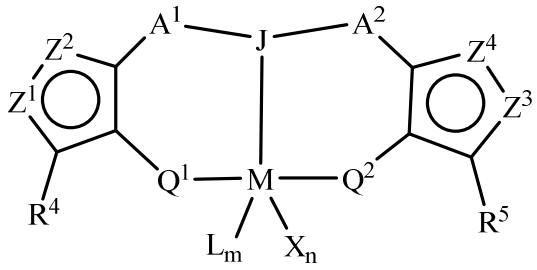
CLAIMS

What is claimed is:

1. A catalyst compound represented by Formula (**I**):



(**I**)

wherein:

M is a group 3, 4, or 5 metal;

each A^1 and A^2 is independently an aromatic, a substituted aromatic, or alkenediyl group;

heterocyclic ring fragments -(Z^1Z^2)- and –(Z^3Z^4)- are independently selected from –(Z^5Z^6)- or –(Z^6Z^5)-, with Z^5 being selected from oxygen, sulfur, S(O), $S(O)_2$, and $N(R^{50})$, and Z^6 being selected from nitrogen and $C(R^{51})$, wherein each R^{50} and R^{51} is independently hydrogen, C_1-C_{40} hydrocarbyl, C_1-C_{40} substituted hydrocarbyl, a monovalent heteroatom, or a heteroatom-bonded monovalent group;

each of R^4 and R^5 is independently hydrogen, C_1-C_{40} hydrocarbyl, C_1-C_{40} substituted hydrocarbyl, a monovalent heteroatom, or a heteroatom-bonded monovalent group;

J is a heterocyclic Lewis base;

each Q^1 and Q^2 are independently selected from oxygen, sulfur, $N(R^{30})$, or $P(R^{30})$, wherein R^{30} is C_1-C_{40} hydrocarbyl, substituted C_1-C_{40} hydrocarbyl, a monovalent heteroatom, or a heteroatom-bonded monovalent group;

L is a Lewis base, optionally any two L groups join together to form a bidentate Lewis base;

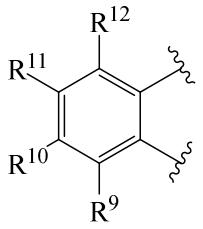
X is an anionic ligand, optionally an X group is joined to an L group to form a monoanionic bidentate group, or optionally, any two X groups are joined together to form a dianionic ligand;

n is 1, 2 or 3;

m is 0, 1, or 2; and

n+m is not greater than 4.

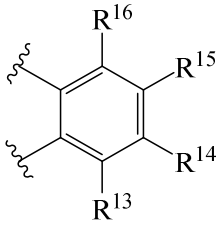
2. The catalyst compound of claim 1, wherein A^1 is represented by the formula:



wherein ~ indicates a connection to the catalyst compound, and

each of R^9, R^{10}, R^{11}, and R^{12} is independently hydrogen, C_1-C_{40} hydrocarbyl, C_1-C_{40} substituted hydrocarbyl, a monovalent heteroatom, or a heteroatom-bonded monovalent group, or one or more of R^9 and R^{10}, R^{10} and R^{11}, or R^{11} and R^{12} may be joined to form one or more substituted hydrocarbyl rings, unsubstituted hydrocarbyl rings, substituted heterocyclic rings, or unsubstituted heterocyclic rings each having 5, 6, 7, or 8 ring atoms.

3. The catalyst compound of claim 1, wherein A^2 is represented by the formula:



wherein ~ indicates a connection to the catalyst compound, and

each of R^{13}, R^{14}, R^{15}, and R^{16} is independently hydrogen, C_1-C_{40} hydrocarbyl, C_1-C_{40} substituted hydrocarbyl, a monovalent heteroatom, or a heteroatom-bonded monovalent group, or one or more of R^{13} and R^{14}, R^{14} and R^{15}, or R^{15} and R^{16} may be joined to form one or more substituted hydrocarbyl rings, unsubstituted hydrocarbyl rings, substituted heterocyclic rings, or unsubstituted heterocyclic rings each having 5, 6, 7, or 8 ring atoms.

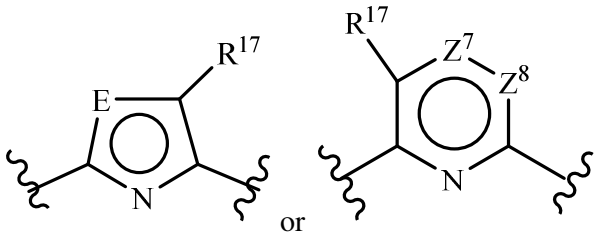
4. The catalyst compound of claim 1, wherein the compound features a tridentate dianionic ligand that is coordinated to the metal to form a pair of 8-membered metallocycle rings.

5. The catalyst compound of claim 1, wherein J is a group 15-containing heterocycle, or a group 16-containing heterocycle.

6. The catalyst compound of claim 1, wherein J is a nitrogen-containing heterocycle, an oxygen-containing heterocycle, a phosphorus-containing heterocycle, or a sulfur-containing heterocycle.

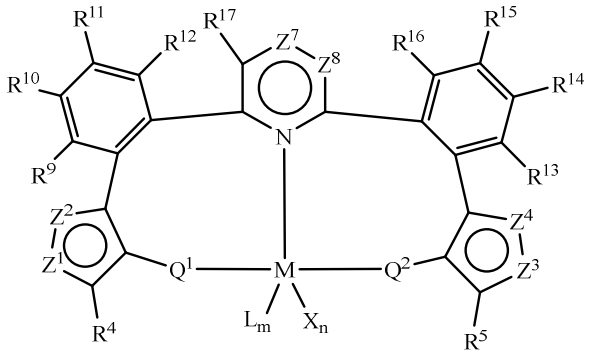
7. The catalyst compound of any of claims 1 to 6, wherein J is selected from a pyridine, a pyrimidine, a pyrazine, a thiazole, an oxazole, an oxazoline, an imidazole, a furan, or a thiofuran.

8. The catalyst compound of any of claims 1 to 6, wherein J is represented by the formula:

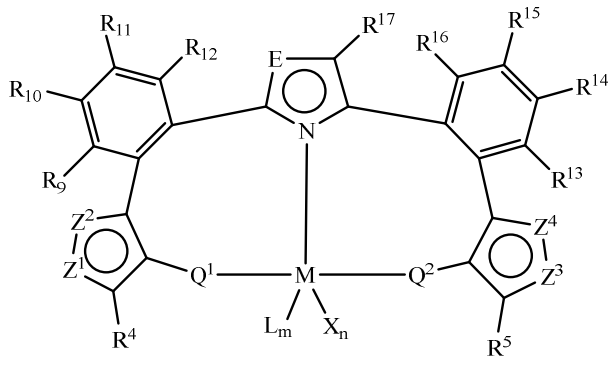


wherein ~ indicates a connection to the catalyst compound; E is oxygen, sulfur, or NR^{17}; Z^7 is selected from nitrogen and $C(R^{18})$; Z^8 is selected from nitrogen and $C(R^{19})$; and each of R^{17} and R^{18} and R^{19} are selected from hydrogen, C_1-C_{40} hydrocarbyl, C_1-C_{40} substituted hydrocarbyl, a monovalent heteroatom, or a heteroatom-bonded monovalent group..

9. The catalyst compound of claim 1, wherein the catalyst compound represented by Formula (**I**) is represented by Formula (**II**) or Formula (**III**):



(**II**)



(**III**)

wherein:

each Q^1 and Q^2 are independently selected from oxygen, sulfur, $N(R^{30})$, or $P(R^{30})$, wherein R^{30} is C_1-C_{40} hydrocarbyl, substituted C_1-C_{40} hydrocarbyl, a monovalent heteroatom, or a heteroatom-bonded monovalent group;

heterocyclic ring fragments -(Z^1Z^2)- and –(Z^3Z^4)- are selected from –(Z^5Z^6)- or –(Z^6Z^5)-, with Z^5 being selected from oxygen, sulfur, S(O), $S(O)_2$, and $N(R^{50})$, and Z^6 being selected from nitrogen and $C(R^{51})$, wherein each R^{50} and R^{51} is independently hydrogen, C_1-C_{40} hydrocarbyl, C_1-C_{40} substituted hydrocarbyl, a monovalent heteroatom, or a heteroatom-bonded monovalent group;

Z^7 is selected from nitrogen and $C(R^{18})$;

Z^8 is selected from nitrogen and $C(R^{19})$;

E is oxygen, sulfur, or $N(R^{20})$;

each of R^4 and R^5 is independently hydrogen, C_1-C_{40} hydrocarbyl, C_1-C_{40} substituted hydrocarbyl, a monovalent heteroatom, or a heteroatom-bonded monovalent group;

each of R^9, R^{10}, R^{11}, and R^{12} is independently hydrogen, C_1-C_{40} hydrocarbyl, C_1-C_{40} substituted hydrocarbyl, a monovalent heteroatom, or a heteroatom-bonded monovalent group, or one or more of R^9 and R^{10}, R^{10} and R^{11}, or R^{11} and R^{12} may be joined to form one or more substituted hydrocarbyl rings, unsubstituted hydrocarbyl rings, substituted heterocyclic rings, or unsubstituted heterocyclic rings each having 5, 6, 7, or 8 ring atoms;

each of R^{13}, R^{14}, R^{15}, and R^{16} is independently hydrogen, C_1-C_{40} hydrocarbyl, C_1-C_{40} substituted hydrocarbyl, a monovalent heteroatom, or a heteroatom-bonded monovalent group, or one or more of R^{13} and R^{14}, R^{14} and R^{15}, or R^{15} and R^{16} may be joined to form one or more substituted hydrocarbyl rings, unsubstituted hydrocarbyl rings, substituted heterocyclic rings, or unsubstituted heterocyclic rings each having 5, 6, 7, or 8 ring atoms;

each of R^{17}, R^{18}, R^{19} and R^{20} is hydrogen, C_1-C_{40} hydrocarbyl, C_1-C_{40} substituted hydrocarbyl, a monovalent heteroatom, or a heteroatom-bonded monovalent group, or one or

more of R^{17} and R^{18}, R^{18} and R_{19} may be joined together to form one or more substituted hydrocarbyl rings, unsubstituted hydrocarbyl rings, substituted heterocyclic rings, or unsubstituted heterocyclic rings each having 5, 6, 7, or 8 ring atoms;

M is a group 3, 4, or 5 metal;

L is a Lewis base;

X is an anionic ligand;

n is 1, 2 or 3;

m is 0, 1, or 2;

n+m is not greater than 4;

any two L groups may be joined together to form a bidentate Lewis base;

an X group may be joined to an L group to form a monoanionic bidentate group; and any two X groups may be joined together to form a dianionic ligand.

10. The catalyst compound of claim 9, wherein M is zirconium or hafnium.

11. The catalyst compound of claim 10, wherein R^9 through R^{17} are hydrogen.

12. The catalyst compound of claim 11, wherein R^4 and R^5 are each selected from C_1-C_{40} hydrocarbyl, C_1-C_{40} substituted hydrocarbyl, or a heteroatom-bonded monovalent group containing up to 40 atoms~~.~~, wherein -(Z^1Z^2)- and –(Z^3Z^4)- are selected from –(Z^5Z^6)- or –(Z^6Z^5)-, with Z^5 being oxygen or sulfur, and wherein R^4 and R^5 are each selected from C_4-C_{40} cyclic tertiary hydrocarbyl groups.

~~13. The catalyst compound of claim 12, wherein (Z^1Z^2) and (Z^3Z^4) are selected from (Z^5Z^6) or (Z^6Z^5) , with Z^5 being oxygen or sulfur.~~

~~14. The catalyst compound of claim 13, wherein R^4 and R^5 are each selected from C_4-C_{40} cyclic tertiary hydrocarbyl groups.~~

~~15.~~13. The catalyst compound (**II**) of claim 9, wherein Z^7 is C(R^{18}), wherein R^{18} is selected from hydrogen, trifluoromethyl, methoxy, Me_2N, or halogen atom~~.~~, wherein Z^8 is C(R^{19}), wherein R^{18} is hydrogen, wherein R^4 and R^5 are each selected from C_4-C_{20} hydrocarbyls, tertiary hydrocarbyl, or cyclic tertiary hydrocarbyl, and wherein each of R^9, R^{10}, R^{11}, R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, and R^{17} is independently hydrogen or C_1-C_{10} alkyl.

~~16. The catalyst compound of claim 15, wherein Z^8 is C(R^{19}), wherein R^{18} is hydrogen.~~

~~17. The catalyst compound of claim 16, wherein R^4 and R^5 are each selected from C_4-C_{20} hydrocarbyls.~~

~~18.~~14. The catalyst compound of claim ~~17~~ 1, wherein R^4 and R^5 are each selected from C_6-C_{20} aryls~~.~~, tertiary hydrocarbyl, or cyclic tertiary hydrocarbyl, preferably adamantan-1-yl, 3,5-dimethyladamantan-1-yl, and 3,5,7-trimethyladamantan-1-yl.

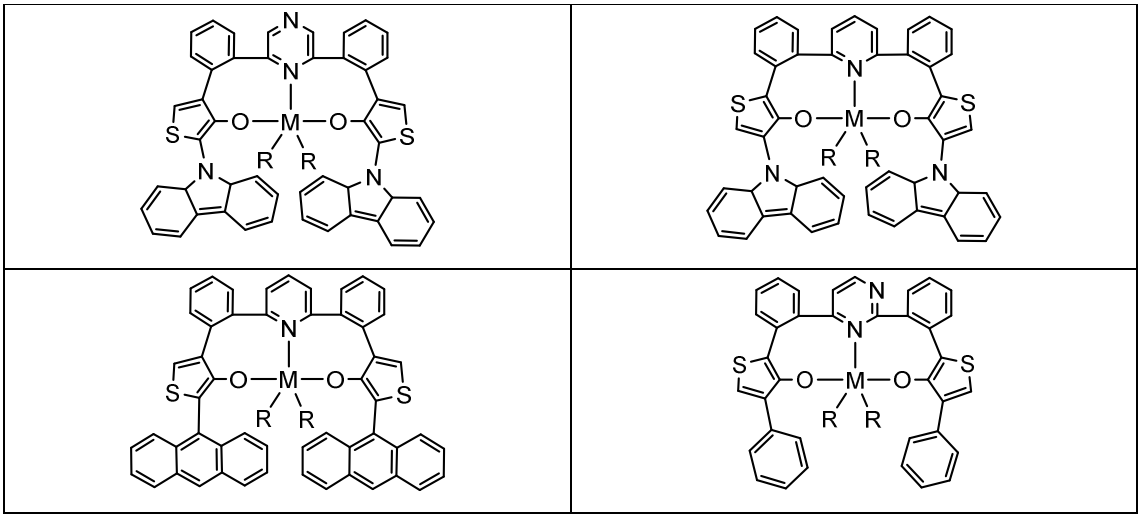
~~19. The catalyst compound of claim 17, wherein R^4 and R^5 are each selected from C_4-C_{20} tertiary hydrocarbyl.~~

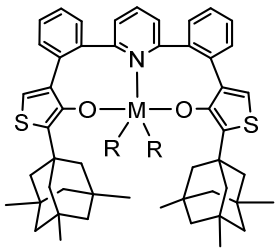
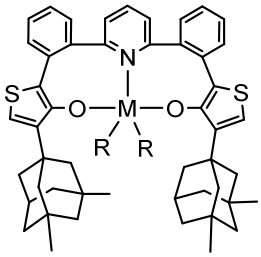
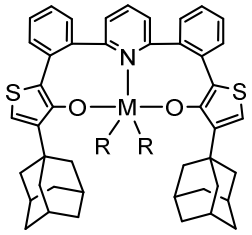
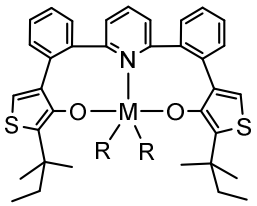
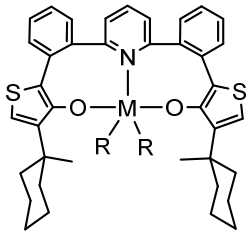
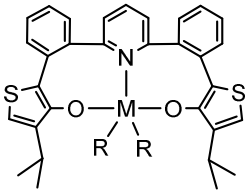
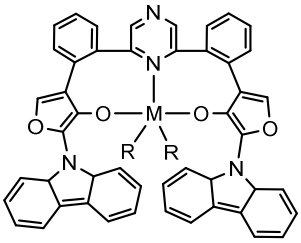
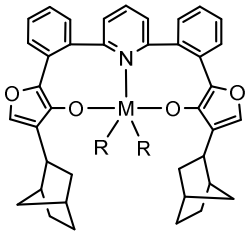
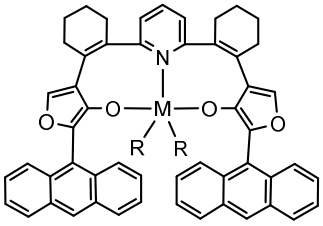
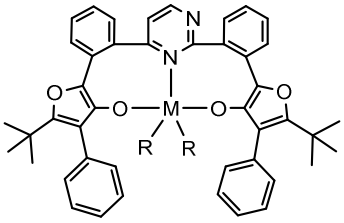
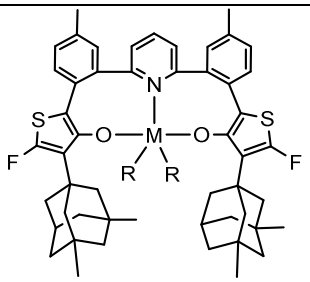
~~20. The catalyst compound of claim 19, wherein R^4 and R^5 are each selected from C_4-C_{20} cyclic tertiary hydrocarbyl.~~

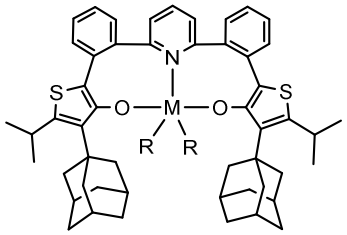
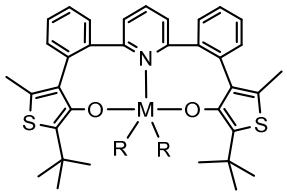
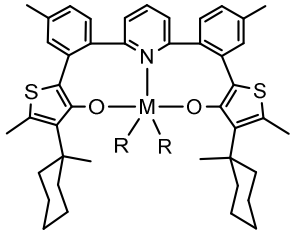
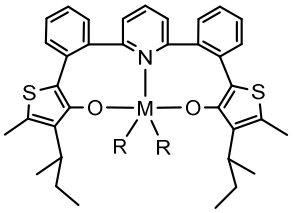
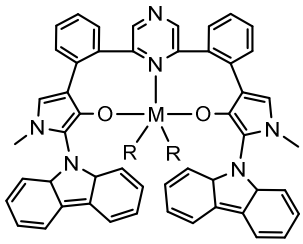
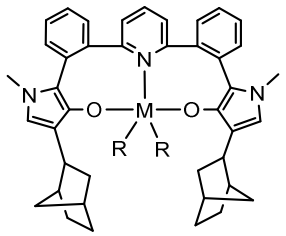
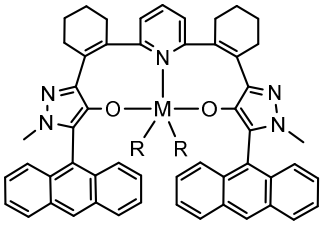
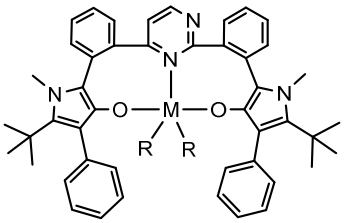
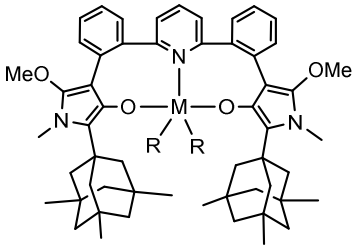
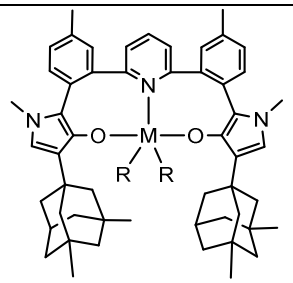
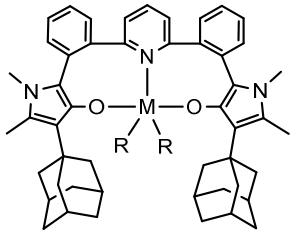
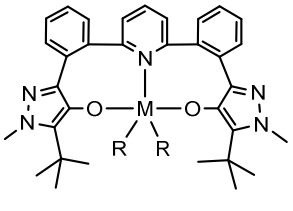
~~21. The catalyst compound of claim 20, wherein R^4 and R^5 are each selected from adamantan-1-yl, 3,5-dimethyladamantan-1-yl, and 3,5,7-trimethyladamantan-1-yl.~~

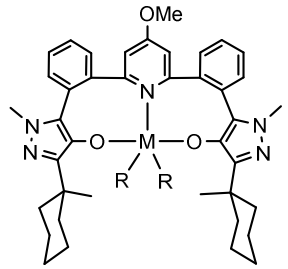
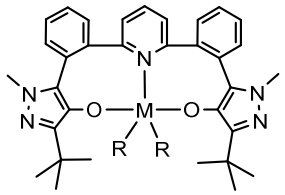
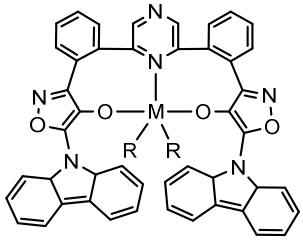
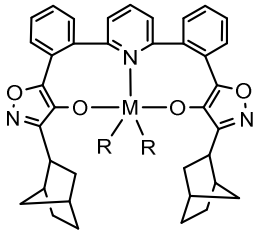
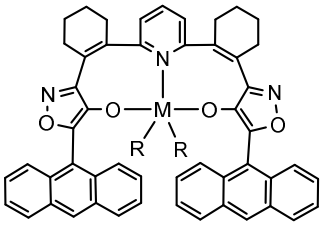
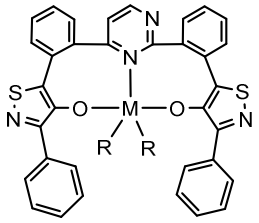
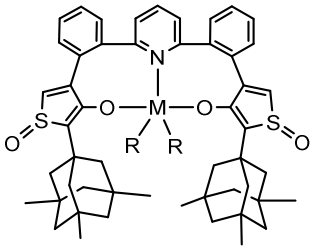
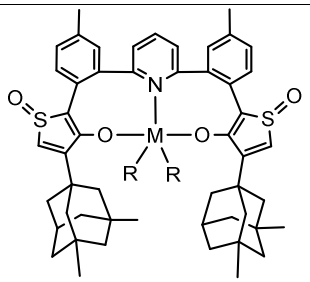
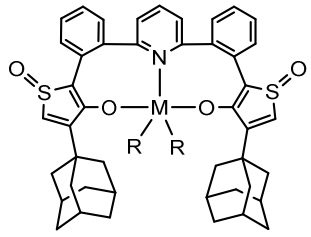
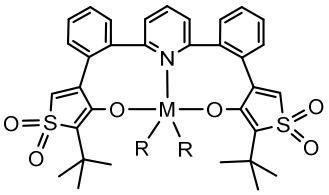
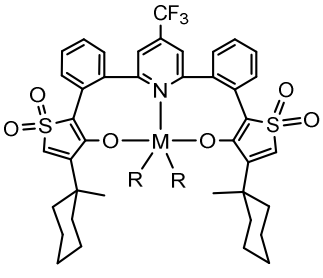
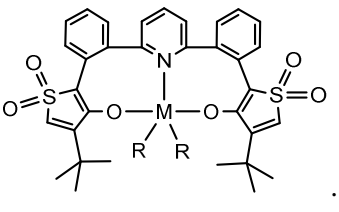
~~22. The catalyst compound of claim 17, wherein each of R^9, R^{10}, R^{11}, R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, and R^{17} is independently hydrogen or C_1-C_{10} alkyl.~~

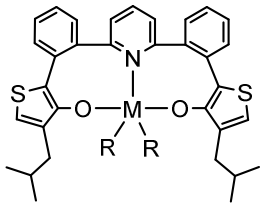
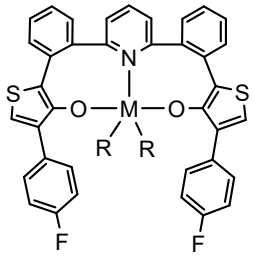
~~23.~~15. The catalyst compound of claim 1, wherein the catalyst compound is selected from the following, with M = Zr or Hf; and R = C_1-C_{20} hydrocarbyl, a monovalent heteroatom, or a heteroatom-bonded monovalent group:



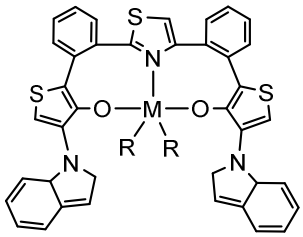
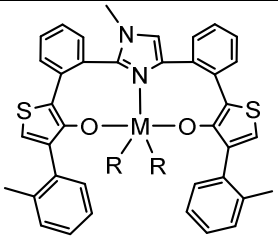
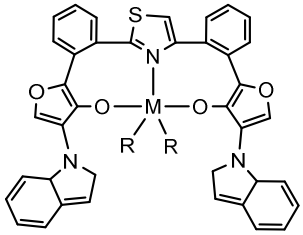
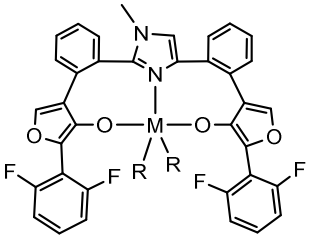
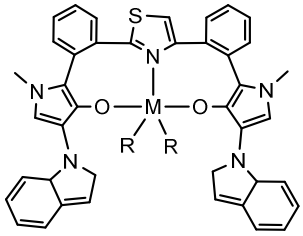
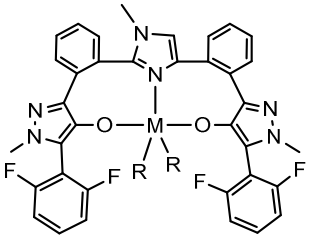
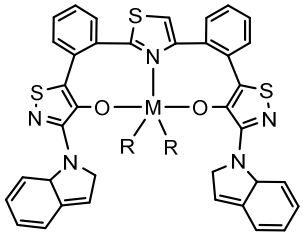
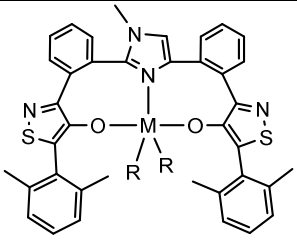
	
	
	
	
	
 MeO OMe	

~~24.~~16. The catalyst compound of claim 1, wherein the catalyst compound is selected from the following, with M = Zr or Hf; and R = C_1-C_{20} hydrocarbyl, a monovalent heteroatom, or a heteroatom-bonded monovalent group:

~~25.~~17. A catalyst system comprising an activator and the catalyst compound of claim 1.

~~26. The catalyst system of claim 25, further comprising a support material.~~

27. The catalyst system of claim 26, wherein the support material is selected from Al_2O_3, ZrO_2, SiO_2, SiO_2/Al_2O_3, SiO_2/TiO_2, silica clay, silicon oxide/clay, or mixtures thereof.

28. The catalyst system of claim 25, wherein the activator comprises a non-coordinating anion activator.

29. The catalyst system of claim 28, wherein the activator is represented by the formula:

$$(Z)_d^+ (A^{d-})$$

wherein Z is (L-H) or a reducible Lewis Acid, L is a Lewis base; H is hydrogen; $(L\text{-}H)^+$ is a Bronsted acid; A^{d-} is a non-coordinating anion having the charge d-; and d is an integer from 1 to 3.

30. The catalyst system of claim 28, wherein the activator is represented by the formula:

$$[R^1R^2R^3EH]_d^+[M^{k+}Q_n]^{d-}$$

wherein:

E is nitrogen or phosphorous;

d is 1, 2 or 3; k is 1, 2, or 3); n is 1, 2, 3, 4, 5, or 6; n - k = d;

each of R^1, R^2, and R^3 is independently H, optionally substituted C_1-C_{40} alkyl or optionally substituted C_5-C_{50} aryl; wherein R^1, R^2, and R^3 together comprise 15 or more carbon atom;

M is an element selected from group 13 of the Periodic Table of the Elements; and

each Q is independently a hydride, bridged or unbridged dialkylamido, halide, alkoxide, aryloxide, hydrocarbyl, substituted hydrocarbyl, halocarbyl, substituted halocarbyl, or halosubstituted hydrocarbyl radical.

31. The catalyst system of claim 28, wherein the activator is one or more of:

N-methyl-4-nonadecyl-N-octadecylanilinium tetrakis(perfluoronaphthalen-2-yl)borate,
N-methyl-4-nonadecyl-N-octadecylanilinium tetrakis(perfluorophenyl)borate,
dioctadecylmethylammonium tetrakis(pentafluorophenyl)borate,
dioctadecylmethylammonium tetrakis(perfluoronaphthyl)borate,
N,N-dimethylanilinium tetrakis(pentafluorophenyl)borate,
triphenylcarbenium tetrakis(pentafluorophenyl)borate,
trimethylammonium tetrakis(perfluoronaphthyl)borate,
triethylammonium tetrakis(perfluoronaphthyl)borate,

tripropylammonium tetrakis(perfluoronaphthyl)borate,
tri(n-butyl)ammonium tetrakis(perfluoronaphthyl)borate,
tri(t-butyl)ammonium tetrakis(perfluoronaphthyl)borate,
N,N-dimethylanilinium tetrakis(perfluoronaphthyl)borate,
N,N-diethylanilinium tetrakis(perfluoronaphthyl)borate,
N,N-dimethyl-(2,4,6-trimethylanilinium) tetrakis(perfluoronaphthyl)borate,
tropillium tetrakis(perfluoronaphthyl)borate,
triphenylcarbenium tetrakis(perfluoronaphthyl)borate,
triphenylphosphonium tetrakis(perfluoronaphthyl)borate,
triethylsilylium tetrakis(perfluoronaphthyl)borate,
benzene(diazonium) tetrakis(perfluoronaphthyl)borate,
trimethylammonium tetrakis(perfluorobiphenyl)borate,
triethylammonium tetrakis(perfluorobiphenyl)borate,
tripropylammonium tetrakis(perfluorobiphenyl)borate,
tri(n-butyl)ammonium tetrakis(perfluorobiphenyl)borate,
tri(t-butyl)ammonium tetrakis(perfluorobiphenyl)borate,
N,N-dimethylanilinium tetrakis(perfluorobiphenyl)borate,
N,N-diethylanilinium tetrakis(perfluorobiphenyl)borate,
N,N-dimethyl-(2,4,6-trimethylanilinium) tetrakis(perfluorobiphenyl)borate,
tropillium tetrakis(perfluorobiphenyl)borate,
triphenylcarbenium tetrakis(perfluorobiphenyl)borate,
triphenylphosphonium tetrakis(perfluorobiphenyl)borate,
triethylsilylium tetrakis(perfluorobiphenyl)borate,
benzene(diazonium) tetrakis(perfluorobiphenyl)borate,
[4-t-butyl-PhNMe$_2$H][($C_6F_3(C_6F_5)_2)_4B$],
trimethylammonium tetraphenylborate,
triethylammonium tetraphenylborate,
tripropylammonium tetraphenylborate,
tri(n-butyl)ammonium tetraphenylborate,
tri(t-butyl)ammonium tetraphenylborate,
N,N-dimethylanilinium tetraphenylborate,
N,N-diethylanilinium tetraphenylborate,
N,N-dimethyl-(2,4,6-trimethylanilinium) tetraphenylborate,
tropillium tetraphenylborate,

triphenylcarbenium tetraphenylborate,
triphenylphosphonium tetraphenylborate,
triethylsilylium tetraphenylborate,
benzene(diazonium)tetraphenylborate,
trimethylammonium tetrakis(pentafluorophenyl)borate,
triethylammonium tetrakis(pentafluorophenyl)borate,
tripropylammonium tetrakis(pentafluorophenyl)borate,
tri(n-butyl)ammonium tetrakis(pentafluorophenyl)borate,
tri(sec-butyl)ammonium tetrakis(pentafluorophenyl)borate,
N,N-dimethylanilinium tetrakis(pentafluorophenyl)borate,
N,N-diethylanilinium tetrakis(pentafluorophenyl)borate,
N,N-dimethyl-(2,4,6-trimethylanilinium) tetrakis(pentafluorophenyl)borate,
tropillium tetrakis(pentafluorophenyl)borate,
triphenylcarbenium tetrakis(pentafluorophenyl)borate,
triphenylphosphonium tetrakis(pentafluorophenyl)borate,
triethylsilylium tetrakis(pentafluorophenyl)borate,
benzene(diazonium) tetrakis(pentafluorophenyl)borate,
trimethylammonium tetrakis-(2,3,4,6-tetrafluorophenyl) borate,
triethylammonium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
tripropylammonium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
tri(n-butyl)ammonium tetrakis-(2,3,4,6-tetrafluoro-phenyl)borate,
dimethyl(t-butyl)ammonium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
N,N-dimethylanilinium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
N,N-diethylanilinium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
N,N-dimethyl-(2,4,6-trimethylanilinium) tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
tropillium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
triphenylcarbenium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
triphenylphosphonium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
triethylsilylium tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
benzene(diazonium) tetrakis-(2,3,4,6-tetrafluorophenyl)borate,
trimethylammonium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
triethylammonium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
tripropylammonium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
tri(n-butyl)ammonium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,

~~tri(t-butyl)ammonium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,~~
~~N,N-dimethylanilinium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,~~
~~N,N-diethylanilinium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,~~
~~N,N-dimethyl-(2,4,6-trimethylanilinium) tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,~~
~~tropillium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,~~
~~triphenylcarbenium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,~~
~~triphenylphosphonium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,~~
~~triethylsilylium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,~~
~~benzene(diazonium) tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,~~
~~di-(i-propyl)ammonium tetrakis(pentafluorophenyl)borate,~~
~~dicyclohexylammonium tetrakis(pentafluorophenyl)borate,~~
~~tri(o-tolyl)phosphonium tetrakis(pentafluorophenyl)borate,~~
~~tri(2,6-dimethylphenyl)phosphonium tetrakis(pentafluorophenyl)borate,~~
~~triphenylcarbenium tetrakis(perfluorophenyl)borate,~~
~~1-(4-(tris(pentafluorophenyl)borate)-2,3,5,6-tetrafluorophenyl)pyrrolidinium,~~
~~tetrakis(pentafluorophenyl)borate,~~
~~4-(tris(pentafluorophenyl)borate)-2,3,5,6-tetrafluoropyridine, and~~
~~triphenylcarbenium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate).~~

~~32. The catalyst system of claim 25, further comprising a metal hydrocarbenyl chain transfer agent represented by the formula:~~

~~$Al(R')_{3-v}(R'')_v$~~

~~wherein each R' independently is a C_1-C_{30} hydrocarbyl group; each R'', independently, is a C_4-C_{20} hydrocarbenyl group having an end-vinyl group; and v is from 1 to 3.~~

~~33. The catalyst system of claim 25, wherein the activator comprises an alkylalumoxane.~~

~~34. The catalyst system of claim 33, wherein the alumoxane is present at a molar ratio of aluminum to catalyst compound transition metal of 100:1 or more.~~

~~35.~~18. A process for the production of an ethylene based polymer comprising: polymerizing ethylene by contacting the ethylene with a catalyst system of claim ~~25~~ 17, in one or more continuous stirred tank reactors or loop reactors, in series or in parallel, at a reactor pressure of from 0.05 MPa to 1,500 MPa and a reactor temperature of from 30°C to 230°C.

~~36.~~19. The process of claim ~~35~~ 18, wherein the ethylene based polymer has an Mw value of from 2,000 to 3,000,000 g/mol, Mn value of from 1,000 to 2,000,000 g/mol, Mz value of from 10,000 to 10,000,000 g/mol, and an Mw/Mn of from 1 to 5.

~~37.~~20. The process of claim ~~35~~ 18, wherein the ethylene based polymer has a melting point of from 110°C to 150°C.

~~38.~~21. A process for the production of a propylene based polymer comprising: polymerizing propylene by contacting the propylene with a catalyst system of claim ~~25~~ 17, in one or more continuous stirred tank reactors or loop reactors, in series or in parallel, at a reactor pressure of from 0.05 MPa to 1,500 MPa and a reactor temperature of from 30°C to 230°C.

~~39.~~22. The process of claim ~~38~~ 21, wherein the propylene based polymer has an Mw value of from 500 to 15,000 g/mol, Mn value of from 500 to 15,000 g/mol, Mz value of from 500 to 20,000 g/mol, and an Mw/Mn of from 1 to 5.

~~40.~~23. The process of claim ~~38~~ 21, wherein the propylene based polymer has a melting point of from 50°C to 150°C.

~~41.~~24. A process for the production of an ethylene alpha-olefin copolymer comprising: polymerizing ethylene and at least one C_3-C_{20} alpha-olefin by contacting the ethylene and the at least one C_3-C_{20} alpha-olefin with a catalyst system of claim ~~25~~ 17, in one or more continuous stirred tank reactors or loop reactors, in series or in parallel, at a reactor pressure of from 0.05 MPa to 1,500 MPa and a reactor temperature of from 30°C to 230°C.

~~42.~~25. The process of claim ~~41~~ 24, wherein the ethylene alpha-olefin copolymer has a comonomer content of 0.1 to 50 wt%, an Mw value of from 1,000 to 3,000,000 g/mol, and Mz value of from 1,000 to 10,000,000 g/mol, an Mn value of from 1,000 to 1,000,000 g/mol, and an Mw/Mn of from 1 to 5.

~~43.~~26. The process of claim ~~41~~ 24, wherein the ethylene alpha-olefin copolymer has a melting point of from 100°C to 140°C.

~~44.~~27. A process for the production of a propylene alpha-olefin copolymer comprising: polymerizing propylene and at least one ethylene or at least one C_4-C_{20} alpha-olefin by contacting the propylene and the at least one ethylene or at least one C_3-C_{20} alpha-olefin with a catalyst system of claim ~~25~~ 17, in one or more continuous stirred tank reactors or loop reactors,

in series or in parallel, at a reactor pressure of from 0.05 MPa to 1,500 MPa and a reactor temperature of from 30°C to 230°C.

~~45.~~28. The process of claim ~~44~~ 27, wherein the propylene alpha-olefin copolymer has a comonomer content of 0.1 to 35 wt%, an Mw value of from 1,000 to 3,000,000 g/mol, and Mz value of from 1,000 to 10,000,000 g/mol, an Mn value of from 1,000 to 1,000,000 g/mol, and an Mw/Mn of from 1 to 5.

~~46.~~29. The process of claim ~~44~~ 27, wherein the propylene alpha-olefin copolymer has a melting point of from 100°C to 140°C.