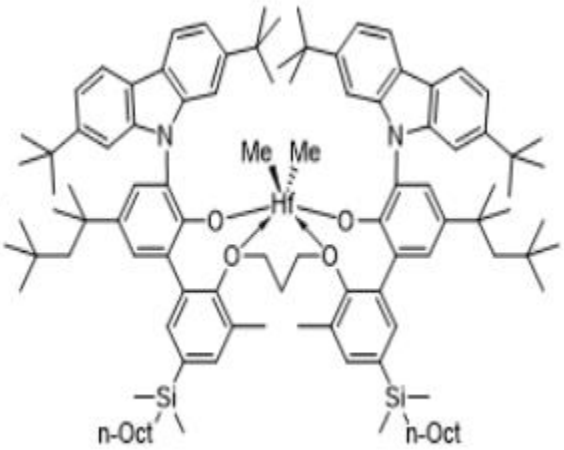
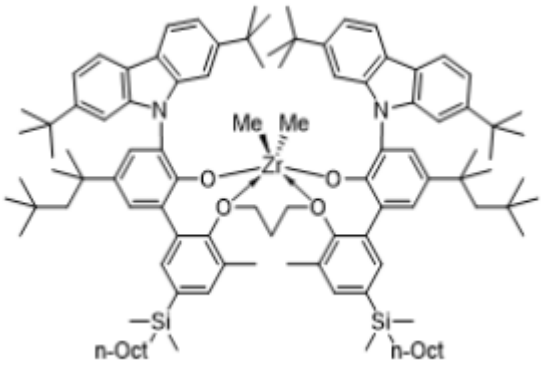
X independently is a halogen, a hydrogen, a (C_1-C_{20})alkyl, a (C_7-C_{20})aralkyl, a (C_1-C_6)alkyl-substituted (C_6-C_{12})aryl, or a (C_1-C_6)alkyl-substituted benzyl, -$CH_2Si(R^C)_3$, where R^C is (C_1-C_{12})hydrocarbon; and where M is zirconium (Zr) or Hafnium (Hf).

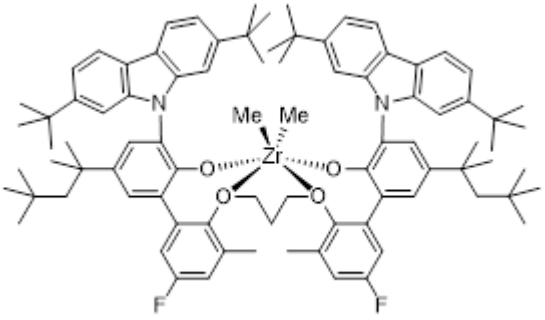
[0005a] In one aspect, there is provided a use of a supported gas-phase biphenylphenol polymerization catalyst to make a polymer via a gas-phase polymerization process, wherein the supported gas-phase biphenylphenol polymerization catalyst is made from a gas-phase biphenylphenol polymerization precatalyst selected from a group consisting of the structures of (i), (ii), (iii), (iv), (v), (vi), (vii), (viii) and (ix)



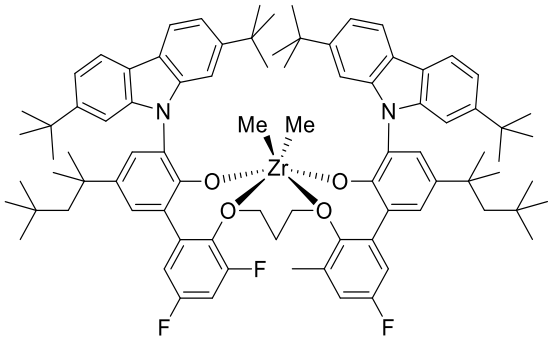
(i);



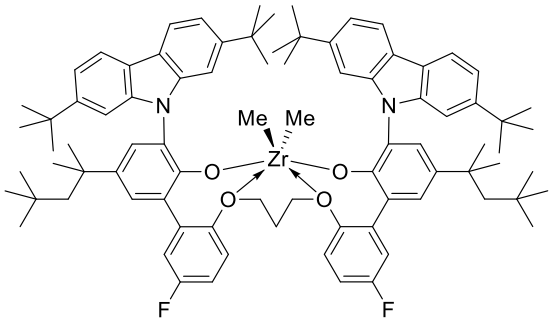
(ii);



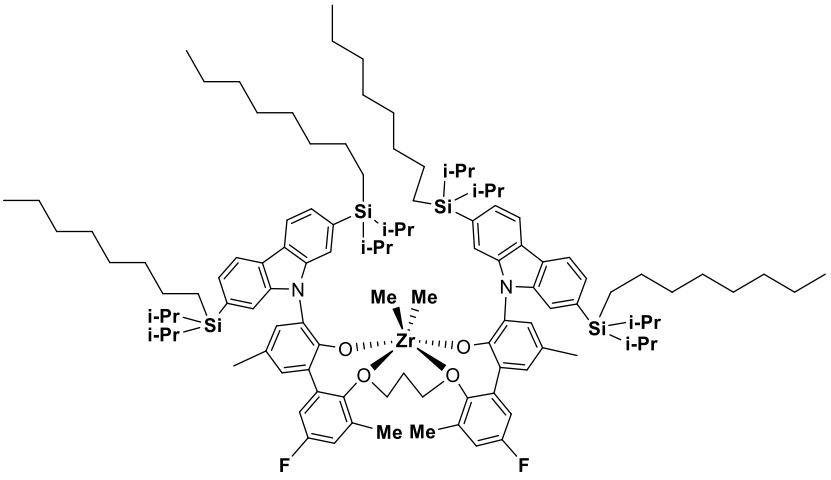
(iii);


Me
Me
Zr
O
O
O
O
N
N
F
F
F

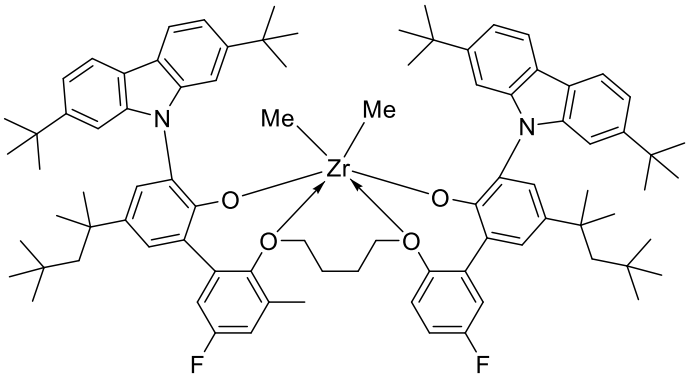
(iv);


Me
Me
Zr
O
O
O
O
N
N
F
F

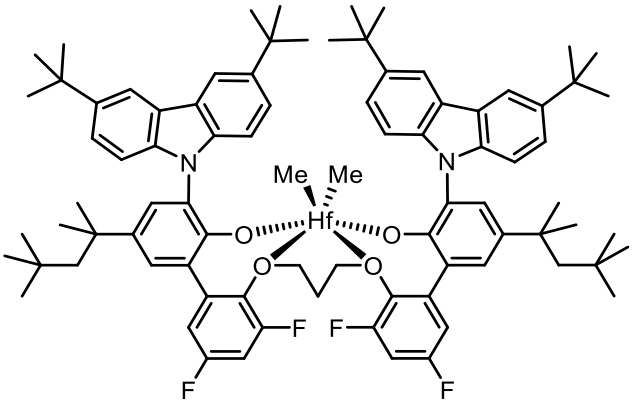
(v);


i-Pr
i-Pr
Si
Si
i-Pr
i-Pr
i-Pr
i-Pr
Si
Si
i-Pr
i-Pr
N
N
Me
Me
Zr
O
O
O
O
Me
Me
F
F

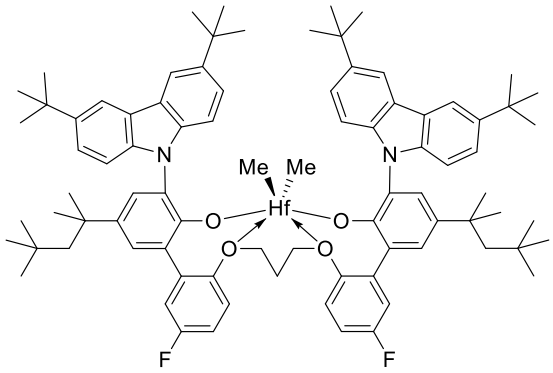
(vi);



(vii);



(viii); and



(ix).

[0005b] In another aspect, there is provided a gas-phase polymerization catalyst system to make a polymer via a gas-phase polymerization process, the gas-phase polymerization catalyst comprising: a metallocene olefin polymerization catalyst; and the supported gas-phase biphenylphenol polymerization catalyst made from the gas-phase biphenylphenol polymerization precatalyst as defined herein.

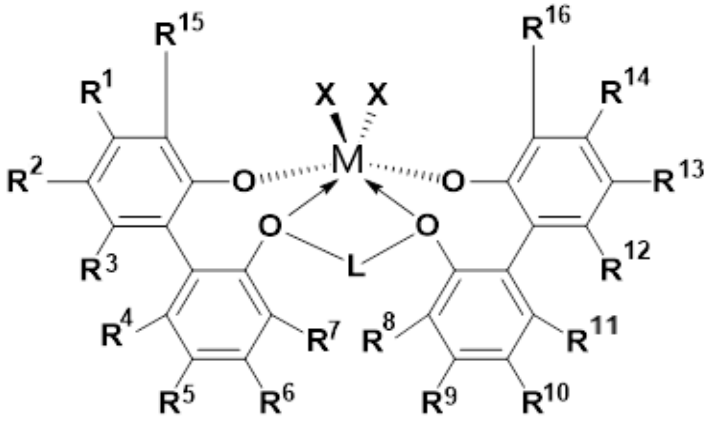
[0005c] In another aspect, there is provided a gas-phase polymerization method to make a polymer, the method comprising: polymerizing an olefin monomer in a gas-phase

polymerization reactor in presence of the gas-phase polymerization catalyst system as defined herein to make the polymer.

[0005d] In another aspect, there is provided a polyethylene composition comprising a high molecular weight polyethylene component and a low molecular weight polyethylene component, wherein the high and low molecular weight polyethylene components are made together in a single gas-phase reactor via a polymerization process employing the gas-phase polymerization catalyst system as defined herein.

Detailed Description

[0006] A supported gas-phase biphenylphenol polymerization catalyst which can be used make a polymer via a gas-phase polymerization process is made from a gas-phase biphenylphenol polymerization precatalyst of Formula I:



(Formula I)

[0007] where each of R^5, R^7, R^8, and R^{10} is independently is a (C_1 to C_{20})alkyl, aryl, aralkyl, halogen, or a hydrogen; where each of R^4 and R^{11} independently is a halogen or a hydrogen; where each of R^2 and R^{13} independently is a (C_1 to C_{20})alkyl, aryl or aralkyl or a hydrogen; where each of R^{15} and R^{16} independently is a 2,7-disubstituted carbazol-9-yl or a 3,6-disubstituted carbazol-9-yl; where L is a linear C_3 or C_4 alkylene that forms a 3-carbon bridge or 4-carbon bridge, respectively, between the two oxygen atoms to which L is covalently bonded; where each of R^1, R^3, R^{12}, and R^{14} independently is a (C_1-C_8)alkyl, halogen, or a hydrogen; where each of R^6 and R^9 is a hydrogen or (C_1-C_8)alkyl; where each X independently is a halogen, a hydrogen, a (C_1-C_{20})alkyl, a (C_7-C_{20})aralkyl, a (C_1-C_6)alkyl-substituted (C_6-C_{12})aryl, or a (C_1-C_6)alkyl-substituted benzyl, $-CH_2Si(R^C)_3$, where R^C is (C_1-C_{12})hydrocarbon; and where M is Zr or Hf.

[0008] The gas-phase biphenylphenol polymerization precatalyst represented by the Formula I (i.e., the gas-phase biphenylphenol polymerization precatalyst), as described

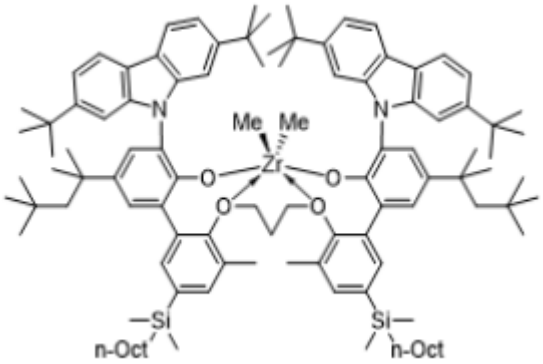
herein, may be utilized to make a gas-phase biphenylphenol polymerization catalysts. For instance, the gas-phase biphenylphenol polymerization precatalyst represent by the Formula I may be contacted, under activating conditions, with an activator so as to activate the gas-

What is claimed is:

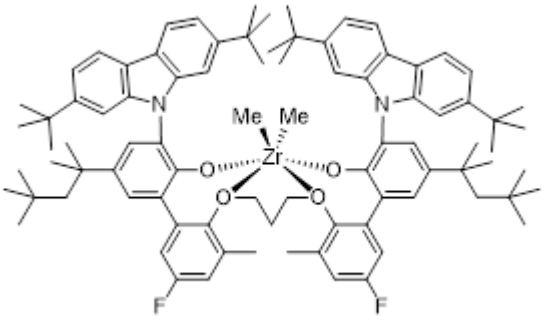
1. A use of a supported gas-phase biphenylphenol polymerization catalyst to make a polymer via a gas-phase polymerization process, wherein the supported gas-phase biphenylphenol polymerization catalyst is made from a gas-phase biphenylphenol polymerization precatalyst selected from a group consisting of the structures of (i), (ii), (iii), (iv), (v), (vi), (vii), (viii) and (ix)



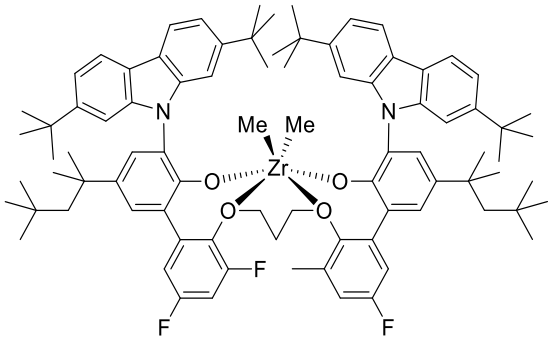
(i);



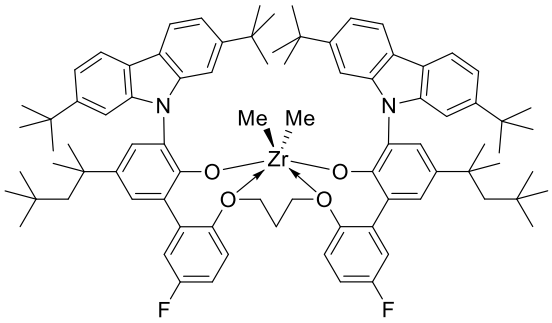
(ii);



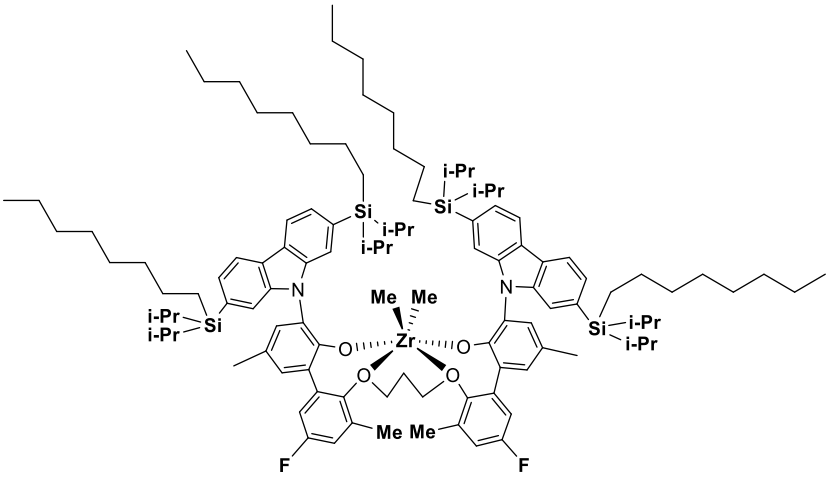
(iii);


Me
Me
Zr
O
O
O
O
N
N
F
F
F

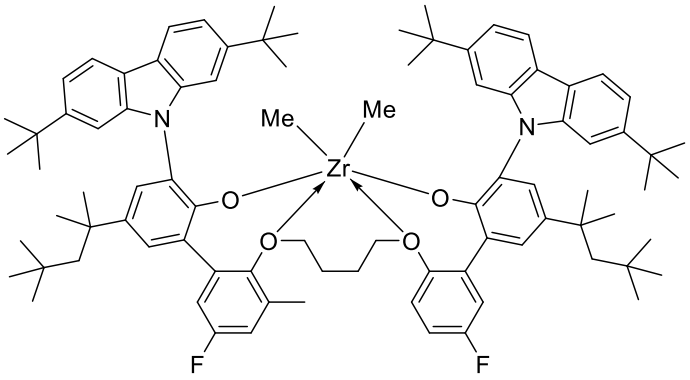
(iv);


Me
Me
Zr
O
O
O
O
N
N
F
F

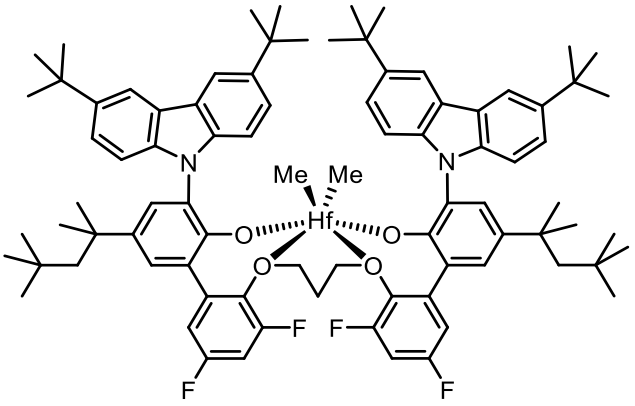
(v);


i-Pr
i-Pr
Si
Si
i-Pr
i-Pr
i-Pr
i-Pr
Si
Si
i-Pr
i-Pr
N
N
Me
Me
Zr
O
O
O
O
Me
Me
F
F

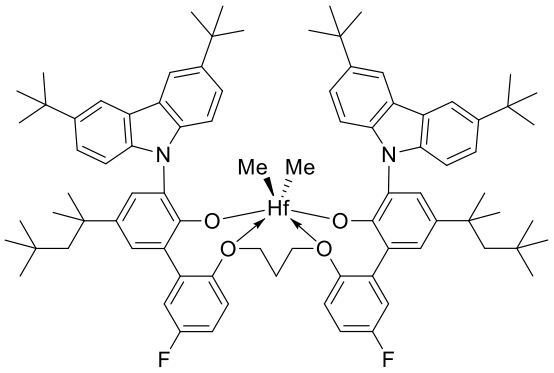
(vi);



(vii);

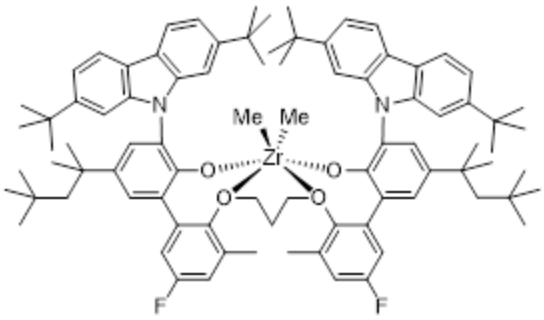


(viii); and

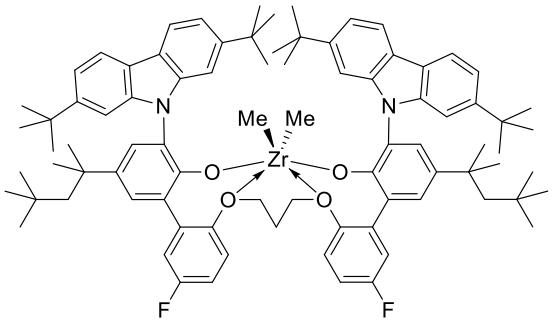


(ix).

2. The use of claim 1, wherein the gas-phase biphenylphenol polymerization precatalyst is selected from a group consisting of the structures of (iii) and (v)



(iii); and



(v).

3. The use of claim 1, wherein the polymer formed at B-conditions (H_2/C_2 = 0.0017 and C_6/C_2 = 0.004 at 100 °C and 230 pounds per square inch (psi) ethylene) has a molecular weight (Mw) in a range of from about 150,000 Daltons to about 1,200,000 Daltons; or wherein the polymer formed at K-conditions (H_2/C_2 = 0.0068 and C_6/C_2 = 0.004 at 100 °C and 230 psi) has Mw of less than about 500,000 Daltons.

4. A gas-phase polymerization catalyst system to make a polymer via a gas-phase polymerization process, the gas-phase polymerization catalyst comprising:

a metallocene olefin polymerization catalyst; and

the supported gas-phase biphenylphenol polymerization catalyst made from the gas-phase biphenylphenol polymerization precatalyst of claim 1.

5. A gas-phase polymerization method to make a polymer, the method comprising:

polymerizing an olefin monomer in a gas-phase polymerization reactor in presence of the gas-phase polymerization catalyst system of claim 4 to make the polymer.

6. A polyethylene composition comprising a high molecular weight polyethylene component and a low molecular weight polyethylene component, wherein the high and low molecular weight polyethylene components are made together in a single gas-phase reactor via a polymerization process employing the gas-phase polymerization catalyst system of claim 4.