Claims

1. An organometallic compound represented by the formula $H_aM(NR_1R_2)_x(NR_3H)_y(NH_2)_z$ wherein M is a metal or metalloid, R_1 is the same or different and is a hydrocarbon group or a heteroatom-containing group, R_2 is the same or different and is a hydrocarbon group or a heteroatom-containing group, R_3 is the same or different and is a hydrocarbon group or a heteroatom-containing group, a is a value from 0 to 3, x is a value from 0 to 3, y is a value from 0 to 4, z is a value from 0 to 4, and a + x + y + z is equal to the oxidation state of M, provided that at least one of y and z is a value of at least 1.

2. The organometallic compound of claim 1 wherein a is a value of 0 or 1, x is a value of 2 or 3, y is a value of 0 or 1, and z is value of 1 or 2, wherein a + x + y + z is equal to the oxidation state of M.

3. The organometallic compound of claim 1 wherein M is Si, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Al, Ga, Ge, a Lanthanide series element or an Actinide series element; and each of R_1, R_2 and R_3 is the same or different and is independently hydrogen, alkyl; a substituted or unsubstituted, saturated or unsaturated, hydrocarbon, aromatic hydrocarbon, cycloaliphatic hydrocarbon, aromatic heterocycle, cycloaliphatic heterocycle, alkyl halide, silylated hydrocarbon, ether, polyether, thioether, ester, lactone, amide, amine, polyamine, nitrile; or mixtures thereof.

4. The organometallic compound of claim 1 selected from tris(dimethylamino)silylamine, tris(pyrrolyl)silylamine, tris(2-methylpyrrolidinyl)silylamine, tris(imidazolyl)silylamine, tris(1-methylpiperazinyl)silylamine, tris(pyrazolyl)silylamine, tetrakis(ethylamino)silane, and tris(dimethylamino)(ethylamino)silane.

5. The organometallic compound of claim 1 represented by the formula $H_aSi(NR_1R_2)_x(NR_3H)_y(NH_2)_z$ wherein R_1 is the same or different and is a hydrocarbon group or a heteroatom-containing group, R_2 is the same or different and is a hydrocarbon group or a heteroatom-containing group, R_3 is the same or different and is a hydrocarbon group or a heteroatom-containing group, a is a value from 0 to 3, x is a value from 0 to 3, y is a value from 0 to 4, z is a value from 0 to 4, and $a + x + y + z = 4$, provided that at least one of y and z is a value of at least 1.

6. An organometallic compound represented by the formula $:M(NR'_1R'_2)_q$ wherein M is a metal or metalloid, R'_1 is the same or different and is a hydrocarbon group or a heteroatom-containing group, R'_2 is the same or different and is a hydrocarbon group or a heteroatom-containing group; when q is a value of 2 or greater, R'_1 or R'_2 of one $(NR'_1R'_2)$ group can be combined with R'_1 or R'_2 of another $(NR'_1R'_2)$ group to form a substituted or unsubstituted, saturated or unsaturated cyclic group; q is a value equal to or less than the oxidation state of M, and : represents 2 electrons.

7. The organometallic compound of claim 6 wherein q is a value from 0 to 4.

8. The organometallic compound of claim 6 wherein M is Si, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Al, Ga, Ge, a Lanthanide series element or an Actinide series element; and each of R'_1 and R'_2 is the same or different and is independently hydrogen, alkyl; a substituted or unsubstituted, saturated or unsaturated, hydrocarbon, aromatic hydrocarbon, cycloaliphatic hydrocarbon, aromatic heterocycle, cycloaliphatic heterocycle, alkyl halide, silylated hydrocarbon, ether, polyether, thioether, ester, lactone, amide, amine, polyamine, nitrile; or mixtures thereof.

9. The organometallic compound of claim 6 selected from N,N'-di-*tert*-butylethene-1,2-diaminosilylene, N,N'-di-*tert*-butylethylene-1,2-diaminosilylene, N,N'-diisopropylethene-1,2-diaminosilylene, bis(di-*tert*-butylamino)silylene, and bis(di-*tert*-amylamino)silylene.

10. The organometallic compound of claim 6 represented by the formula $:Si(NR'_1R'_2)_2$ wherein R'_1 is the same or different and is a hydrocarbon group or a heteroatom-containing group, R'_2 is the same or different and is a hydrocarbon group or a heteroatom-containing group; R'_1 or R'_2 of one $(NR'_1R'_2)$ group can be combined with R'_1 or R'_2 of another $(NR'_1R'_2)$ group to form a substituted or unsubstituted, saturated or unsaturated cyclic group; and : represents 2 electrons.

11. A process for the production of an organometallic compound of claim 1 comprising (i) reacting in a first pot a nitrogen-containing compound with an alkali metal, or an alkali metal-containing compound, or an alkaline earth metal, or an alkaline earth metal-containing compound, in the presence of a solvent and under reaction conditions sufficient to produce a first reaction mixture comprising a base material, (ii) adding said base material to a second pot containing a metal source compound and optionally an amine compound, (iii) reacting in said second pot said base material with said metal source compound and optionally said amine compound under reaction conditions sufficient to produce a second reaction mixture comprising said organometallic compound, and (iv) separating said organometallic compound from said second reaction mixture.

12. A process for the production of an organometallic compound of claim 7 comprising (i) reacting in a first pot a nitrogen-containing compound with an alkali metal, or an alkali metal-containing compound, or an alkaline earth metal, or an alkaline earth metal-containing compound, in the presence of a solvent and under reaction conditions sufficient to produce a first reaction mixture comprising a base material, (ii) adding said base material to a second pot

containing a metal source compound and optionally an amine compound, (iii) reacting in said second pot said base material with said metal source compound and optionally said amine compound under reaction conditions sufficient to produce a second reaction mixture comprising an organometallic compound derivative, (iv) subjecting said second reaction mixture to reduction or dehalogenation under conditions sufficient produce a third reaction mixture comprising said organometallic compound, and (v) separating said organometallic compound from said third reaction mixture.

13. A method for producing a film, coating or powder by decomposing an organometallic precursor compound of claims 1 or 7, thereby producing the film, coating or powder.

14. The method of claim 13 wherein said organometallic precursor compound is vaporized and the vapor is directed into a deposition reactor housing a substrate.

Claims

1. An organometallic precursor compound represented by the formula :$M(NR'_1R'_2)_q$ wherein M is a metal or metalloid, R'_1 is the same or different and is a hydrocarbon group or a heteroatom-containing group, R'_2 is the same or different and is a hydrocarbon group or a heteroatom-containing group; when q is a value of 2 or greater, R'_1 or R'_2 of one ($NR'_1R'_2$) group can be combined with R'_1 or R'_2 of another ($NR'_1R'_2$) group to form a substituted or unsubstituted, saturated or unsaturated cyclic group; q + 2 is a value equal to the oxidation state of M, and : represents 2 electrons; wherein the organometallic compound is a liquid at 20°C, wherein M is Si, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Al, Ga, Ge, a Lanthanide series element or an Actinide series element; and each of R'_1 and R'_2 is the same or different and is independently hydrogen, alkyl; a substituted or unsubstituted, saturated or unsaturated, hydrocarbon, aromatic hydrocarbon, cycloaliphatic hydrocarbon, aromatic heterocycle, cycloaliphatic heterocycle, alkyl halide, silylated hydrocarbon, ether, polyether, thioether, ester, lactone, amide, amine, polyamine, nitrile; or mixtures thereof.

2. An organometallic precursor compound represented by the formula :$M(NR'_1R'_2)_q$ wherein M is a metal or metalloid, R'_1 is the same or different and is a hydrocarbon group or a heteroatom-containing group, R'_2 is the same or different and is a hydrocarbon group or a heteroatom-containing group; when q is a value of 2 or greater, R'_1 or R'_2 of one ($NR'_1R'_2$) group can be combined with R'_1 or R'_2 of another ($NR'_1R'_2$) group to form a substituted or unsubstituted, saturated or unsaturated cyclic group; q + 2 is a value equal to the oxidation state of M, and : represents 2 electrons; wherein the organometallic compound is a liquid at 20°C, and further wherein the organometallic precursor compound is selected from N,N'-di-*tert*-butylethene-1,2-diaminosilylene, N,N'-di-*tert*-butylethylene-1,2-diaminosilylene, N,N'-diisopropylethene-1,2-diaminosilylene, bis(di-*tert*-butylamino)silylene, and bis(di-*tert*-amylamino)silylene.