

CLAIMS

1. A method for making a dense organosilica film with improved mechanical
5 properties, the method comprising the steps of:
 providing a substrate within a reaction chamber;
 introducing into the reaction chamber a gaseous composition comprising one or more
selected from the group consisting of 1-methyl-1-iso-propoxy-silacyclopentane and 1-methyl-
1-iso-propoxy-silacyclobutane; and
10 applying energy to the gaseous composition in the reaction chamber to induce
reaction of the gaseous composition and thereby deposit an organosilica film on the
substrate, wherein the organosilica film has a dielectric constant of from 2.80 to 3.00 and an
elastic modulus of from 11 to 18 GPa.
- 15 2. The method of claim 1 wherein the gaseous composition is free of a hardening
additive.
3. The method of claim 1 which is a chemical vapor deposition method.
- 20 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 comprises at least one
oxidant selected from the group consisting of O₂, N₂O, NO, NO₂, CO₂, water, H₂O₂, ozone,
25 and combinations thereof.
6. The method of claim 1 wherein the gaseous composition comprises O₂ and is
introduced during reaction of the gaseous composition at a rate of no greater than 32 sccm.
- 30 7. The method of claim 1 wherein the gaseous composition does not comprise an
oxidant.
8. 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, N₂, Kr, Xe, CO₂,
35 and CO.

9. The method of claim 1 wherein the organosilica film has a refractive index (RI) of from 1.44 to 1.49 at 632 nm and an at. % carbon as measured by XPS of from 25% to 31%.

5 10. The method of claim 1 wherein the organosilica film is deposited at a rate of from 41 nm/min to 80 nm/min.

10 11. The method of claim 8 wherein the organosilica film has a $\text{SiCH}_2\text{Si/SiO}_x \times 10^4$ IR ratio of from 17 to 19.

12. A method for making a dense organosilica film with improved mechanical properties, the method comprising the steps of:
providing a substrate within a reaction chamber;
introducing into the reaction chamber a gaseous composition comprising one or more
15 selected from the group consisting of 1-methyl-1-iso-propoxy-silacyclopentane and 1-methyl-1-iso-propoxy-silacyclobutane; and
applying energy to the gaseous composition in the reaction chamber to induce reaction of the gaseous composition and thereby deposit an organosilica film on the substrate, wherein the organosilica film has a dielectric constant of from 2.80 to 3.10, an
20 elastic modulus of from 11 to 20 GPa, and an at. % carbon of from 12 to 31 as measured by XPS.

25 13. The method of claim 11 wherein the gaseous composition is free of a hardening additive.

14. The method of claim 11 which is a chemical vapor deposition method.

15. The method of claim 11 which is a plasma enhanced chemical vapor deposition method.

30 16. The method of claim 11 wherein the gaseous composition comprises at least one oxidant selected from the group consisting of O_2 , N_2O , NO , NO_2 , CO_2 , water, H_2O_2 , ozone, and combinations thereof.

17. The method of claim 16 wherein the gaseous composition comprises O₂ and is introduced during reaction of the gaseous composition at a rate of no greater than 32 sccm.

18. The method of claim 11 wherein the gaseous composition does not comprise an oxidant.

19. The method of claim 11 wherein the reaction chamber in the applying step comprises at least one gas selected from the group consisting of He, Ar, N₂, Kr, Xe, CO₂, and CO.

20. The method of claim 11 wherein the organosilica film has a refractive index (RI) of from 1.443 to 1.488 at 632 nm.

21. The method of claim 11 wherein the organosilica film is deposited at a rate of from 41 nm/min to 80 nm/min.

22. The method of claim 18 wherein the organosilica film has a SiCH₂Si/SiO_x*1E⁴ IR ratio of from 17 to 19.

23. A method for making a dense organosilica film with improved mechanical properties, the method comprising the steps of:
providing a substrate within a reaction chamber;
introducing into the reaction chamber a gaseous composition comprising 1-methyl-1-iso-propoxy-silacyclopentane or 1-methyl-1-iso-propoxy-silacyclobutane; and
applying energy to the gaseous composition in the reaction chamber to induce reaction of the gaseous composition and thereby deposit an organosilica film on the substrate, wherein the organosilica film has a dielectric constant of from 2.70 to 3.20 and an elastic modulus of from 11 to 25 GPa.