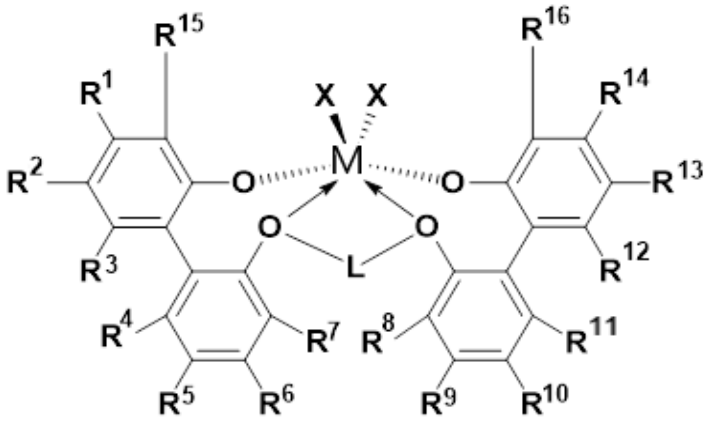
What is claimed is:

1. A use of a supported biphenylphenol polymerization catalyst to make a polymer via a slurry-phase polymerization process, wherein the supported biphenylphenol polymerization catalyst is made from a biphenylphenol polymerization precatalyst of Formula I:




(Formula I)

wherein each of $R^5$, $R^7$, $R^8$, and $R^{10}$ independently is a ($C_1$ to $C_{20}$)alkyl, aryl, aralkyl, halogen, or a hydrogen;

wherein each of $R^4$ and $R^{11}$ independently is a halogen or a hydrogen;

wherein each of $R^2$ and $R^{13}$ independently is a ($C_1$ to $C_{20}$)alkyl, aryl or aralkyl or a hydrogen;

wherein each of $R^{15}$ and $R^{16}$ independently is a 2,7-disubstituted carbazol-9-yl or a 3,6-disubstituted carbazol-9-yl;

wherein L is a $C_3$ alkylene or $C_4$ alkylene that forms a bridge between the two oxygen atoms to which L is covalently bonded;

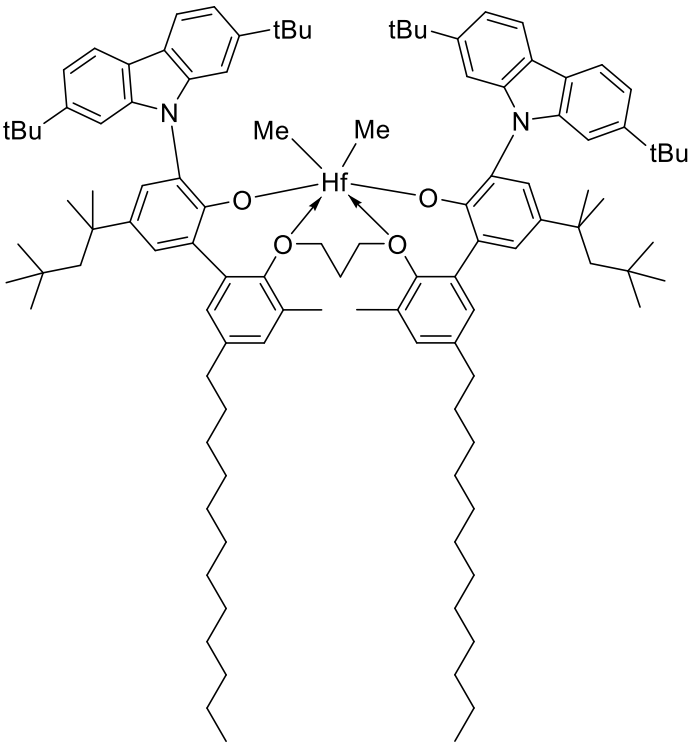
wherein each of $R^1$, $R^3$, $R^{12}$, and $R^{14}$ independently is a ($C_1$-$C_8$)alkyl, halogen, or a hydrogen;

wherein each of $R^6$ and $R^9$ is a hydrogen, ($C_1$-$C_8$)alkyl, or halogen, optionally, $R^6$ can be linked with $R^7$ and $R^8$ can be linked to $R^9$ to form a cyclic structure;

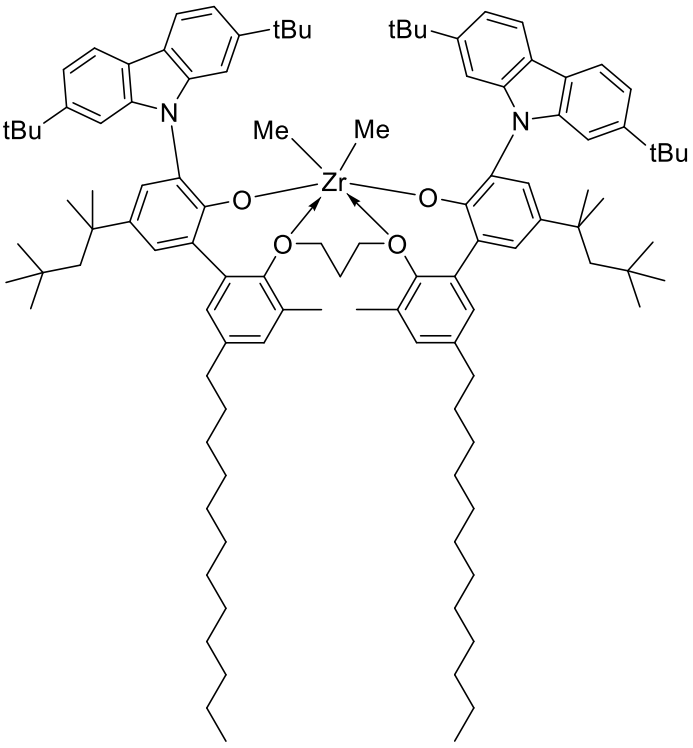
wherein each X independently is a halogen, a hydrogen, a ($C_1$-$C_{20}$)alkyl, a ($C_7$-$C_{20}$)aralkyl, a ($C_1$-$C_6$)alkyl-substituted ($C_6$-$C_{12}$)aryl, or a ($C_1$-$C_6$)alkyl-substituted benzyl, $-CH_2Si(R^C)_3$, where $R^C$ is ($C_1$-$C_{12}$)hydrocarbon; and

wherein M is Zr or Hf.

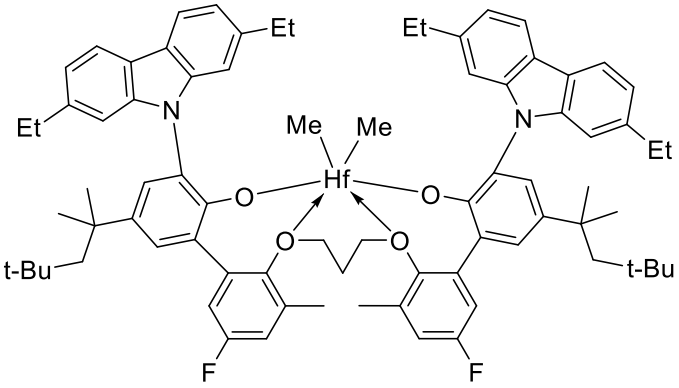
2. The use of claim 1, wherein the biphenylphenol polymerization precatalyst of Formula I is selected from a group consisting of the structures of (i), (ii), (iii), (iv), (v), (vi), (vii), (viii), (ix), (x), (xi), (xii), (xiii), (xiv), and (xv).



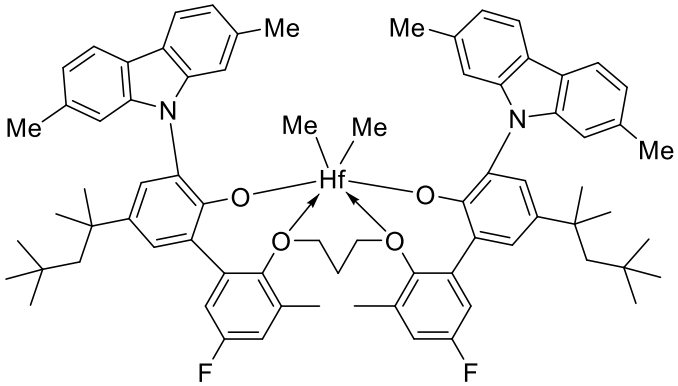

(i);


tBu
tBu
tBu
tBu
N
N
Me
Me
Zr
O
O
O
O

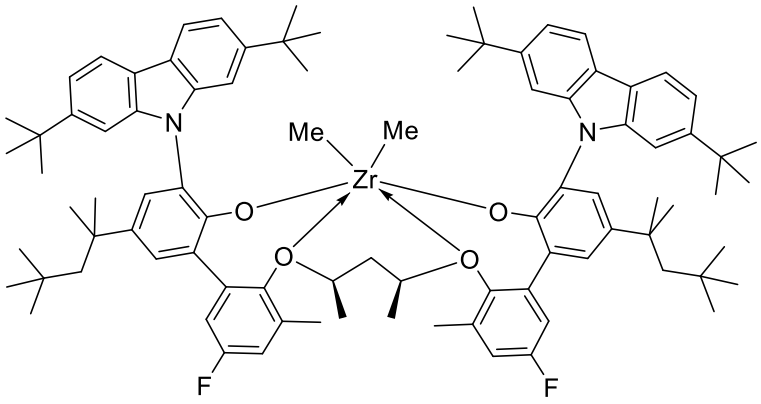
(ii);


Et
Et
Et
Et
N
N
Me
Me
Hf
O
O
O
O
t-Bu
t-Bu
F
F

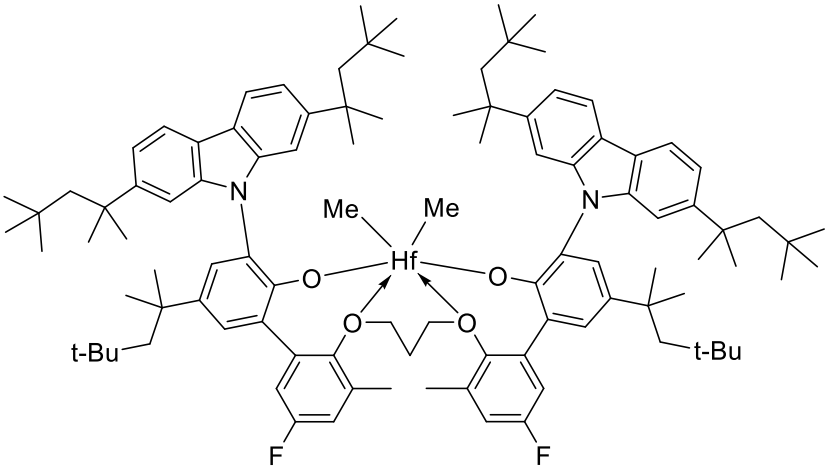
(iii);


Me
Me
Me
Me
N
N
Me
Me
Hf
O
O
O
O
F
F

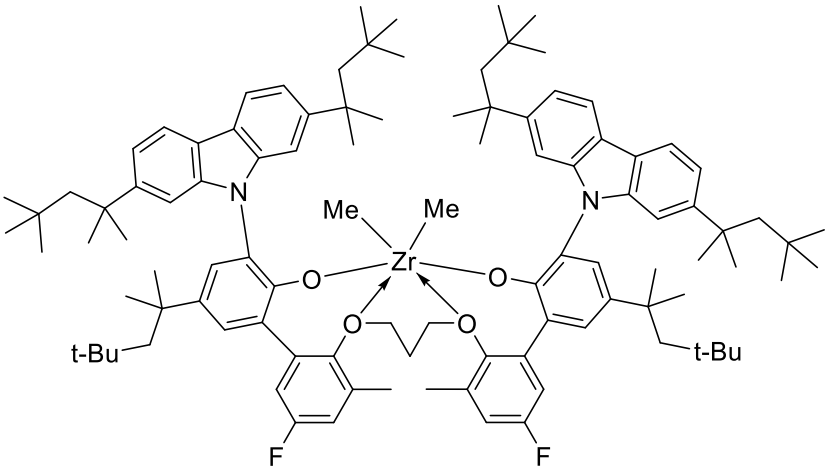
(iv);


Me
Me
Zr
N
N
O
O
O
O
F
F

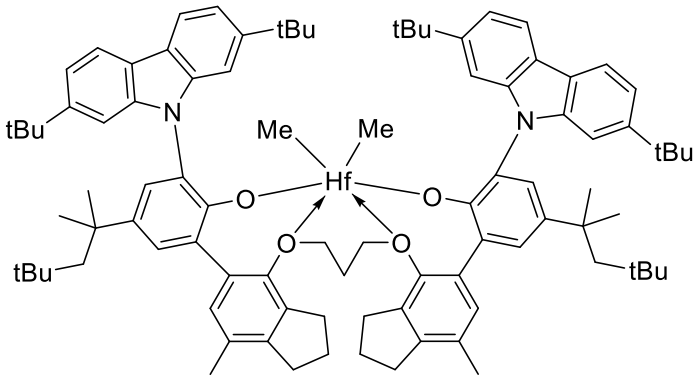
(v);


Me
Me
Hf
N
N
O
O
O
O
t-Bu
t-Bu
F
F

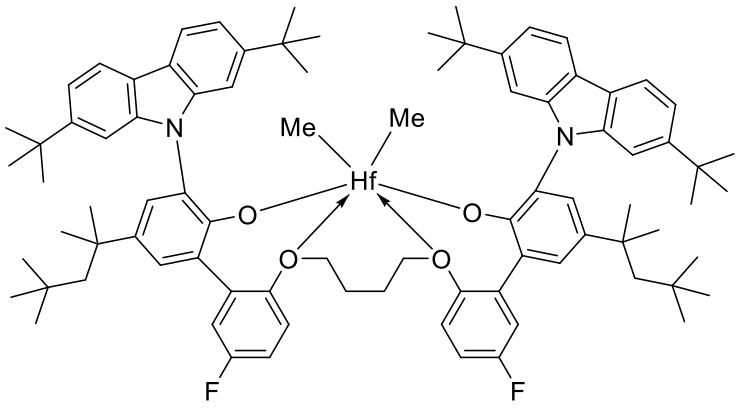
(vi);


Me
Me
Zr
N
N
O
O
O
O
t-Bu
t-Bu
F
F

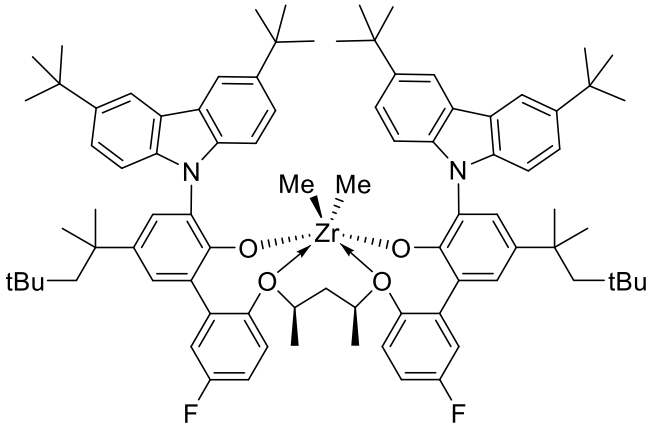
(vii);


tBu
tBu
tBu
tBu
N
N
Me
Me
Hf
O
O
O
O
tBu
tBu

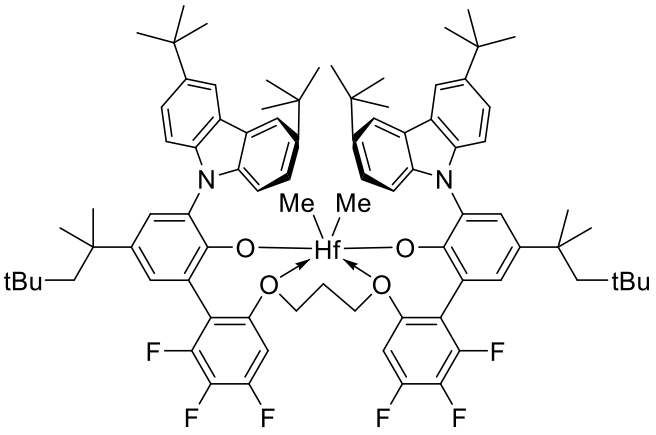
(viii);


N
N
Me
Me
Hf
O
O
O
O
F
F

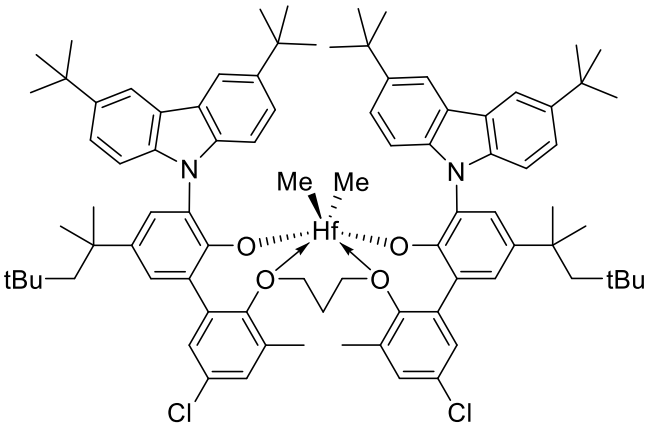
(ix);


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

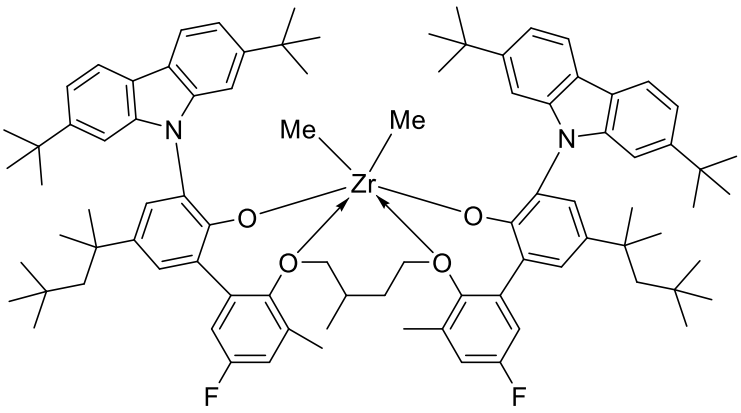
(x);



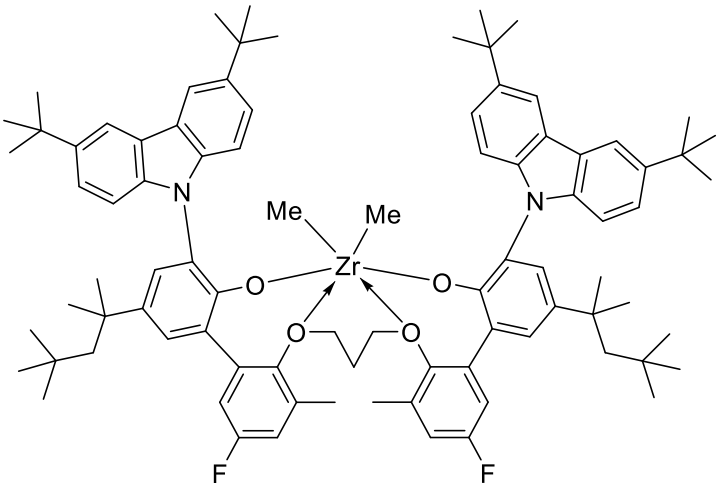

(xi);



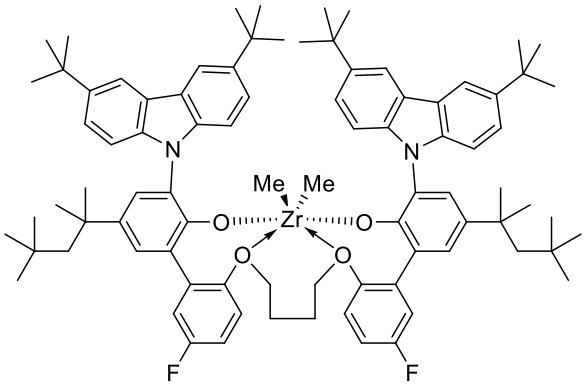

(xii);




(xiii);




(xiv); and




(xv).

3. The use of claim 1, wherein the polymer formed at B-conditions ($H_2/C_2$ = 0.0017 and $C_6/C_2$ = 0.4 at 100 °C and 100 pounds per square inch (psi) ethylene) has a molecular weight (Mw) in a range of from about 150,000 Daltons to about 800,000 Daltons.

4. The use of claim 1, wherein the polymer formed at K-conditions ($H_2/C_2$ = 0.0068 and $C_6/C_2$ = 0.4 at 100 °C and 100 psi) has a molecular weight (Mw) of less than about 500,000 Daltons.

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

a metallocene olefin polymerization catalyst; and

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

6. A slurry-phase polymerization method to make a polymer, the method comprising:

polymerizing an olefin monomer in a slurry-phase polymerization reactor in presence of the polymerization catalyst system of claim 5 to make the polymer.

7. The polymerization catalyst system of claim 5, wherein each of $R^{15}$ and $R^{16}$ is a 3,6-di-t-butylcarbazol-9-yl.

8. The polymerization catalyst system of claim 5, wherein each of $R^{15}$ and $R^{16}$ is a 2,7-di-t-butylcarbazol-9-yl.

9. The polymerization catalyst system of claim 5, wherein the metallocene olefin polymerization catalyst is selected from the group consisting of:

(pentamethylcyclopentadienyl)(propylcyclopentadienyl)$MX_2$,

(tetramethylcyclopentadienyl)(propylcyclopentadienyl)$MX_2$,

(tetramethylcyclopentadienyl)(butylcyclopentadienyl)$MX_2$,

(methylcyclopentadienyl)(1,3-dimethyl-tetrahydroindenyl)$MX_2$,

(cyclopentadienyl)(1,3-dimethyl-tetrahydroindenyl)$MX_2$,

(cyclopentadienyl)(4,7-dimethylindenyl)$MX_2$,

(cyclopentadienyl)(1,5-dimethylindenyl)$MX_2$,

(cyclopentadienyl)(1,4-dimethylindenyl)$MX_2$,

$Me_2Si(indenyl)_2MX_2$,

$Me_2Si(tetrahydroindenyl)_2MX_2$,

(n-propyl cyclopentadienyl)$_2MX_2$,

(n-butyl cyclopentadienyl)$_2MX_2$,

(1-methyl, 3-butyl cyclopentadienyl)$_2MX_2$,

$HN(CH_2CH_2N(2,4,6\text{-}Me_3phenyl))_2MX_2$,

$HN(CH_2CH_2N(2,3,4,5,6\text{-}Me_5phenyl))_2MX_2$,

(butyl cyclopentadienyl)$_2MX_2$,

(propyl cyclopentadienyl)$_2MX_2$, and mixtures thereof,

wherein M is Zr or Hf, and X is selected from F, Cl, Br, I, Me, benzyl, $CH_2SiMe_3$, and ($C_1$ to $C_5$)alkyls or alkenyls.

10. 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 slurry-phase reactor via a polymerization process employing the polymerization catalyst system of claim 5.