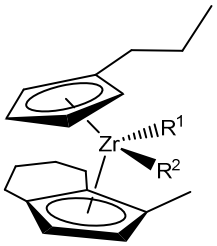
CLAIMS

What is claimed is:

1. A polymerization catalyst system comprising:

a non-metallocene catalyst; and

a metallocene catalyst of the formula:



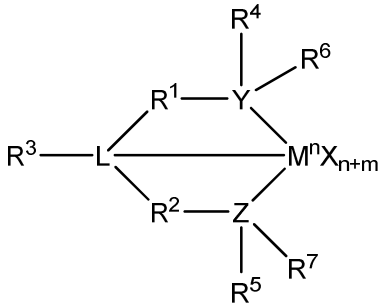
,

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

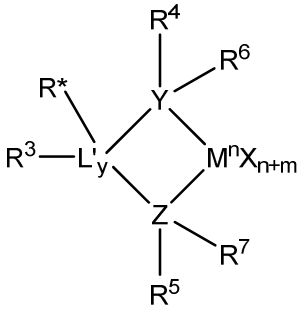
2. The polymerization catalyst system of claim 1, wherein the non-metallocene catalyst comprises a Group 15 metal-containing catalyst compound; or

wherein the non-metallocene catalyst comprises at least two Group 15 atoms, and wherein the non-metallocene comprises a Group 4 metal atom bound to at least one leaving group and also bound to the at least two Group 15 atoms.

3. The polymerization catalyst system of claim 1, wherein the non-metallocene catalyst comprises a catalyst having the formula:



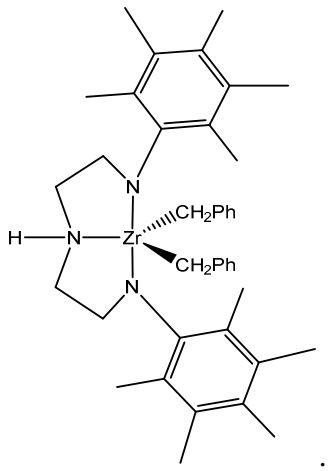
; or



,

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; R1 and R2 are independently a C1 to C20 hydrocarbon group, a heteroatom containing group having up to twenty carbon atoms, silicon, germanium, tin, lead, or phosphorus; R1 and R2 may be interconnected to each other; R3 is absent, a hydrocarbon group, hydrogen, a halogen, or a heteroatom containing group; R4 and R5 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; R4 and R5 may be interconnected to each other; R6 and R7 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; or

wherein the non-metallocene catalyst comprises a catalyst of the formula:



.

4. The polymerization catalyst system of claim 1, wherein the non-metallocene catalyst and the metallocene catalyst are co-supported on a single support; or

wherein at least a portion of the metallocene catalyst is added as a trim feed to the support.

5. The polymerization catalyst system of claim 1, wherein the polymerization catalyst is a slurry mixture comprising a diluent.

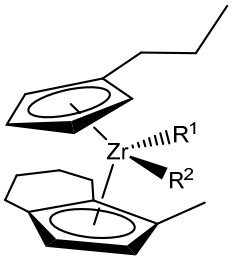
6. The polymerization catalyst system of claim 1, comprising another non-metallocene catalyst or another metallocene catalyst, or both.

7. A polymer comprising:

polyethylene, wherein the polymer comprises chains formed via a polymerization catalyst system comprising:

a non-metallocene catalyst; and

a metallocene catalyst of the formula:



,

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

8. The polymer of claim 7, wherein the polyethylene comprises a copolymer of ethylene and an alpha olefin comonomer having from 5 to 20 carbon atoms; or

wherein the alpha olefin comonomer comprises 1-hexene; or

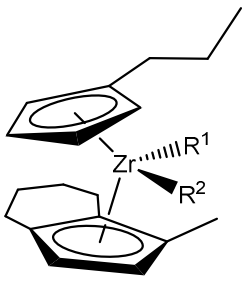
wherein the polyolefin comprises a density in the range of 0.89 grams per cubic centimeter (g/cm3) to 0.97 g/cm3.

9. A method of producing polyethylene, the method comprising:

polymerizing ethylene in a reactor in presence of a catalyst system to form the polyethylene, wherein the catalyst system comprises:

a non-metallocene catalyst; and

a metallocene catalyst of the formula:



,

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

10. The method of claim 9, comprising impregnating the metallocene catalyst and non-metallocene catalyst on a single support.