BIPHENYLPHENOL POLYMERIZATION CATALYSTS HAVING IMPROVED KINETIC INDUCTION TIMES

Field of Disclosure

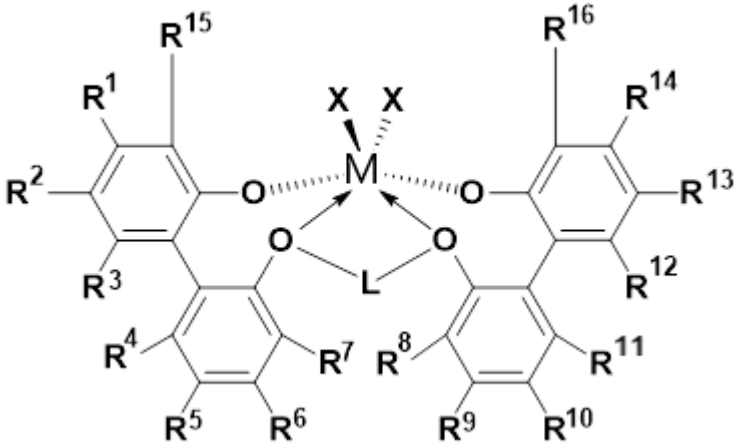
[0001] Embodiments of the present disclosure are directed towards biphenylphenol polymerization precatalysts and biphenylphenol polymerization catalysts formed therefrom, more specifically, to biphenylphenol polymerization precatalysts of Formula I and biphenylphenol polymerization catalysts made therefrom that have improved induction times.

Background

[0002] Polymers may be utilized for a number of products including as films, fibers, nonwoven and/or woven fabrics, extruded articles, and/or molded articles, among others. Polymers can be made by reacting one or more types of monomer in a polymerization reaction in the presence of a polymerization catalyst.

Summary

[0003] The present disclosure provides a use of a biphenylphenol polymerization catalyst to make a polymer in a gas-phase or slurry-phase polymerization process conducted in a single gas-phase or slurry-phase polymerization reactor, wherein the biphenylphenol polymerization catalyst is made from a biphenylphenol polymerization precatalyst of Formula I:



(Formula I)

wherein each of R^1, R^2, R^3, R^4, R^5, R^{10}, R^{11}, R^{12}, R^{13}, and R^{14} is independently a C_1 to C_{20} alkyl, aryl or aralkyl, a hydrogen, halogen, or silyl group;

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

wherein L is a saturated C_4 alkyl that forms a bridge between the two oxygen atoms to which L is covalently bonded;

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;

wherein each of R^7 and R^8 is independently a C_1 to C_{20} alkyl, aryl or aralkyl or a hydrogen; wherein at least one of R^7 and R^8 comprises a C_1 to C_{20} alkyl, aralkyl, or hydrogen;

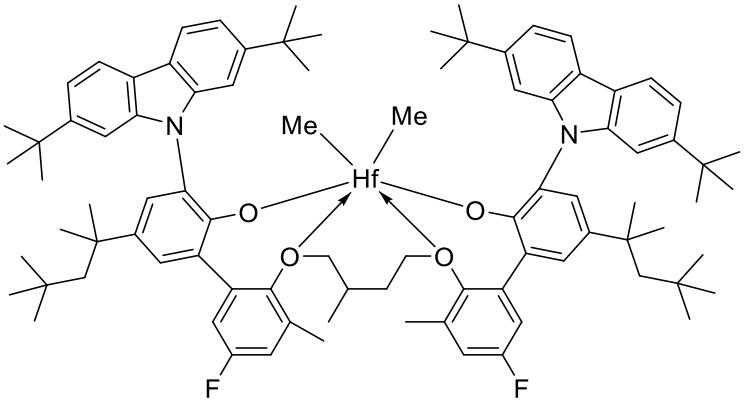
wherein M is Zr or Hf;

wherein each of R^6 and R^9 is independently a halogen, C_1 to C_{20} alkyl, aryl or aralkyl or a hydrogen; and

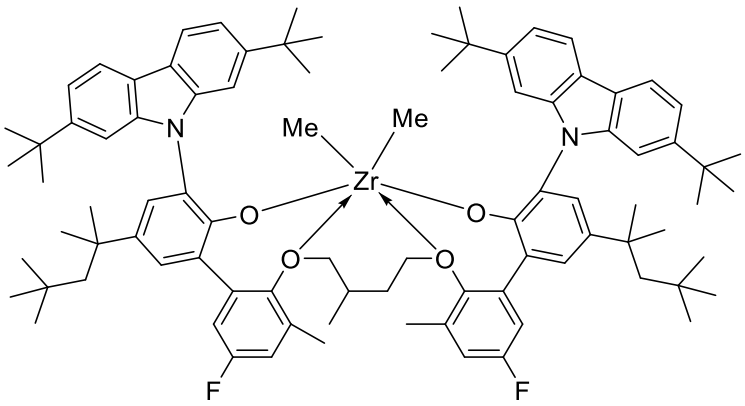
wherein a biphenylphenol polymerization catalyst has a kinetic induction time of greater than 40 seconds as determined by a least squares fit of a first-order exponential for a rate of increase of an instantaneous polymerization rate for the gas-phase or slurry-phase polymerization process.

[0004] The present disclosure also provides a biphenylphenol polymerization precatalyst selected from a group consisting of structures (i), (ii), (iii), (iv), and (v), as detailed herein.

[0004a] In one aspect, there is provided a biphenylphenol polymerization precatalyst selected from a group consisting of the structures of (iv), and (v):



(iv); and



(v).

[0005] The present disclosure also provides a method of making a biphenylphenol polymerization catalyst, the method comprising contacting, under activating conditions, a biphenylphenol polymerization precatalyst of Formula I with an activator so as to activate the biphenylphenol polymerization precatalyst of Formula I, thereby making the biphenylphenol polymerization catalyst that has a kinetic induction time of greater than 40 seconds as determined by a least squares fit of a first-order exponential for a rate of increase of an instantaneous polymerization rate.

[0005a] In another aspect, there is provided a method of making a biphenylphenol polymerization catalyst, the method comprising contacting, under activating conditions, a biphenylphenol polymerization precatalyst of at least one of structures of (iv) and (v) as defined herein with an activator so as to activate the biphenylphenol polymerization precatalyst of structure (iv) or (v), thereby making the biphenylphenol polymerization catalyst, in a slurry-phase polymerization process conducted at a temperature of 100 °C, an ethylene pressure of 100 psi, a hydrogen to ethylene (H_2/C_2) molar gas ratio of 0.0017, and a 1-hexene to ethylene (C_6/C_2) molar ratio of 0.4, that has a kinetic induction time of greater than 40 seconds as determined by a least squares fit of a first-order exponential for a rate of increase of an instantaneous polymerization rate.

[0006] The present disclosure also provides a method of making a polyethylene, the method comprising polymerizing an olefin monomer in a polymerization reactor in presence of the biphenylphenol polymerization catalyst to make a polyethylene composition.

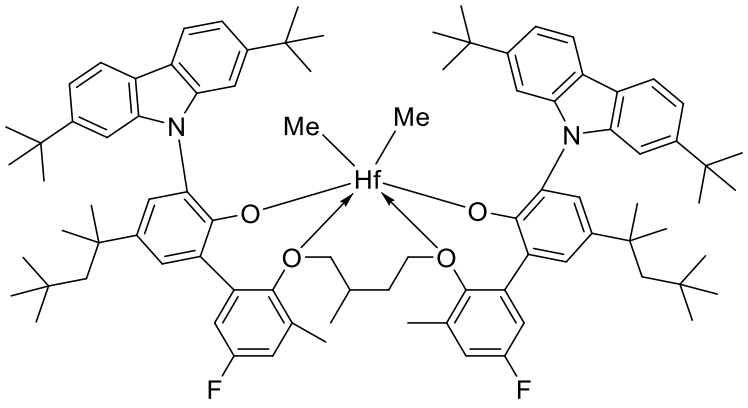
Detailed Description

[0007] The biphenylphenol polymerization precatalyst herein can be represented by the Formula I:

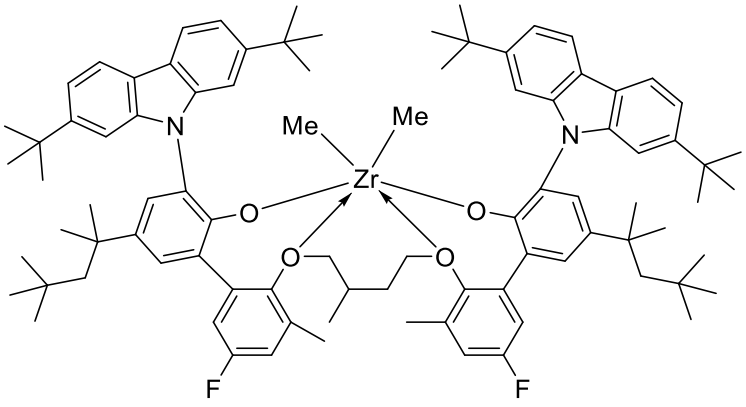
Claims:

What is claimed is:

1. A biphenylphenol polymerization precatalyst selected from a group consisting of the structures of (iv), and (v):



(iv); and



(v).

2. A method of making a biphenylphenol polymerization catalyst, the method comprising contacting, under activating conditions, a biphenylphenol polymerization precatalyst of at least one of structures of (iv) and (v) of claim 1 with an activator so as to activate the biphenylphenol polymerization precatalyst of structure (iv) or (v), thereby making the biphenylphenol polymerization catalyst, in a slurry-phase polymerization process conducted at a temperature of 100 °C, an ethylene pressure of 100 psi, a hydrogen to ethylene (H_2/C_2) molar gas ratio of 0.0017, and a 1-hexene to ethylene (C_6/C_2) molar ratio of 0.4, that has a kinetic induction time of greater than 40 seconds as determined by a least squares fit of a first-order exponential for a rate of increase of an instantaneous polymerization rate.

3. A method of making a polyethylene, the method comprising:

polymerizing an olefin monomer in a polymerization reactor in presence of the biphenylphenol polymerization catalyst of claim 2 to make a polyethylene composition.

4. The method of claim 3, wherein the biphenylphenol polymerization catalyst of claim 2 is introduced into the polymerization reactor in the form of:

a slurry including the biphenylphenol polymerization catalyst; or

a spray-dried catalyst composition including the biphenylphenol polymerization catalyst.