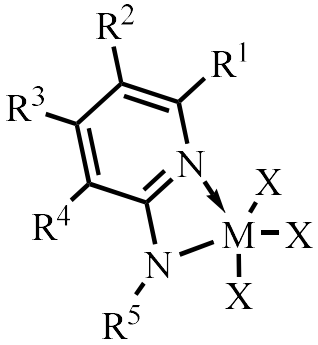
[0010a] In one aspect, there is provided a process for polymerizing olefin, the process comprising contacting ethylene and optionally one or more (C_3−C_{12})α-olefin in the presence of a catalyst system, wherein the catalyst system comprises a metal−ligand complex having a structure according to formula (I):

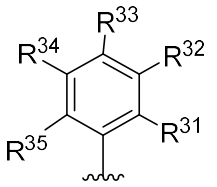


where:

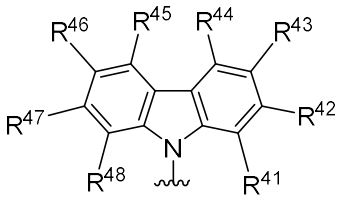
M is titanium, zirconium, or hafnium;

each X is benzyl, (C_1−C_{12})alkyl, halogen atom, −$CH_2SiR^R_3$, or −$(CH_2)_n(SiR^C)_3$, wherein n is an integer from 1 to 10, wherein each R^R is (C_1−C_{12})alkyl, and wherein each R^C is independently (C_1−C_{30})hydrocarbyl, (C_1−C_{30})heterohydrocarbyl, or –H;

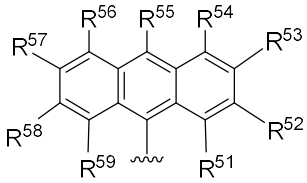
R^1 is selected from the group consisting of radicals having formula (II), radicals having formula (III), and radicals having formula (IV):



II)



III)



IV)

where each of $R^{31–35}$, $R^{41–48}$, and $R^{51–59}$ is independently chosen from (C_1−C_{40})hydrocarbyl, (C_1−C_{40})heterohydrocarbyl, −$Si(R^T)_3$, −$Ge(R^T)_3$, −$P(R^T)_2$, −$N(R^T)_2$, −$N{=}CHR^T$, −OR^T, −SR^T, −NO_2, −CN, −CF_3, $R^TS(O)$−, $R^TS(O)_2$−, $(R^T)_2C{=}N$−, $R^TC(O)O$−, $R^TOC(O)$−, $R^TC(O)N(R^T)$−, $(R^T)_2NC(O)$−, halogen, or –H, wherein R^T is (C_1−C_{30})hydrocarbyl or –H;

R^2, R^3, and R^4 are independently chosen from −H, (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, −CF_3, $R^CS(O)$−, $R^CS(O)_2$−, $(R^C)_2C{=}N$−, $R^CC(O)O$−, $R^COC(O)$−, $(R^C)_2NC(O)$−, or halogen, wherein each R^C, each R^P and each R^N is (C_1−C_{30})hydrocarbyl, (C_1−C_{30})heterohydrocarbyl, or –H; and

R^5 is benzyl, (C_1−C_{20})alkyl, or −$CH_2SiR^R_3$, wherein R^R is (C_1−C_{12})alkyl.

BRIEF SUMMARY OF THE DRAWINGS

[0011] FIG. 1 depicts Ligand 1 to Ligand 8.

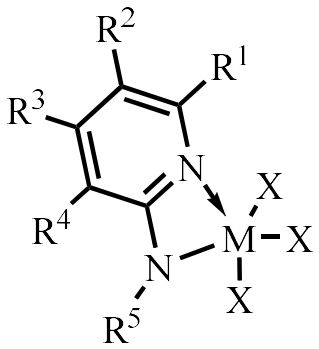
DETAILED DESCRIPTION

[0012] Specific embodiments of catalyst systems will now be described. It should be understood that the catalyst systems of this disclosure may be embodied in different forms and should not be construed as limited to the specific embodiments set forth in this disclosure. Rather, embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the subject matter to those skilled in the art.

[0013] Common abbreviations are listed below:

CLAIMS

1. A process for polymerizing olefin, the process comprising contacting ethylene and optionally one or more (C_3−C_{12})α-olefin in the presence of a catalyst system, wherein the catalyst system comprises a metal−ligand complex having a structure according to formula (I):



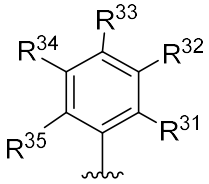
(I)

where:

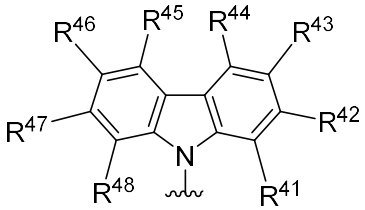
M is titanium, zirconium, or hafnium;

each X is benzyl, (C_1−C_{12})alkyl, halogen atom, −$CH_2SiR^R_3$, or −$(CH_2)_n(SiR^C)_3$, wherein n is an integer from 1 to 10, wherein each R^R is (C_1−C_{12})alkyl, and wherein each R^C is independently (C_1−C_{30})hydrocarbyl, (C_1−C_{30})heterohydrocarbyl, or –H;

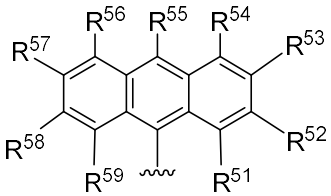
R^1 is selected from the group consisting of radicals having formula (II), radicals having formula (III), and radicals having formula (IV):



(II)



(III)



(IV)

where each of $R^{31–35}$, $R^{41–48}$, and $R^{51–59}$ is independently chosen from (C_1−C_{40})hydrocarbyl, (C_1−C_{40})heterohydrocarbyl, −$Si(R^T)_3$, −$Ge(R^T)_3$, −$P(R^T)_2$, −$N(R^T)_2$, −$N{=}CHR^T$, −OR^T, −SR^T, −NO_2, −CN, −CF_3, $R^TS(O)$−, $R^TS(O)_2$−, $(R^T)_2C{=}N$−, $R^TC(O)O$−, $R^TOC(O)$−, $R^TC(O)N(R^T)$−, $(R^T)_2NC(O)$−, halogen, or –H, wherein R^T is (C_1−C_{30})hydrocarbyl or –H;

R^2, R^3, and R^4 are independently chosen from −H, (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, −CF_3, $R^CS(O)$−, $R^CS(O)_2$−, $(R^C)_2C{=}N$−,

$R^CC(O)O-$, $R^COC(O)-$, $(R^C)_2NC(O)-$, or halogen, wherein each R^C, each R^P and each R^N is (C_1-C_{30})hydrocarbyl, (C_1-C_{30})heterohydrocarbyl, or –H; and

R^5 is benzyl, (C_1-C_{20})alkyl, or $-CH_2SiR^R_3$, wherein R^R is (C_1-C_{12})alkyl.

2. The process of claim 1, wherein R^1 is a radical having formula (II), and wherein R^{31}, R^{33}, and R^{35} are independently (C_1-C_{12})alkyl or (C_1-C_{20})aryl.

3. The process of claim 1, wherein R^1 is a radical having formula (II), and wherein R^{32} and R^{34} are independently (C_1-C_{12})alkyl or (C_1-C_{20})aryl.

4. The process of claim 1, wherein R^1 is a radical having formula (IV), and wherein R^{52} and R^{58} are independently (C_1-C_{12})alkyl or (C_1-C_{20})aryl.

5. The process of claim 1, wherein R^1 is a radical having formula (IV), and wherein R^{53} and R^{58} are independently (C_1-C_{12})alkyl or (C_1-C_{20})aryl.

6. The process of claim 1, wherein R^1 is a radical having formula (IV), and wherein R^{53} and R^{57} are independently (C_1-C_{12})alkyl or (C_1-C_{20})aryl.

7. The process of claim 1, wherein R^1 is a radical having formula (IV), and wherein R^{53}, R^{55}, and R^{57} are independently (C_1-C_{12})alkyl or (C_1-C_{20})aryl.

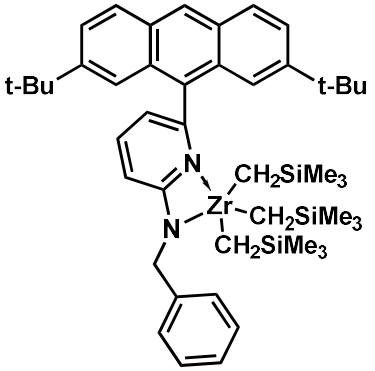
8. The polymerization process of any one of the preceding claims, wherein the contacting occurs in a reactor at a reactor temperature of greater than or equal to 120 °C.

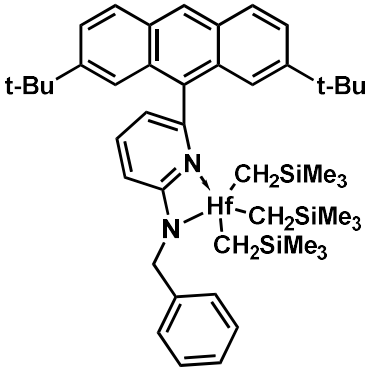
9. The polymerization process of any one of the preceding claims, wherein the contacting occurs in a solution polymerization reactor at a reactor pressure from 10 psi to 2000 psi.

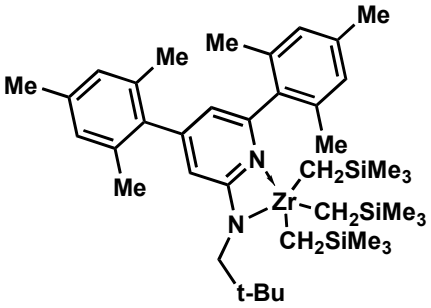
10. The polymerization process of any of one of claims 1 to 9, wherein the contacting occurs within a reactor including therein the catalyst system and a chain transfer agent or chain shuttling agent.

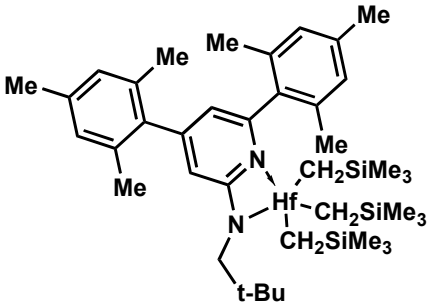
11. The polymerization process of claim 10, wherein the chain transfer or chain shuttling agent is diethyl zinc.

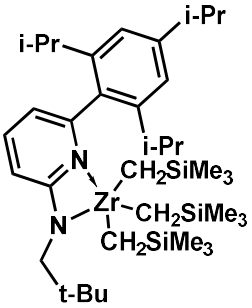
12. The polymerization process of any one of the preceding claims, wherein the structure according to formula (I) is selected from the group consisting of:

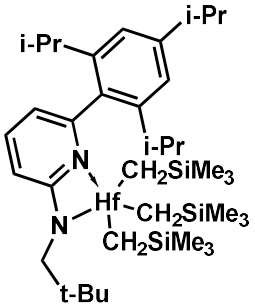


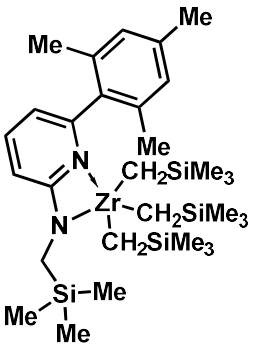


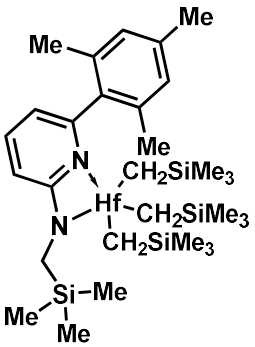


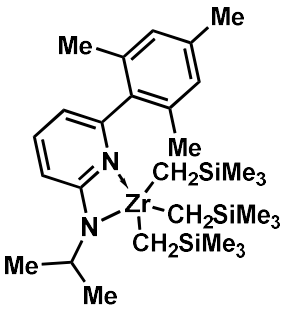


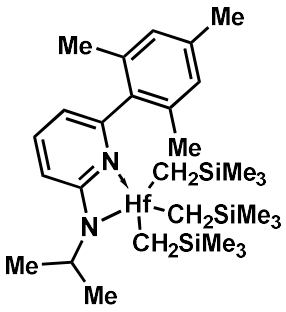


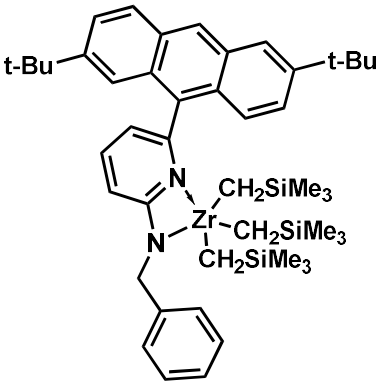


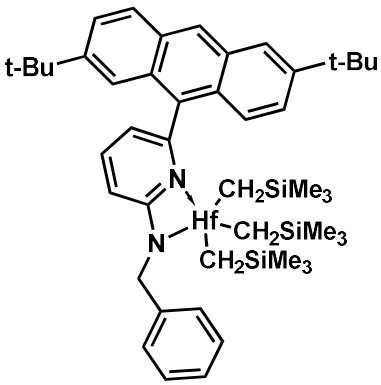


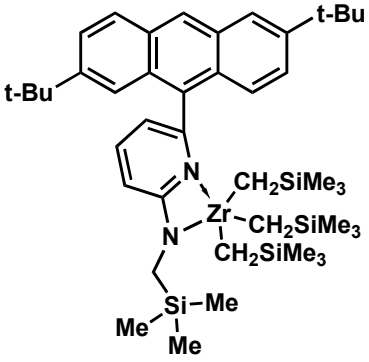


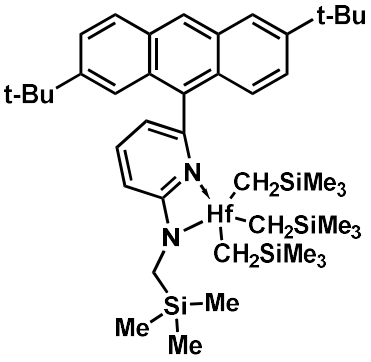

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Me
N
Zr
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CH2SiMe3
CH2SiMe3
N
Me
Me
Me

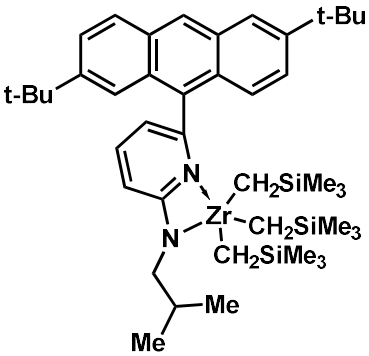

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Hf
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Me
Me
Me

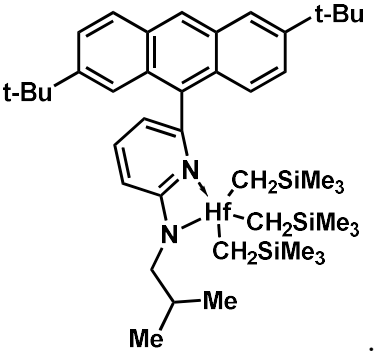

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