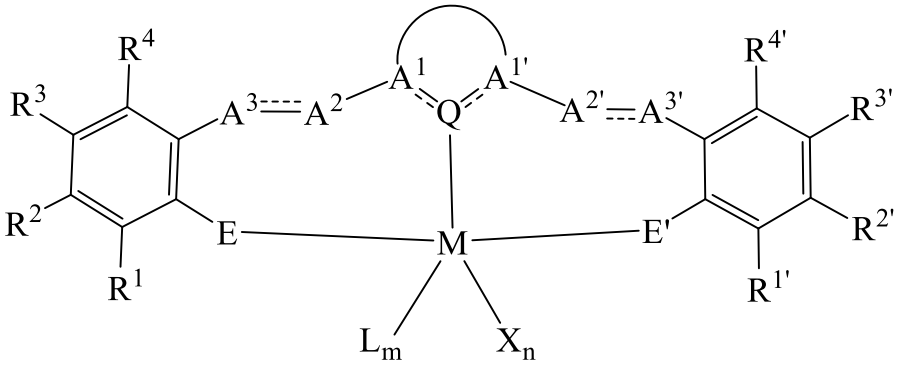
Claims

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



(**I**)

wherein:

M is a group 3, 4, 5, or 6 transition metal or a Lanthanide, preferably Hf, Zr or Ti;

E and E' are each independently O, S, or NR^9 where R^9 is independently hydrogen, a C_1-C_{40} hydrocarbyl, a C_1-C_{40} substituted hydrocarbyl or a heteroatom-containing group;

Q is group 14, 15, or 16 atom that forms a dative bond to metal M;

$A^1QA^{1'}$ are part of a heterocyclic Lewis base containing 4 to 40 non-hydrogen atoms that links A^2 to $A^{2'}$ via a 3-atom bridge with Q being the central atom of the 3-atom bridge, A^1 and $A^{1'}$ are independently C, N, or $C(R^{22})$, where R^{22} is selected from hydrogen, C_1-C_{20} hydrocarbyl, C_1-C_{20} substituted hydrocarbyl;

A^3---A^2 is a divalent group containing 2 to 40 non- hydrogen atoms that links A^1 to the E-bonded aryl group via a 2-atom bridge;

$A^{2'}$---$A^{3'}$ is a divalent group containing 2 to 40 non- hydrogen atoms that links $A^{1'}$ to the E'-bonded aryl group via a 2-atom bridge;

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;

each of R^1, R^2, R^3, R^4, $R^{1'}$, $R^{2'}$, $R^{3'}$, and $R^{4'}$ is independently hydrogen, a C_1-C_{40} hydrocarbyl, a C_1-C_{40} substituted hydrocarbyl, a heteroatom or a heteroatom-containing group,

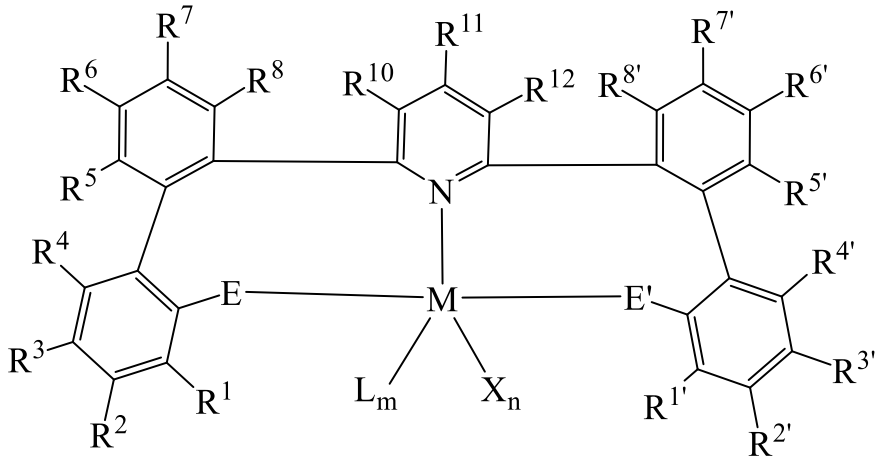
and one or more of R^1 and R^2, R^2 and R^3, R^3 and R^4, $R^{1'}$ and $R^{2'}$, $R^{2'}$ and $R^{3'}$, $R^{3'}$ and $R^{4'}$ may be joined to form one or more substituted hydrocarbyl rings, unsubstituted hydrocarbyl rings, substituted heterocyclic rings, or unsubstituted heterocyclic rings each having 5, 6, 7, or 8 ring atoms, and where substitutions on the ring can join to form additional rings;

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;

any two X groups may be joined together to form a dianionic ligand group.

2. The catalyst compound of formula 1 where the catalyst compound represented by the Formula (**II**):



(**II**)

wherein:

M is a group 3, 4, 5, or 6 transition metal or a Lanthanide;

E and E' are each independently O, S, or NR^9, where R^9 is independently hydrogen, a C_1-C_{40} hydrocarbyl, a C_1-C_{40} substituted hydrocarbyl, or a heteroatom-containing group;

each L is independently a Lewis base;

each X is independently an anionic ligand;

n is 1, 2 or 3;

m is 0, 1, or 2;

n+m is not greater than 4;

each of R^1, R^2, R^3, R^4, $R^{1'}$, $R^{2'}$, $R^{3'}$, and $R^{4'}$ is independently hydrogen, C_1-C_{40} hydrocarbyl, C_1-C_{40} substituted hydrocarbyl, a heteroatom or a heteroatom-containing group, or one or more of R^1 and R^2, R^2 and R^3, R^3 and R^4, $R^{1'}$ and $R^{2'}$, $R^{2'}$ and $R^{3'}$, $R^{3'}$ and $R^{4'}$ 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, and where substitutions on the ring can join to form additional rings;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;

any two X groups may be joined together to form a dianionic ligand group;

each of R^5, R^6, R^7, R^8, $R^{5'}$, $R^{6'}$, $R^{7'}$, $R^{8'}$, R^{10}, R^{11}, and R^{12} is independently hydrogen, a C_1-C_{40} hydrocarbyl, a C_1-C_{40} substituted hydrocarbyl, a heteroatom or a heteroatom-containing

group, or one or more of R^5 and R^6, R^6 and R^7, R^7 and R^8, $R^{5'}$ and $R^{6'}$, $R^{6'}$ and $R^{7'}$, $R^{7'}$ and $R^{8'}$, 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, and where substitutions on the ring can join to form additional rings.

3. The catalyst compound of claim 1or 2 wherein R^1 and $R^{1'}$ is independently a C_4-C_{40} tertiary hydrocarbyl group, is independently a C_4-C_{40} cyclic tertiary hydrocarbyl group, or is independently a C_4-C_{40} polycyclic tertiary hydrocarbyl group.

4. The catalyst compound any of claims 1 to 3 wherein each X is, independently, selected from the group consisting of substituted or unsubstituted hydrocarbyl radicals having from 1 to 20 carbon atoms, hydrides, amides, alkoxides, sulfides, phosphides, halides, and a combination thereof, (two X's may form a part of a fused ring or a ring system).

5. The catalyst compound any of claims 1 to 4 wherein each L is, independently, selected from the group consisting of: ethers, thioethers, amines, phosphines, ethyl ether, tetrahydrofuran, dimethylsulfide, triethylamine, pyridine, alkenes, alkynes, alenes, and carbenes and a combinations thereof, optionally two or more L's may form a part of a fused ring or a ring system).

6. The catalyst compound of claim 1, wherein M is Zr or Hf, Q is nitrogen, both A^1 and $A^{1'}$ are carbon, both E and E' are oxygen, and both R^1 and $R^{1'}$ are C_4-C_{20} cyclic tertiary alkyls, both R^1 and $R^{1'}$ are adamantan-1-yl or substituted adamantan-1-yl, or both R^1 and $R^{1'}$ are C_6-C_{20} aryls.

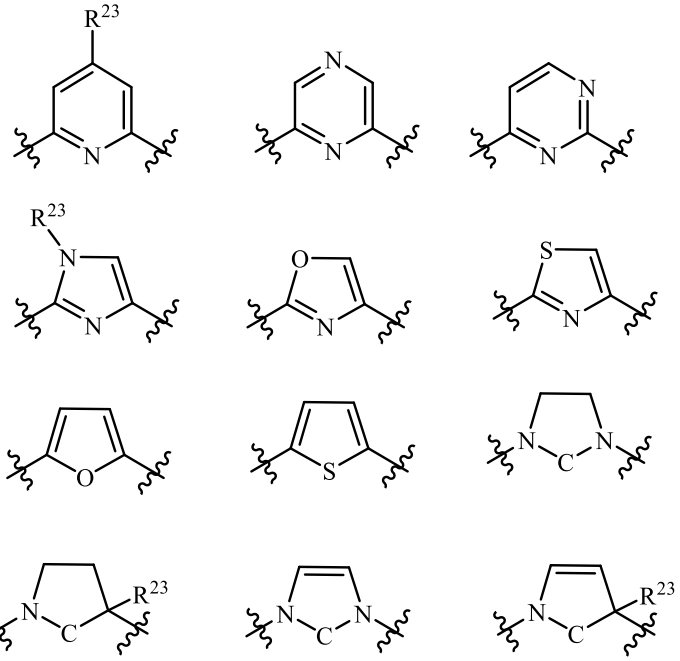
7. The catalyst compound of claim 1, wherein Q is nitrogen, A^1 and $A^{1'}$ are both carbon, both R^1 and $R^{1'}$ are hydrogen, both E and E' are NR^9, where R^9 is selected from a C_1-C_{40} hydrocarbyl, a C_1-C_{40} substituted hydrocarbyl, or a heteroatom-containing group.

8. The catalyst compound of claim 1, wherein

Q is carbon, A^1 and $A^{1'}$ are both nitrogen, and both E and E' are oxygen, or

Q is carbon, A^1 is nitrogen, $A^{1'}$ is $C(R^{22})$, and both E and E' are oxygen, where R^{22} is selected from hydrogen, C_1-C_{20} hydrocarbyl, C_1-C_{20} substituted hydrocarbyl.

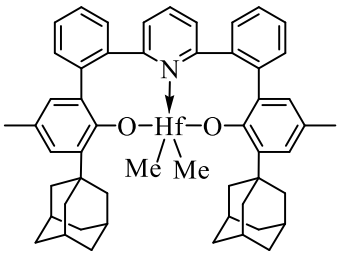
9. The catalyst compound of claim 1, wherein the heterocyclic Lewis base is selected from the groups represented by the following formulas:



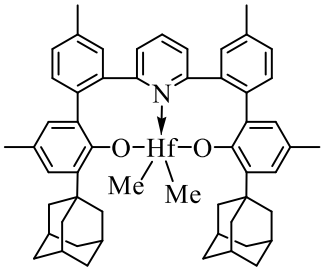
where each R^{23} is independently selected from hydrogen, C_1-C_{20} alkyls, and C_1-C_{20} substituted alkyls.

10. The catalyst compound of claim 2, wherein M is Zr or Hf, both E and E' are oxygen, and at least on one of the following: (a) R^1 and $R^{1'}$ are C_4-C_{20} cyclic tertiary alkyls or adamantan-1-yl or substituted adamantan-1-yl; (b) each of R^1, $R^{1'}$, R^3 and $R^{3'}$ are adamantan-1-yl or substituted adamantan-1-yl; (c) R^1 and $R^{1'}$ are C_4-C_{20} cyclic tertiary alkyls, and both R^7 and $R^{7'}$ are C_1-C_{20} alkyls; (d) both R^1 and $R^{1'}$ are C_4-C_{20} cyclic tertiary alkyls, and both R^7 and $R^{7'}$ are C_1-C_{20} alkyls; and (e) both R^1 and $R^{1'}$ are C_4-C_{20} cyclic tertiary alkyls and both R^7 and $R^{7'}$ are C_1-C_3 alkyls.

11. The catalyst compound of claim 1 wherein the catalyst compoud is represented by one or more of the following formulas:



Complex 1



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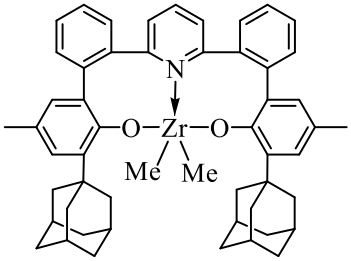

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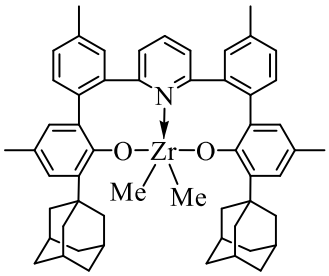

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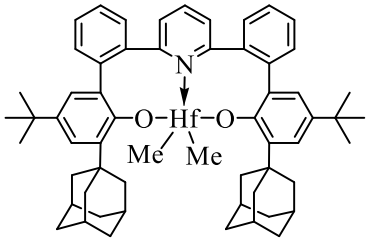

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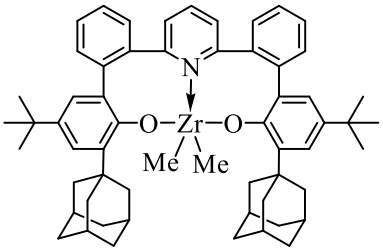

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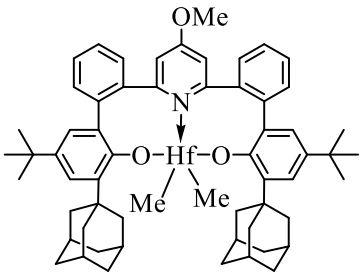

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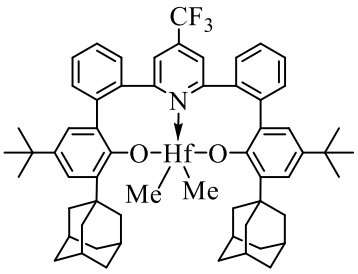

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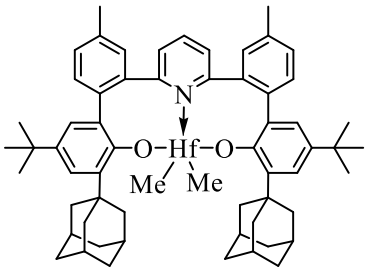

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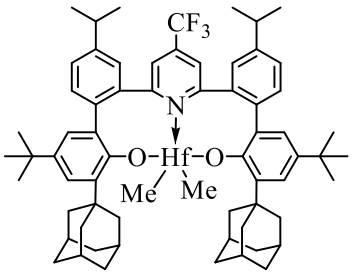

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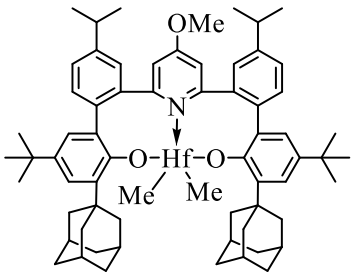

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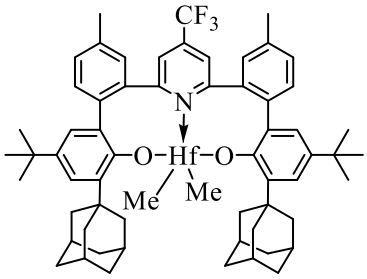

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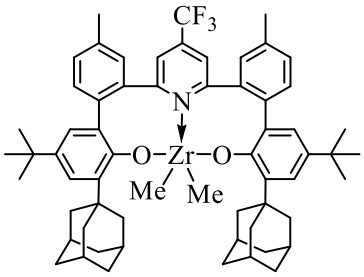

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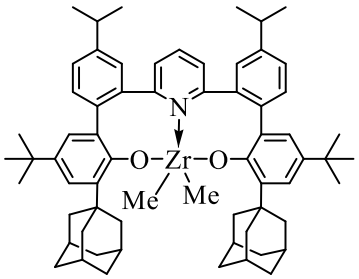

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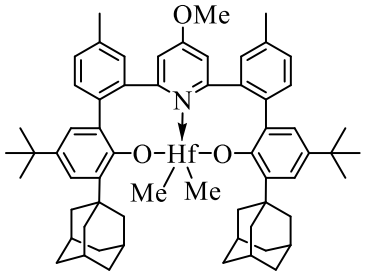
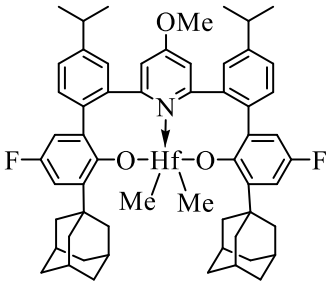
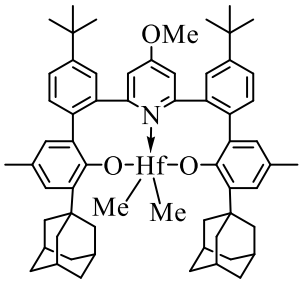


Complex 15



Complex 16



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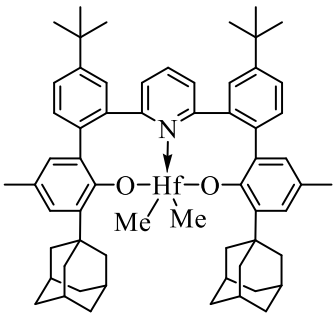

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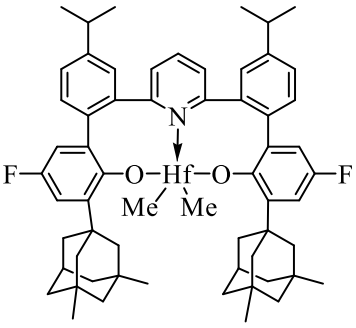

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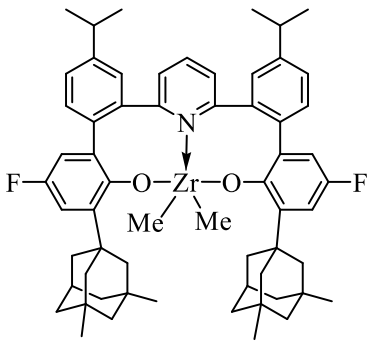

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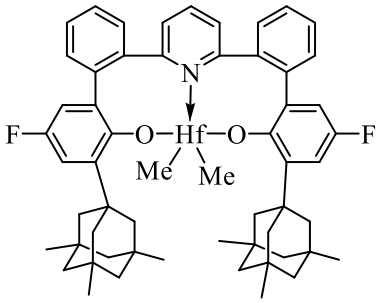

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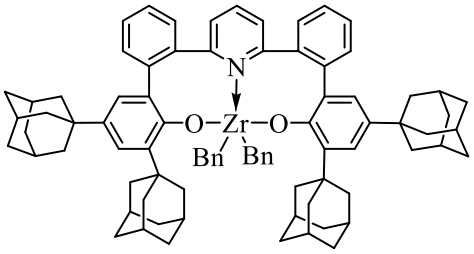

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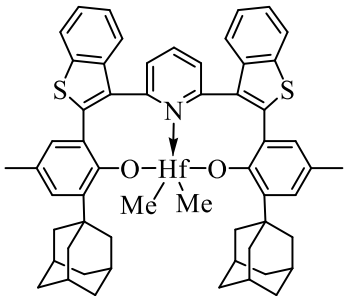
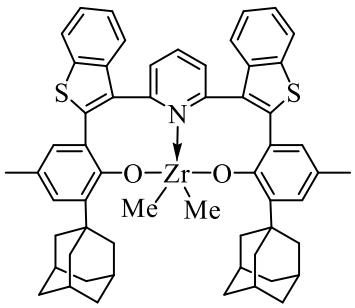


Complex 23



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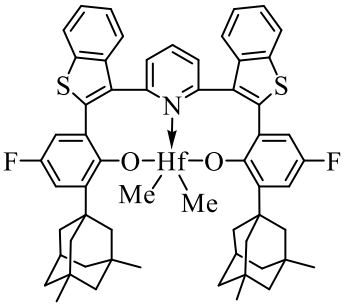
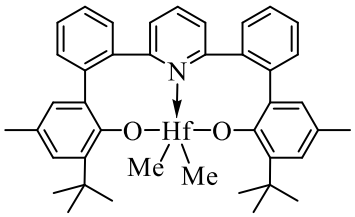
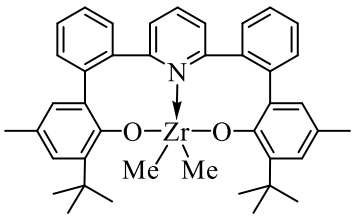


Complex 25



Complex 26



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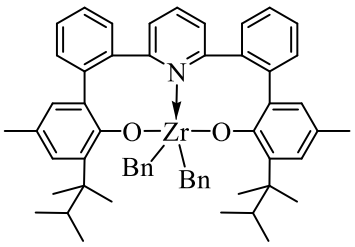

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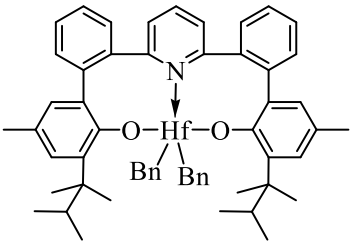

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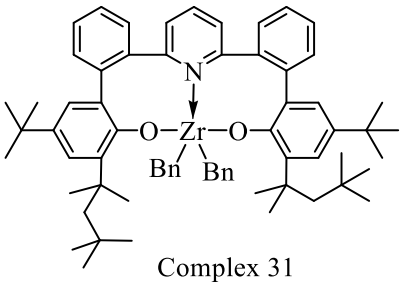
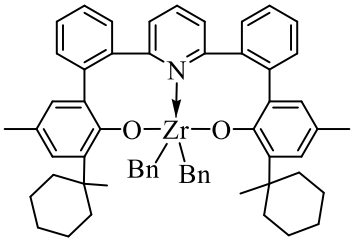


Complex 31



Complex 32

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12. A process to polymerize olefins comprising: contacting one or more olefins, preferably one or more substituted or unsubstituted C_2 to C_{40} alpha olefins, with a catalyst system including an activator and the catalyst of any one of claims 1 to 11; and obtaining a polymer.

13. The process of claim 12 wherein the process occurs at a temperature of from about 0°C to about 300°C, at a pressure in the range of from about 0.35 MPa to about 10 MPa, and at a time up to 300 minutes.