

CLAIMS

What is claimed is:

1. An organometallic compound of Formula 1:



wherein:

A is selected from the group consisting of $(Y_aR'_z)$ and a 3- to 7-membered N-containing heterocyclic group;

each R group is independently selected from the group consisting of an alkyl or aryl group having from 1 to 10 carbon atoms;

each R' group is independently selected from the group consisting of an alkyl, acyl or aryl group having from 1 to 10 carbon atoms;

x is an integer from 0 to 4;

a is an integer from 0 to 1;

Y is selected from the group consisting of N, O, S, and P; and

z is 1 when Y is O, S or when Y is absent and z is 2 when Y is N or P.

2. The organometallic compound of claim 1, wherein A is selected from the group consisting of an (NR'_2) group and a 3- to 7-membered N-containing heterocyclic group.
3. The organometallic compound of claim 2, wherein A is an (NR'_2) group.
4. The organometallic compound of claim 2, wherein A is a 3- to 7-membered N-containing heterocyclic group.
5. The organometallic compound of claim 8, wherein A is a pyrrolidinyl group.
6. The organometallic compound of claim 1, wherein A_{4-x} is $(NMe_2)_2$ or $(NEtMe)_2$.
7. The organometallic compound of any one of the preceding claims, wherein each R and R' group is an independently selected alkyl group having from 1 to 10 carbon atoms.
8. The organometallic compound of claim 4, wherein each R and R' group is an independently selected alkyl group having from 1 to 6 carbon atoms.
9. The organometallic compound of claim 5, wherein each R and R' group is an independently selected alkyl group having from 1 to 4 carbon atoms.
10. The organometallic compound of claim 6, wherein each R and R' is independently selected from the group consisting of methyl, ethyl, propyl, iso-propyl, tert-butyl, iso-butyl and n-butyl.
11. The organometallic compound of any one of claims 1-6 or 8-12, wherein R and R' represent different alkyl groups.

12. The organometallic compound of claim 1, wherein the compound of Formula I is selected from the group consisting of $\text{Me}_2\text{Sn}(\text{NMe}_2)_2$, $\text{Me}_2\text{Sn}(\text{NEtMe})_2$, $\text{t-BuSn}(\text{NEtMe})_3$, $\text{i-PrSn}(\text{NEtMe})_3$, $\text{n-Pr}(\text{NEtMe})_3$, $\text{EtSn}(\text{NEtMe})_3$, $\text{i-BuSn}(\text{NEtMe})_3$, $\text{Et}_2\text{Sn}(\text{NEtMe})_2$, $\text{Me}_2\text{Sn}(\text{NEtMe})_2$, $\text{Sn}(\text{NEtMe})_4$, $\text{Bu}_2\text{Sn}(\text{NEtMe})_2$, $\text{Et}_2\text{Sn}(\text{NMe}_2)_2$, $\text{Me}_2\text{Sn}(\text{NEt}_2)_2$, $\text{Sn}(\text{Pyrrolidinyl})_4$ and $\text{Bu}_2\text{Sn}(\text{Pyrrolidinyl})_2$.
13. The organometallic compound of claim 12, wherein the compound of Formula I is selected from the group consisting of $\text{Me}_2\text{Sn}(\text{NMe}_2)_2$, $\text{Me}_2\text{Sn}(\text{NEtMe})_2$, $\text{Et}_2\text{Sn}(\text{NMe}_2)_2$, $\text{Me}_2\text{Sn}(\text{NEt}_2)_2$, $\text{Sn}(\text{Pyrrolidinyl})_4$, and $\text{Bu}_2\text{Sn}(\text{Pyrrolidinyl})_2$.
14. The organometallic compound of claim 13, wherein the compound of Formula I is selected from the group consisting of $\text{Me}_2\text{Sn}(\text{NEtMe})_2$ and $\text{Me}_2\text{Sn}(\text{NMe}_2)_2$.
15. The organometallic compound of claim 14, wherein the compound of Formula I is $\text{Me}_2\text{Sn}(\text{NMe}_2)_2$.
16. A composition comprising the organometallic compound of any one of the compounds in claims 1-6, 8-10, or 12-15 and another organometallic compound containing Sn.
17. The composition of claim 16, wherein the another organometallic compound is a compound of Formula I.
18. The composition of claim 16, wherein the another organometallic compound is selected from the group consisting of $\text{MeSn}(\text{NMe}_2)_3$ and $\text{Sn}(\text{NMe}_2)_4$.
19. A method for the deposition of a tin oxide layer on a substrate by a vapour deposition process, the method comprising the steps of:
- providing at least one substrate having functional O-H groups covering the surface;
 - delivering to said substrate the organometallic compound of any of claims 1-6, 8-10, or 12-15 in the gaseous phase;
 - delivering to said substrate an oxygen source in the gaseous phase, forming the tin oxide layer; and
 - repeating steps a to c to generate the desired thickness of the tin oxide layer, wherein steps b and c are carried out under activating conditions.
20. The method of claim 19, wherein the activation condition is plasma generation.
21. A method for spacer-defined double patterning deposition, the method comprising the steps of:
- (a) depositing a layer of (photo)resist onto a substrate having functional O-H groups covering the surface, forming a pattern in the resist with electron-beam (e-beam) lithography, and developing the photoresist to give the pattern;

(b) depositing a spacer layer onto the resist using energy-enhanced ALD in the presence of the organometallic compound of any one of claims 1-6, 8-10, or 12-15;

(c) performing an anisotropic etch to remove the tops of the features, using reactive ion etching (RIE) or ion milling (IM);

(d) removing the photoresist, either by a wet or plasma etch;

(e) anisotropically etching into the target layer; and

(f) removing the spacer, leaving the patterned substrate.

22. A method of using multistage distillation to purify the organometallic compound of any one of claims 1-6, 8-10, or 12-15.

23. The method of claim 21, wherein 2 to 20 stages are required to reduce metal contamination to <1ppm.

24. The method of claim 21, wherein 2 to 20 stages are required to reduce metal contamination to <100ppb.

25. The method of claim 21, wherein 2 to 20 stages are required to reduce metal contamination to <10ppb.

26. The method of claim 21, wherein 2 to 20 stages are required to reduce metal contamination to 1ppb or less.