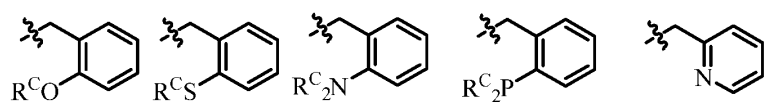


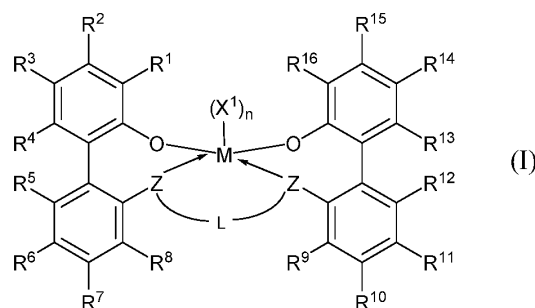
CLAIMS

1. A catalyst system comprising:
 - a non-hydrogen-generating post-metallocene procatalyst;
 - a co-catalyst; and
 - a hydrogenation procatalyst having the formula $\text{Cp}_2\text{TiX}_2\text{TiCp}_2$ or Cp_2TiX_nwhere:
 - each Cp is cyclopentadienyl optionally substituted with at least one $(\text{C}_1\text{--C}_{10})$ alkyl;
 - each X is independently monoanionic or neutral, wherein each X is independently $(\text{C}_1\text{--C}_{40})$ hydrocarbon, $(\text{C}_1\text{--C}_{40})$ heterohydrocarbon, $(\text{C}_1\text{--C}_{40})$ hydrocarbyl, $(\text{C}_1\text{--C}_{40})$ heterohydrocarbyl, or a halogen atom; and
 - n is 1 or 2.
2. A catalyst system comprising:
 - a non-hydrogen-generating post-metallocene procatalyst; and
 - Cp_2TiX_2 treated with an aluminum alkyl species, where:
 - each Cp is cyclopentadienyl substituted with at least one $(\text{C}_1\text{--C}_{10})$ alkyl;
 - each X is independently monoanionic or neutral, wherein each X is independently $(\text{C}_1\text{--C}_{40})$ hydrocarbon, $(\text{C}_1\text{--C}_{40})$ heterohydrocarbon, $(\text{C}_1\text{--C}_{40})$ hydrocarbon anion, $(\text{C}_1\text{--C}_{40})$ heterohydrocarbon anion, or a halogen atom; and
 - n is 1 or 2.
3. The catalyst system of claim 2, wherein the aluminum species comprises alkylaluminumoxane, modified alkylaluminumoxane, or an aluminum alkyl having the formula AlR_3 wherein each R is independently $(\text{C}_1\text{--C}_{40})$ hydrocarbon $(\text{C}_1\text{--C}_{40})$ heterohydrocarbon, $(\text{C}_1\text{--C}_{40})$ hydrocarbyl, $(\text{C}_1\text{--C}_{40})$ heterohydrocarbyl, or a halogen atom.
4. The catalyst system of claim 2 or claim 3, wherein the aluminum species is the reaction product of AlR_3 and water, alcohol, silanol, or a Lewis basic.

5. The catalyst system of claim 4, wherein the Lewis base is pyridine or mono-substituted alkylamine, disubstituted alkylamine, or tri-substituted alkylamine.
6. The catalyst system of any one of claims 2 to 5, wherein the aluminum species is diisobutylaluminum oxide (DIBAO or DIBAL-O) or Isobutylaluminoxane (IBAO).
7. The catalyst system of any one of the preceding claims, wherein the catalyst system further comprises an impurity scavenger.
8. The catalyst system of any one of the preceding claims, wherein each X is a substituted benzyl or substituted heteroarylbenzyl.
9. The catalyst system of any one of the preceding claims, wherein X is selected from the group consisting of:



10. The catalyst system of any one of the preceding claims, wherein the non-hydrogen-generating post metallocene procatalyst produces less than or equal to 1 ppm of hydrogen under polymerization conditions.
11. The catalyst system of any one of the preceding claims, wherein the non-hydrogen-generating post metallocene procatalyst is unsupported and the hydrogenating catalyst is unsupported.
12. The catalyst system of any one of the preceding claims, wherein the non-hydrogen-generating post metallocene procatalyst is a metal–ligand complex according to formula (I):



where:

M is a metal chosen from titanium, zirconium, or hafnium, the metal being in 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 independently a monodentate ligand;

each X^1 that is a monodentate ligand is independently halogen, unsubstituted (C_1-C_{20}) hydrocarbonyl, unsubstituted (C_1-C_{20}) hydrocarbonylC(O)O-, or $R^K R^L N-$, where each of R^K and R^L is independently an unsubstituted (C_1-C_{20}) hydrocarbonyl;

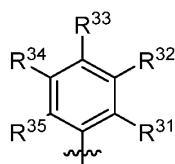
L is a diradical selected from the group consisting of (C_1-C_{40}) hydrocarbylene,

(C_1-C_{40}) heterohydrocarbylene, $-Si(R^C)_2-$, $-Si(R^C)_2OSi(R^C)_2-$, $-Si(R^C)_2C(R^C)_2-$, $-Si(R^C)_2Si(R^C)_2-$, $-Si(R^C)_2C(R^C)_2Si(R^C)_2-$, $-C(R^C)_2Si(R^C)_2C(R^C)_2-$, $-N(R^N)C(R^C)_2-$, $-N(R^N)N(R^N)-$, $-C(R^C)_2N(R^N)C(R^C)_2-$, $-Ge(R^C)_2-$, $-P(R^P)-$, $-N(R^N)-$, $-O-$, $-S-$, $-S(O)-$, $-S(O)_2-$, $-N=C(R^C)-$, $-C(O)O-$, $-OC(O)-$, $-C(O)N(R)-$, and $-N(R^C)C(O)-$;

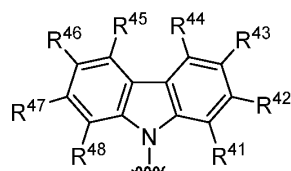
each Z is independently chosen from $-O-$, $-S-$, $-N(R^N)-$, or $-P(R^P)-$;

$R^1, R^2, R^3, R^4, R^5, R^6, R^7, R^8, R^9, R^{10}, R^{11}, R^{12}, R^{13}, R^{14}, R^{15}$, and R^{16} are independently selected from the group consisting of $-H$,

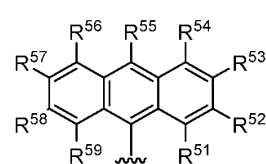
(C_1-C_{40}) hydrocarbonyl, (C_1-C_{40}) heterohydrocarbonyl, $-Si(R^C)_3$, $-Ge(R^C)_3$, $-P(R^P)_2$, $-N(R^N)_2$, $-OR^C$, $-SR^C$, $-NO_2$, $-CN$, $-CF_3$, $R^C S(O)-$, $R^C S(O)_2-$, $-N=C(R^C)_2$, $R^C C(O)O-$, $R^C OC(O)-$, $R^C C(O)N(R)-$, $(R^C)_2 NC(O)-$, halogen, radicals having formula (XI), radicals having formula (XII), and radicals having formula (XIII):



(XI)



(XII)



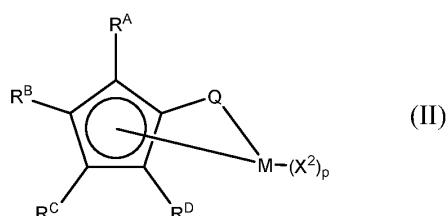
(XIII)

where:

each of $R^{31} - R^{35}$, $R^{41} - R^{48}$, and $R^{51} - R^{59}$ is independently chosen from $-H$, (C_1-C_{40}) hydrocarbonyl, (C_1-C_{40}) heterohydrocarbonyl, $-Si(R^C)_3$, $-Ge(R^C)_3$, $-P(R^P)_2$, $-N(R^N)_2$, $-OR^C$, $-SR^C$, $-NO_2$, $-CN$, $-CF_3$, $R^C S(O)-$, $R^C S(O)_2-$,

$(R^C)_2C=N-$, $R^CC(O)O-$, $R^COC(O)-$, $R^CC(O)N(R^N)-$, $(R^C)_2NC(O)-$, or halogen.

13. The catalyst system of any one of claims 1 to 7, wherein the non-hydrogen-generating post metallocene procatalyst is a metal–ligand complex according to formula (II):



where:

M is a metal selected from metals of any of Groups 3 to 13 of the Periodic Table of the Elements, lanthanides, and actinides, the metal being in a formal oxidation state of +2, +3 or +4,

each R^A , R^B , R^C and R^D is $-H$, (C_1-C_{40}) hydrocarbyl, (C_1-C_{40}) heterohydrocarbyl, $-Si(R^C)_3$, $-Ge(R^C)_3$, $-P(R^C)_2$, $-N(R^C)_2$, $-OR^C$, $-SR^C$, $-NO_2$, $-CN$, $-CF_3$, $R^CS(O)-$, $R^CS(O)_2-$, $-N=C(R^C)_2$, $R^CC(O)O-$, $R^COC(O)-$, $R^CC(O)N(R)-$, $(R^C)_2NC(O)-$, or halogen, where optionally any two of R^A , R^B , R^C and R^D may be connected to form a non-aromatic ring or an aromatic ring, and each R^C is independently a (C_1-C_{18}) hydrocarbon or (C_5-C_{18}) aryl;

Q is boron, nitrogen, phosphorus, sulfur, oxygen, carbon, silicon, or germanium;

each X^2 is independently a monodentate ligand, wherein the monodentate ligand is monoanionic or dianionic, a halogen, unsubstituted

(C_1-C_{20}) hydrocarbyl, unsubstituted (C_1-C_{20}) hydrocarbyl $C(O)O-$, or R^KR^LN- , wherein each of R^K and R^L independently is an unsubstituted (C_1-C_{20}) hydrocarbyl; and

p is 1, 2, or 3.