CLAIMS

What is claimed is:

1. A polymerization catalyst for forming a polyethylene copolymer, comprising:

a catalyst support;

a first catalyst that is impregnated on the catalyst support, wherein the first catalyst generates polymers having a slope for a plot of H_2/C_2 versus 1/Mw of between about $1.0x10^{-6}$ and about $1.5\ x10^{-6}$, and wherein at a C_6/C_2 ratio of between about 0.008 and about 0.012, the first catalyst generates a polymer having an MI of

about 1.0 dg/10 min, a density of about 0.92 g/cc, and an melt index ratio (MIR) less than about 25; and

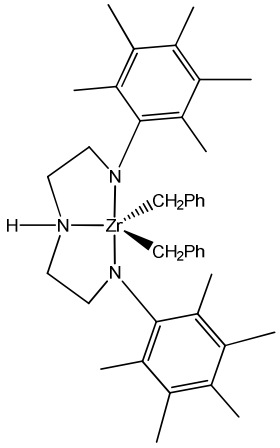
a second catalyst that is impregnated on the catalyst support with the first catalyst, wherein the second catalyst generates polymers having a slope for a plot of H_2/C_2 versus 1/Mw of between about $3.0x10^{-6}$ and about $4 x10^{-6}$, and wherein at a C_6/C_2 ratio of between about 0.03 and about 0.04, the second catalyst generates a polymer having an MI of about 1.0 dg/10 min, a density of about 0.92 g/cc, and an melt index ratio (MIR) less than about 25.

2. The system of claim 1, wherein a catalyst impregnated on the catalyst support is bis(n-propylcyclopentadienyl) hafnium $(CH_3)_2$, bis(n-propylcyclopentadienyl) hafnium F_2, bis(n-propylcyclopentadienyl) hafnium Cl_2, or any combinations thereof.

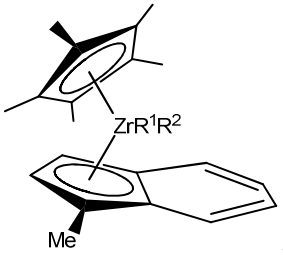
3. The system of claim 1, wherein a catalyst impregnated on the catalyst support is bis(n-butyl, methyl cyclopentadienyl) zirconium $(CH_3)_2$, bis(n-butyl, methyl cyclopentadienyl) zirconium Cl_2, bis(n-butyl, methyl cyclopentadienyl) zirconium F_2, or any combinations thereof.

4. The system of claim 1, wherein a catalyst impregnated on the catalyst support is bis(1-ethylindenyl) zirconium $(CH_3)_2$, bis(1-ethylindenyl) zirconium F_2, bis(1-ethylindenyl) zirconium Cl_2, or any combinations thereof.

5. The system of claim 1, wherein a catalyst impregnated on the catalyst support is represented by the formula:



6. The system of claim 1, wherein a catalyst impregnated on the catalyst support is any one, or any combination, of the compounds represented by the following formulas:



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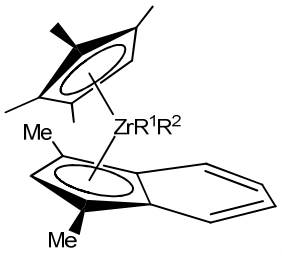

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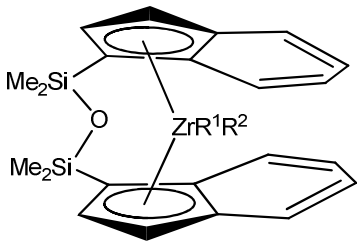

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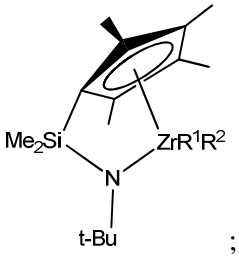


; wherein R^1 and R^2 are each, independently, methyl, chloro, fluoro, or a hydrocarbyl group.

7. The system of claim 1, wherein a chromium catalyst is impregnated on the support.

8. The system of claim 1, where a conventional-type transition metal catalyst is impregnated on the support.

9. The system of claim 1, wherein the catalyst support comprises silica.

10. The system of claim 1, wherein the catalyst support comprises an aluminoxane.

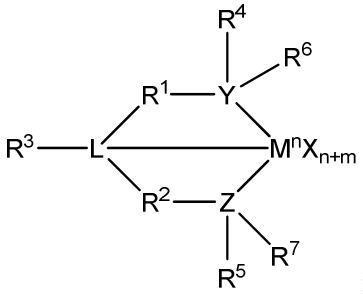
11. The system of claim 1, wherein a catalyst impregnated on the support has the formula:

$$Cp^ACp^BMX_n \text{ or } Cp^A(A)Cp^BMX_n,$$

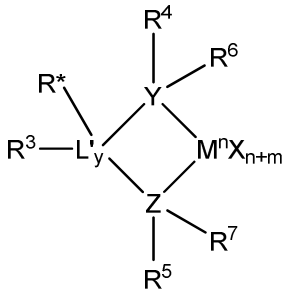
wherein M is a Group 4, 5, or 6 atom; Cp^A and Cp^B are each bound to M and are independently selected from the group consisting of cyclopentadienyl ligands, substituted cyclopentadienyl ligands, ligands isolobal to cyclopentadienyl and substituted ligands isolobal to cyclopentadienyl; (A) is a divalent bridging group bound to both Cp^A and Cp^B selected from the group consisting of divalent C_1 to C_{20} hydrocarbyls and C_1 to C_{20} heteroatom containing

hydrocarbonyls, wherein the heteroatom containing hydrocarbonyls comprise from one to three heteroatoms; each X is independently a chloride ion, a bromide ion, a C_1 to C_{10} alkyl, a C_2 to C_{12} alkenyl, a carboxylate, an acetylacetonate, or an alkoxide; and n is an integer from 1 to 3.

12. The system of claim 1, wherein a catalyst impregnated on the support has the formula:



; or



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wherein M is a Group 3 to 12 transition metal or a Group 13 or 14 main group metal; each X is independently an anionic leaving group; y is 0 or 1; n is the oxidation state of M; m is the formal charge of the ligand represented by YZL or YZL'; L is a Group 15 or 16 element; L' is a group 15 or 16 element or Group 14 containing group; Y is a Group 15 element; Z is a Group 15 element; R^1 and R^2 are independently a C_1 to C_{20} hydrocarbon group, a heteroatom containing group having up to twenty carbon atoms, silicon, germanium, tin, lead, or phosphorus; R^1 and R^2 may be interconnected to each other; R^3 is absent, a hydrocarbon group, hydrogen, a halogen, or a heteroatom containing group; R^4 and R^5 are independently an alky group, an aryl group, a substituted aryl group, a cyclic alkyl group, a substituted cyclic alkyl group, a cyclic aralkyl group, a substituted cyclic aralkyl group, or a multiple ring system; R^4 and R^5 may be interconnected to each other; R^6 and R^7 are independently absent, hydrogen, an alkyl group, a halogen, a heteroatom, or a hydrocarbyl group; and R^* is absent, hydrogen, a Group 14 atom containing group, a halogen, or a heteroatom containing group.

13. The system of claim 1, wherein the polyethylene copolymer formed has a molecular weight ratio for a high molecular weight component to a low molecular weight component of between about 1:2 and 1:5.

14. The system of claim 1, wherein the polyethylene copolymer formed has a density of a high molecular weight component that is between about 0.02 and about 0.05 less than a density of a low molecular weight component.

15. The system of claim 1, wherein the polyethylene copolymer formed has a high molecular weight component with a weight average molecular weight between about 75,000 and about 150,000.

16. The system of claim 1, wherein the polyethylene copolymer formed has a low molecular weight component with a weight average molecular weight between about 10,000 and about 40,000.

17. The system of claim 1, wherein the polyethylene copolymer formed has a weight average molecular weight between about 90,000 and about 110,000.