of 5 ppm or less as measured by IC.