

CLAIMS

1. A method for depositing an organosilica film, the method comprising:
providing a substrate within a reaction chamber;
5 introducing into the reaction chamber a gaseous composition comprising a hydrido-
dimethyl-alkoxysilane having the structure given in Formula (1):
$$(1) \text{H}(\text{Me})_2\text{SiOR}$$

wherein R is selected from the group consisting of iso-propyl, sec-butyl, tert-butyl, 2-pentyl,
3-pentyl, 3-methyl-2-butyl, tert-pentyl, cyclopentyl, and cyclohexyl; and
10 applying energy to the gaseous composition in the reaction chamber to induce a
reaction of the hydrido-dimethyl-alkoxysilane and thereby deposit the organosilica film on the
substrate.
2. The method of claim 1, wherein the composition comprising the hydrido-dimethyl-
15 alkoxysilane of Formula (1) is substantially free of one or more impurities selected from the
group consisting of halide compounds, water, metals, oxygen-containing impurities, nitrogen-
containing impurities and combinations thereof.
3. The method of claim 1, wherein the organosilica film has a dielectric constant of
20 from ~ 2.70 to ~ 3.50, an elastic modulus of from ~ 6 to ~ 36 GPa, and an XPS carbon
content of from ~ 10 to ~36 at. %.
4. The method of claim 1 wherein the gaseous composition comprising hydrido-
dimethyl-alkoxysilane is free of a hardening additive.
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5. The method of claim 1 which is a chemical vapor deposition method.
6. The method of claim 1 which is a plasma enhanced chemical vapor deposition
method.
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7. The method of claim 1 wherein the gaseous composition comprising hydrido-
dimethyl-alkoxysilane further comprises the at least one oxidant selected from the group
consisting of O₂, N₂O, NO, NO₂, CO₂, CO, water, H₂O₂, ozone, alcohols, and combinations
thereof.
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8. The method of claim 1 wherein the gaseous composition comprising hydrido-dimethyl-alkoxysilane does not comprise an oxidant.

9. The method of claim 1 wherein the reaction chamber during the applying step
5 comprises at least one gas selected from the group consisting of He, Ar, N₂, Kr, Ne, and Xe.

10. The method of claim 9, wherein the reaction chamber during the applying step further comprises at least one oxidant selected from the group consisting of O₂, N₂O, NO, NO₂, CO₂, CO, water, H₂O₂, ozone, alcohols, and combinations thereof.

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11. The method of claim 1 wherein the organosilica film has a refractive index (RI) of from ~ 1.3 to ~ 1.7 at 632 nm.

12. The method of claim 1 wherein the organosilica film is deposited at a rate of from
15 ~ 5 nm/min to ~ 400 nm/min.

13. The method of claim 1, wherein the organosilica film has a value of relative bridging methylene (SiCH₂Si) density as determined by IR spectroscopy of ~ 10 to ~30, and further has a ratio of relative SiCH₂Si Density*/ total carbon (at. % XPS) is greater than ~ 0.65.

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14. The method of claim 1, wherein the organosilica film has a value of the leakage current density of less than 1×10^{-9} A/cm² at an electric field strength greater than or equal to 4 MV/cm.

25 15. The method of claim 1, wherein R is sec-butyl.

16. A composition for a vapor deposition of a dielectric film comprising a hydrido-dimethyl-alkoxysilane having the structure given in Formula (1):



30 wherein R is selected from the group consisting of iso-propyl, sec-butyl, tert-butyl, 2-pentyl, 3-pentyl, 3-methyl-2-butyl, tert-pentyl, cyclopentyl, and cyclohexyl.

17. The composition of claim 16, wherein the composition is substantially free of one or more impurities selected from the group consisting of halide compounds, water,
35 oxygen-containing impurities, nitrogen-containing impurities, and metals.

18. The composition of claim 16, wherein the composition is substantially free of chloride compounds.

5 19. The composition of claim 18, wherein the chloride compounds, if present, are present at a concentration of 10 ppm or less as measured by IC.

20. The composition of claim 18, wherein the chloride compounds, if present, are present at a concentration of 5 ppm or less as measured by IC.

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21. The composition of claim 18, wherein the chloride compounds, if present, are present at a concentration of 1 ppm or less as measured by IC.

22. The composition of claim 16, wherein the composition is substantially free of nitrogen-containing impurities.

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23. The composition of claim 22, wherein the nitrogen-containing impurities, if present, are present at a concentration of ~1000 ppm or less as measured by GC.

20 24. The composition of claim 22, wherein the nitrogen-containing impurities, if present, are present at a concentration of ~500 ppm or less as measured by GC.

25. 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 a nitrogen content of 0.1 at. % or less as measured by XPS or SIMS or RBS.

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26. The composition of claim 16 wherein the hydrido-dimethyl-alkoxysilane is selected from the group consisting of dimethyl-iso-propoxysilane, dimethyl-sec-butoxysilane, dimethyl-tert-butoxysilane, dimethyl-2-pentoxysilane, dimethyl-3-pentoxysilane, dimethyl-3-methyl-2-pentoxysilane, dimethyl-tert-pentoxysilane, dimethyl-cyclopentoxysilane, and dimethyl-cyclohexoxysilane.

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27. The composition of claim 16, which comprises dimethyl-iso-propoxysilane.

35 28. The composition of claim 16, which comprises dimethyl-tert-pentoxysilane.

29. The composition of claim 16, which comprises dimethyl-2-pentoxysilane.
30. A compound of dimethyl-sec-butoxysilane.
- 5 31. A compound of dimethyl-cyclopentoxysilane.