What is claimed is:

1. A polyethylene copolymer, wherein the copolymer has a comonomer partitioning tendency (ξ) of greater than 1.30, and wherein the comonomer partitioning tendency is defined by equation (1) and measures a proclivity of the polyethylene comonomer to have comonomer in high molecular weight chains;

$$\xi = \frac{CPI}{PDI \times CDI} \qquad (1)$$

wherein

CPI is a comonomer partitioning index (χ_w/χ_n) wherein $\chi_w = \sum N_i(M_iC_i)^2/\sum N_i(M_iC_i)$ and $\chi_n = \sum N_i(M_iC_i)/\sum N_i$;

PDI is a polydispersity index (M_w/M_n);

CDI is a comonomer dispersity index (C_{w+1}/C_w) wherein $C_w = \sum N_iM_iC_i/\sum N_iM_i$ and $C_{w+1} = \sum N_iM_iC_i^2/\sum N_iM_iC_i$;

M_i = molecular weight of a copolymer;

N_i = number of copolymers having molecular weight M_i;

C_i = weight fraction of comonomer in a copolymer;

M_w = weight average molecular weight of the copolymer;

M_n = number average molecular weight of the copolymer; and

C_w = average weight fraction of comonomer in the copolymer.

2. A copolymer according to claim 1, wherein the copolymer has a comonomer partitioning tendency (ξ) of greater than or equal to about 1.4; or

wherein the parameters N_i, M_i, C_i, M_w, M_n and C_w are obtained using one or more analytical techniques that measure molecular weight and comonomer composition; or

wherein the parameters are obtained using cross-fractionation chromatography; or
wherein the parameters are obtained using a combination of cross-fractionation chromatography and another technique measuring molecular weight.
wherein the parameters are obtained using a combination of cross-fractionation chromatography and conventional GPC.

3. A copolymer according to claim 1, wherein the comonomer is one or more comonomers containing 3 to 16 carbon atoms; or
wherein the comonomer is one or more alpha-olefins; or

4. A copolymer according to any one of claims 1 to 3, wherein the copolymer has a melt index (I_2) ranging from about 0.01 to about 500; or
wherein the copolymer has a melt index (I_2) ranging from about 0.1 to about 100; or
wherein the copolymer has a melt index (I_2) ranging from about 0.2 to about 20; or
wherein the copolymer has a melt index ratio (I_{21}/I_2) ranging from about 5 to about 300; or
wherein the copolymer has a melt index ratio (I_{21}/I_2) ranging from about 10 to about 150; or
wherein the copolymer has a melt index ratio (I_{21}/I_2) ranging from about 15 to about 70; or
wherein the copolymer has a density ranging from about 0.87 g/cm^3 to about 0.97 g/cm^3; or
wherein the copolymer has a density ranging from about 0.89 g/cm^3 to about 0.94 g/cm^3; or
wherein the copolymer has a polydispersity index (M_w/M_n) ranging from about 1.5 to about 20.

5. A method for preparing a polyethylene copolymer having a comonomer partitioning tendency of greater than 1.30 by polymerizing ethylene and one or more comonomers in the presence of one or more catalyst compositions, wherein the comonomer

partitioning tendency measures a proclivity of the polyethylene comonomer to have comonomer in high molecular weight chains.

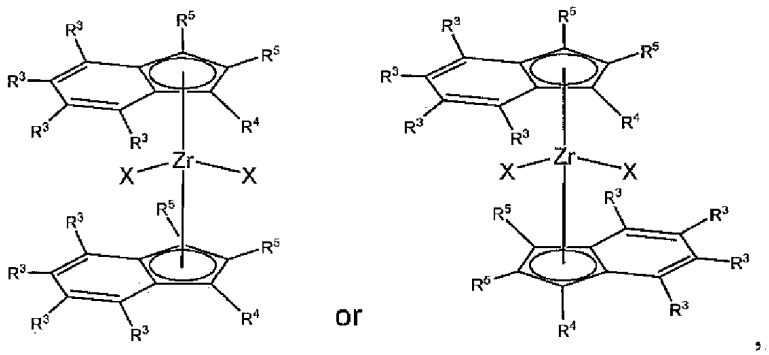
6. A method according to claim 5, wherein the one or more catalyst compositions comprises a catalyst compound having a titanium, a zirconium or a hafnium atom; or
wherein the catalyst composition comprises two or more catalyst compounds comprising a titanium, a zirconium or a hafnium atom; or
wherein the catalyst composition comprises a supported catalyst composition; or
wherein two or more catalyst compounds are co-supported on the same particles of support or carrier; or
wherein the catalyst composition further comprises one or more activators or co-catalysts; or
wherein the activator or co-catalyst comprises an alumoxane, a Lewis acidic borane, or a non-coordinating ionizing activator or combinations thereof.

7. A method according to claim 5 or 6, wherein the one or more catalyst compounds comprises a compound with the following formula:

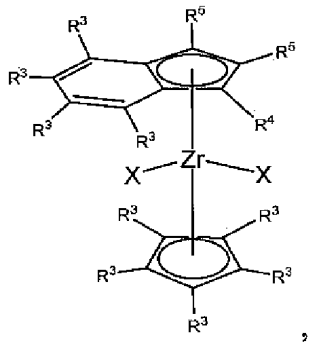
$$(C_5H_aR^1{}_b)(C_5H_cR^2{}_d)HfX_2.$$

wherein, each R^1 is independently H, a hydrocarbyl group, a substituted hydrocarbyl group, or a heteroatom group; each R^2 is independently H, a hydrocarbyl group, a substituted hydrocarbyl group, or a heteroatom group; a and c are ≥ 3; a+b = c+d = 5; at least one R^1 and at least one R^2 is a hydrocarbyl or substituted hydrocarbyl group; adjacent groups R^1 and R^2 groups may be coupled to form a ring; and each X is independently a leaving group selected from a labile hydrocarbyl, substituted hydrocarbyl, or heteroatom group, or a divalent radical that links to an R^1 or R^2 group; or

wherein the one or more catalyst compounds comprises a compound having at least one of the following formulas:

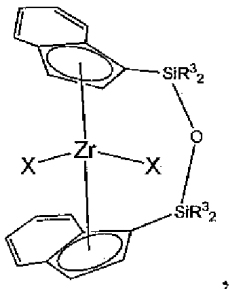


wherein each R^3 is independently H, a hydrocarbyl group, a substituted hydrocarbyl group, or a heteroatom group; R^4 is a hydrocarbyl group, a substituted hydrocarbyl group, or a heteoatom group; each R^5 is independently H, a hydrocarbyl group, a substituted hydrocarbyl group, or a heteroatom group; wherein R^3, R^4, and R^5 may be the same or different; wherein R^3, R^4, or R^5 groups may be joined with R^3, R^4, or R^5 groups on an opposing cyclopentadienyl structure to form one or more bridges if the number of atoms connecting the two cyclopentadienyl rings is $\geq$ 3; and each X is independently a leaving group selected from a labile hydrocarbyl, substituted hydrocarbyl, or heteroatom group, or a divalent radical that links to a R^3, R^4, or R^5 substituent; or wherein the one or more catalyst compounds comprises a compound having the following formula:



wherein, each R^3 is independently H, a hydrocarbyl group, a substituted hydrocarbyl group, or a heteroatom group; R^4 is a hydrocarbyl group, a substituted hydrocarbyl group, or a heteroatom group; each R^5 is independently H, a hydrocarbyl group, a substituted hydrocarbyl group, or a heteroatom group; wherein R^3, R^4, and R^5 may be the same or different; wherein R^3, R^4, or R^5

groups may be joined with R^3, R^4, or R^5 groups on an opposing cyclopentadienyl structure to form one or more bridges if the number of atoms connecting the two cyclopentadienyl rings is ≥ 3; and each X is independently a leaving group selected from a labile hydrocarbyl, substituted hydrocarbyl, or heteroatom group, or a divalent radical that links to a R^3, R^4, or R^5 substituent; or wherein the one or more catalyst compounds comprises a compound having the following formula:



wherein, each R^3 is independently H, a hydrocarbyl group, a substituted hydrocarbyl group, or a heteroatom group, wherein each R^3 may be the same or different, each X is independently a leaving group selected from a labile hydrocarbyl, a substituted hydrocarbyl, a heteroatom group, or a divalent radical that links to an R^3 group.

8. A method according to claim 5 or 6 wherein the catalyst composition comprises two or more of the catalyst compounds according to claim 7 in any ratio; or
wherein the comonomer is one or more comonomers containing 3 to 16 carbon atoms; or
wherein the comonomer is one or more alpha-olefins; or
wherein the polymerization is performed in gas phase, slurry phase, solution phase, high pressure or combinations thereof; or
wherein the polymerization is performed in a single gas phase reactor.

9. A method for determining the proclivity of a polyethylene copolymer to have comonomer in high molecular weight chains comprising the following steps:

a) analyzing the copolymer, wherein the analysis comprises at least cross-fractionation chromatography or a technique affording equivalent data;

b) obtaining the parameters N_i, M_i, C_i, M_w, M_n and C_w from the analysis; and

c) calculating the comonomer partitioning tendency (ξ), using equation (1)

$$\xi = \frac{CPI}{PDI \times CDI} \qquad (1)$$

wherein

CPI is a comonomer partitioning index (χ_w/χ_n) wherein $\chi_w = \sum N_i(M_iC_i)^2/\sum N_i(M_iC_i)$ and $\chi_n = \sum N_i(M_iC_i)/\sum N_i$;

PDI is a polydispersity index (M_w/M_n);

CDI is a comonomer dispersity index (C_{w+1}/C_w) wherein $C_w = \sum N_iM_iC_i/\sum N_iM_i$ and $C_{w+1} = \sum N_iM_iC_i^2/\sum N_iM_iC_i$;

M_i = molecular weight of a copolymer;

N_i = number of copolymers having molecular weight M_i;

C_i = weight fraction of comonomer in a copolymer;

M_w = weight average molecular weight of the copolymer;

M_n = number average molecular weight of the copolymer; and

C_w = average weight fraction of comonomer in the copolymer.

10. A method according to claim 9, wherein the analysis additionally comprises conventional GPC; or

wherein the comonomer is one or more comonomers containing 3 to 16 carbon atoms; or

wherein the comonomer is one or more alpha-olefins; or

wherein the copolymer has a melt index (I_2) ranging from about 0.01 to about 500; or

wherein the copolymer has a melt index (I_2) ranging from about 0.1 to about 100; or

wherein the copolymer has a melt index (I_2) ranging from about 0.2 to about 20; or
wherein the copolymer has a melt index ratio (I_{21}/I_2) ranging from about 5 to about 300; or
wherein the copolymer has a melt index ratio (I_{21}/I_2) ranging from about 10 to about 150; or
wherein the copolymer has a melt index ratio (I_{21}/I_2) ranging from about 15 to about 70; or
wherein the copolymer has a density ranging from about 0.87 g/cm^3 to about 0.97 g/cm^3; or
wherein the copolymer has a density ranging from about 0.89 g/cm^3 to about 0.94 g/cm^3; or
wherein the copolymer has a polydispersity index (M_w/M_n) ranging from about 1.5 to about 20.