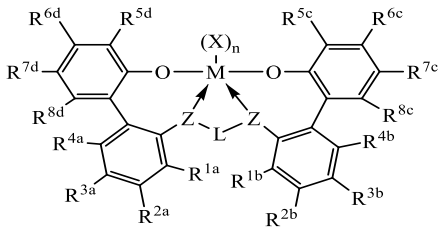
CLAIMS:

1. A process for preparing an olefin homopolymer or copolymer, comprising contacting ethylene, an alpha-olefin, or a combination thereof, and a catalytic amount of a metal-ligand complex catalyst of the formula (I):



where

M is titanium, zirconium, or hafnium, and has a formal oxidation state of +2, +3, or +4;

n is 0, 1, or 2;

when n is 1, X is a monodentate ligand or a bidentate ligand;

when n is 2, each X is an independently chosen monodentate ligand;

the metal-ligand complex is overall charge-neutral;

each Z is independently chosen from −O−, −S−, −N(R^N)−, or –P(R^P)−;

L is (C_1-C_{40})hydrocarbylene or (C_1-C_{40})heterohydrocarbylene, provided such has a portion that comprises a 2- to 8-carbon atom linker backbone linking the Z moieties, each atom of such 2- to 8-atom linker being independently a carbon atom or a heteroatom, wherein each heteroatom independently is O, S, S(O), S(O)$_2$, Si(R^C)$_2$, Ge(R^C)$_2$, P(R^P), or N(R^N), wherein independently each R^C is unsubstituted (C_1–C_{18})hydrocarbyl or the two R^C are taken together to form a (C_2–C_9)alkylene, each R^P is unsubstituted (C_1–C_{18})hydrocarbyl; and each R^N is unsubstituted (C_1–C_{18})hydrocarbyl, a hydrogen atom or absent;

R^{1a} and R^{1b} are independently a halogen atom or a hydrogen, provided that at least one of R^{1a} and R^{1b} is a halogen atom;

R^{2a}, R^{3a}, R^{4a}, R^{2b}, R^{3b}, R^{4b}, R^{6c}, R^{7c}, R^{8c}, R^{6d}, R^{7d}, and R^{8d} independently is a hydrogen atom; (C_1-C_{40})hydrocarbyl; (C_1-C_{40})heterohydrocarbyl; Si(R^C)$_3$, Ge(R^C)$_3$, P(R^P)$_2$, N(R^N)$_2$, OR^C, SR^C, NO_2, CN, F_3C, F_3CO, RCS(O)-, RCS(O)$_2$-, (RC)$_2$C=N-, RCC(O)O-, RCOC(O)-, RCC(O)N(R)-, (RC)$_2$NC(O)- or halogen atom; and

R^{5c} and R^{5d} are independently selected from: phenanthren-9-yl; 2,3-dihydro-1*H*-inden-6-yl; naphthalene-2-yl; 2,6-diethylphenyl; 2,6-diphenyl-phenyl; 3,5-dimethylphenyl; 3,5-bis(tri-

fluoromethyl)phenyl; 3,5-bis(1-methylethyl)phenyl; 2,4,6-trimethylphenyl; and 2,4,6-tris(1-methylethyl)phenyl); 1-methyl-2,3-dihydro-1*H*-inden-6-yl; 1,1-dimethyl-2,3-dihydro-1*H*-inden-6-yl; 1-methyl-1,2,3,4-tetrahydro-naphthalen-5-yl; 1,1-dimethyl-1,2,3,4-tetrahydronaphthalen-5-yl; 3,6-di(tertiary-octyl)-carbazolyl; 3,6-di(tertiary-octyl)-carbazol-9-yl; 3,6-diphenylcarbazol-9-yl; 3,6-bis(2,4,6-trimethylphenyl)-carbazol-9-yl; quinolin-4-yl; quinolin-5-yl; quinolin-8-yl; 1,2,3,4-tetrahydroquinolin-1-yl; isoquinolin-1-yl; isoquinolin-4-yl; isoquinolin-5-yl; isoquinolin-8-yl; 1,2,3,4-tetrahydroisoquinolin-2-yl; 1*H*-indol-1-yl; 1*H*-indolin-1-yl; 1,2,3,4-tetrahydrocarbazolyl-9-yl; 1,2,3,4,5,6,7,8-octahydrocarbazolyl-9-yl; 4,6-bis(1,1-dimethylethyl)pyridine-2-yl; 4,6-diphenylpyridin-2-yl; 3-phenyl-1*H*-indol-1-yl; 3-(1,1-dimethylethyl)-1*H*-indol-1-yl; 3,6-diphenyl-9*H*-carbazol-9-yl; 3,6-di(1-methylethyl)-9*H*-carbazol-9-yl; 3,6-dimethyl-9*H*-carbazol-9-yl; 3,6-diethyl-9*H*-carbazol-9-yl; 3,6-bis[2′,4′,6′-tris(1,1-dimethylphenyl)]-9*H*-carbazol-9-yl; 3,6-di(tertiary-butyl)-carbazol-9-yl, provided that when R^{5c} and R^{5d} are 3,6-di(tertiary-butyl)-carbazol-9-yl, R^{1a} or R^{1b} is –H;

under conditions such that an ethylene homopolymer, an alpha-olefin homopolymer, or an ethylene/alpha-olefin copolymer is formed,

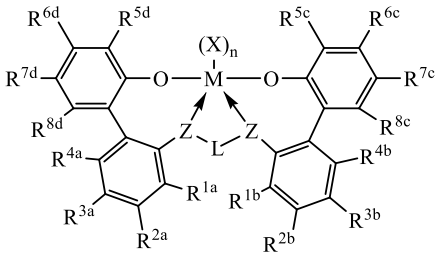
such having a weight average molecular weight that is reduced by at least 20 percent when compared with an otherwise identical ethylene homopolymer, alpha-olefin homopolymer or ethylene/alpha-olefin copolymer prepared under identical conditions with a catalyst that is otherwise identical but wherein neither R^{1a} nor R^{1b} is a halogen atom.

2. The process of claim 1 wherein R^{1a}, R^{1b}, or both is independently a halogen atom chosen from fluorine, chlorine, or iodine.

3. The process of any of claim 1 or 2 wherein the alpha-olefin is selected from the group consisting of (A) linear alpha-olefins having from 3 to 12 carbons, (B) branched alpha-olefins having from 5 to 16 carbons, and both (A) and (B).

4. The process of any of claims 1 to 3 wherein R^{2a}, R^{2b}, R^{3a}, R^{3b}, R^{4a}, R^{4b} are hydrogen.

5. A process for preparing an olefin homopolymer or copolymer, comprising contacting ethylene, an alpha-olefin, or a combination thereof, and a catalytic amount of a metal-ligand complex catalyst of the formula (I):



where

M is titanium, zirconium, or hafnium and has a formal oxidation state of +2, +3, or +4;

n is 0, 1, or 2;

when n is 1, X is a monodentate ligand or a bidentate ligand;

when n is 2, each X is an independently chosen monodentate ligand;

the metal–ligand complex is overall charge-neutral;

each Z is independently chosen from −O−, −S−, −N(R^N)−, or –P(R^P)−;

L is (C_1–C_{40})hydrocarbylene or (C_1–C_{40})heterohydrocarbylene, provided such has a portion that comprises a 2- to 8-carbon atom linker backbone linking the Z moieties, each atom of such 2- to 8-atom linker being independently a carbon atom or a heteroatom, wherein each heteroatom independently is O, S, S(O), S(O)$_2$, Si(R^C)$_2$, Ge(R^C)$_2$, P(R^p), or N(R^N), wherein independently each R^C is unsubstituted (C_1–C_{18})hydrocarbyl or the two R^C are taken together to form a (C_2–C_9)alkylene, each R^P is unsubstituted (C_1–C_{18})hydrocarbyl; and each R^N is unsubstituted (C_1–C_{18})hydrocarbyl, a hydrogen atom;

one of R^{1a} and R^{1b} is halogen, and the other is methyl or hydrogen;

R^{2a}, R^{3a}, R^{4a}, R^{2b}, R^{3b}, R^{4b}, R^{6c}, R^{7c}, R^{8c}, R^{6d}, R^{7d}, and R^{8d} independently is a hydrogen atom; (C_1-C_{40}) F_3CO–, R_3Si–, R_3Ge–, RO–, RS–, RS(O)–, RS(O)$_2$–, R_2P–, R_2N–, R_2C═N–, NC–, RC(O)O–, ROC(O)–, RC(O)N(R)–, or $R_2NC(O)$–, or two of the R^S are taken together to form an unsubstituted (C_1-C_{18})alkylene, wherein each R^S independently is an unsubstituted (C_1–C_{18})alkyl;

R^{5c} and R^{5d} are independently a (C_6–C_{40})aryl or (C_1–C_{40})heteroaryl; and each of the aryl, heteroaryl, hydrocarbyl, hydrocarbylene, and heterohydrocarbylene groups is independently unsubstituted or substituted with one or more substituents R^S; and each R^S is independently a halogen atom, polyfluoro substitution, perfluoro substitution, unsubstituted (C_1–C_{18})alkyl, F_3C–, FCH_2O–, F_2HCO–,

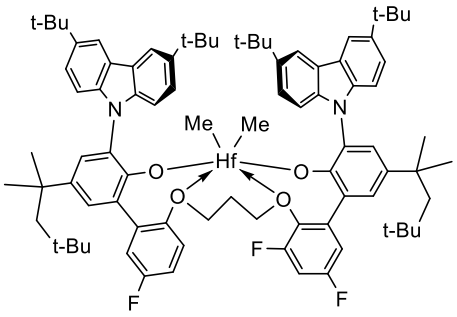
under conditions such that an ethylene homopolymer, an alpha-olefin homopolymer, or an ethylene/alpha-olefin copolymer is formed, such having a weight average molecular weight that is reduced by at least 20 percent when compared with an otherwise identical ethylene homopolymer, alpha-olefin homopolymer or ethylene/alpha-olefin copolymer prepared under identical conditions with a catalyst that is otherwise identical but wherein neither R^{1a} nor R^{1b} is a halogen atom.

6. The process of claim 5 wherein R^{la} or R^{lb} is a halogen atom chosen from fluorine, chlorine, or iodine.

7. The process of any of claim 5 or 6 wherein the alpha-olefin is selected from the group consisting of (A) linear alpha-olefins having from 3 to 12 carbons, (B) branched alpha-olefins having from 5 to 16 carbons, and both (A) and (B).

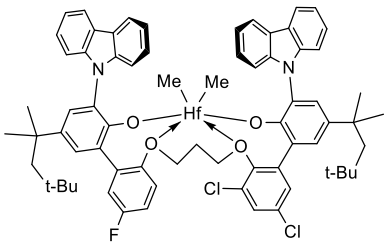
8. The process of any of claims 5 to 7, wherein R^{2a}, R^{2b}, R^{3a}, R^{3b}, R^{4a}, R^{4b} are hydrogen.

9. The process of any of claims 5 to 8, wherein the metal-ligand complex catalyst of the formula (I) is:



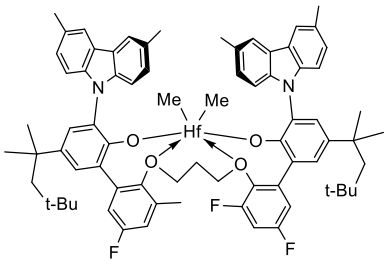
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10. The process of any of claims 5 to 8, wherein the metal-ligand complex catalyst of the formula (I) is:



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11. The process of any of claims 5 to 8, wherein the metal-ligand complex catalyst of the formula (I) is:



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