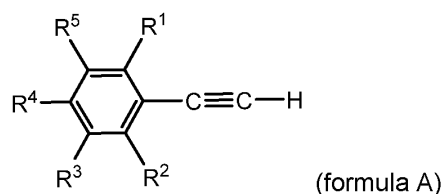


Claims

1. A method of making an productivity enhanced non-metallocene catalyst, the method comprising combining a first non-metallocene precatalyst, an effective amount of an activator, and an effective amount of a productivity-increasing organic compound under conditions effective for the activator and the productivity-increasing organic compound to chemically convert the first non-metallocene precatalyst into the productivity enhanced non-metallocene catalyst; wherein the productivity-increasing organic compound is of formula (A):



wherein each of R^5 , R^4 and R^3 independently is H, a halogen, or a (C_1-C_{20}) hydrocarbyl; with the proviso that at least one of R^5 and R^3 is a halogen or a haloalkyl; wherein each of R^2 and R^1 independently is H, a halogen, or a (C_1-C_{20}) hydrocarbyl, wherein each (C_1-C_{20}) hydrocarbyl independently is unsubstituted or substituted with from 1 to 4 substituent groups R^S ; wherein each substituent group R^S is independently selected from halogen, unsubstituted (C_1-C_5) alkyl, $-C\equiv CH$, $-OH$, (C_1-C_5) alkoxy, $-C(=O)-(unsubstituted\ (C_1-C_5)alkyl)$, $-NH_2$, $-N(H)(unsubstituted\ (C_1-C_5)alkyl)$, $-N(unsubstituted\ (C_1-C_5)alkyl)_2$, $-COOH$, $-C(=O)-NH_2$, $-C(=O)-N(H)(unsubstituted\ (C_1-C_5)alkyl)$, $-C(=O)-N(unsubstituted\ (C_1-C_5)alkyl)_2$, $-S(unsubstituted\ (C_1-C_5)alkyl)$, $-S(=O)_2(unsubstituted\ (C_1-C_5)alkyl)$, $-S(=O)_2-NH_2$, $-S(=O)_2-N(H)(unsubstituted\ (C_1-C_5)alkyl)$, $-S(=O)_2-N(unsubstituted\ (C_1-C_5)alkyl)_2$, $-C(=S)-S(unsubstituted\ (C_1-C_5)alkyl)$ and $-COO(unsubstituted\ (C_1-C_5)alkyl)$.

2. The method of claim 1 wherein one of R^5 and R^3 is a halogen and the other of R^5 and R^3 is H or a (C_1-C_{20}) hydrocarbyl; or wherein each of R^5 and R^3 is a halogen or haloalkyl.

3. The method of any one of claims 1 to 2 wherein each of R^2 and R^1 is H.

4. The method of any one of claims 1 to 3 wherein R^4 is a halogen or H.

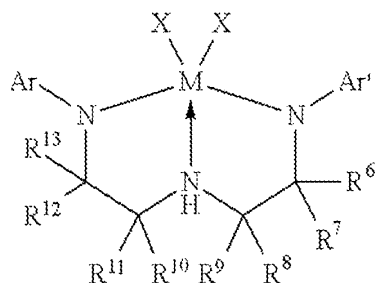
5. The method of claim 1 wherein the productivity-increasing organic compound is selected from a group consisting of 1-ethynyl-3-fluorobenzene, 1-ethynyl-3,5-difluorobenzene, 4-ethynyl-1,2-difluorobenzene, 1-ethynyl-3,5-bis(trifluoromethyl)benzene, and 3,4,5-trifluorophenylacetylene.

6. The method of any one of claims 1 to 5 wherein the method further comprises combining

the first non-metallocene precatalyst, the effective amount of an activator, the effective amount of a productivity-increasing organic compound, a support material, and an inert hydrocarbon solvent to make a mixture, and removing the inert hydrocarbon solvent from the mixture so as to give the productivity enhanced non-metallocene catalyst disposed on the support material.

7. The method of any one of claims 1 to 6 wherein the order of the combining step comprises any one of limitations (i) to (iv): (i) combining the first non-metallocene precatalyst with the effective amount of the activator to give a first intermediate mixture that is free of the productivity-increasing organic compound, and then combining the first intermediate mixture with the productivity-increasing organic compound; (ii) combining the first non-metallocene precatalyst with the effective amount of the productivity-increasing organic compound to give a second intermediate mixture, and then combining the second intermediate mixture with the effective amount of the activator; (iii) combining the effective amount of the activator with the effective amount of the productivity-increasing organic compound to give a third intermediate mixture that is free of the first non-metallocene precatalyst, and then combining the third intermediate mixture with the first non-metallocene precatalyst; and (iv) simultaneously combining the first non-metallocene precatalyst, the effective amount of the activator, and the effective amount of the productivity-increasing organic compound.

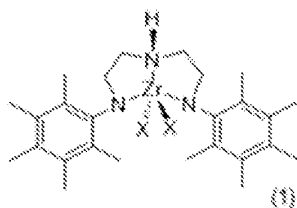
8. The method of any one of claims 1 to 7 wherein the first non-metallocene precatalyst is a non-metallocene precatalyst of formula (I)



(I); wherein M is a group 4 element, each of R⁶- R¹³

are independently a hydrogen or a methyl group, Ar is an aryl group or a substituted aryl group, Ar' is an aryl group or a substituted aryl group, and each X is, independently, a hydride group, an amide, a benzyl group, a methyl group, a chloro group, a fluoro group, a methylene(trimethylsilyl) group, a hydrocarbyl group, or a heterohydrocarbyl group.

9. The method of any one of claims 1 to 8 wherein the first non-metallocene precatalyst of formula (I) is of compound (1):



, wherein each X is, independently, a hydride group, an amide, a benzyl group, a methyl group, a chloro group, a fluoro group, methylene(trimethylsilyl) group, a hydrocarbyl group, or a heterohydrocarbyl group.

10. The method of any one of claims 1 to 9 wherein the metal of the first non-metallocene precatalyst is M, wherein the activator is an organoaluminum compound, and wherein the effective amount of the activator is an Al/M molar ratio of from 0.5 to 10,000, alternatively from 0.95 to 200, alternatively from 1.0 to 150, alternatively from 10 to 100; and/or wherein the effective amount of the productivity-increasing organic compound comprises a molar ratio of productivity-increasing organic compound-to-first non-metallocene precatalyst (PIC/NMC molar ratio) of from 0.5:1.0 to 50.0:1.0, alternatively from 0.9:1.0 to 20.0:1.0, alternatively from 0.9:1.0 to 11:1.0, alternatively from 0.95:1.0 to 6:1.0.

11. A productivity enhanced non-metallocene catalyst made by the method of any one of claims 1 to 10.

12. The productivity enhanced non-metallocene catalyst of claim 11 wherein a comparative non-metallocene catalyst, made from the first non-metallocene precatalyst and activator in absence of the productivity-increasing organic compound, under the same polymerization conditions has a productivity of x, and the productivity enhanced non-metallocene catalyst has a productivity of 1.1x to 7.5x.

13. A method of feeding a productivity enhanced non-metallocene catalyst to a slurry-phase, solution-phase, or gas-phase polymerization reactor containing an olefin monomer and a moving bed of polyolefin polymer, the method comprising making the productivity enhanced non-metallocene catalyst outside of the reactor and according to the method of any one of claims 1 to 10, and feeding the productivity enhanced non-metallocene catalyst in neat form or as a solution or slurry thereof in an inert hydrocarbon liquid or mineral oil through a feed line free of olefin monomer into the slurry-phase, solution-phase, or gas-phase polymerization reactor.

14. A multimodal catalyst system comprising the enhanced productivity non-metallocene catalyst made by the method of any one of claims 1 to 10, and at least one second catalyst selected from a metallocene catalyst and a different non-metallocene catalyst.

15. A method of making a polyolefin polymer, the method comprising contacting at least one 1-alkene monomer with the productivity enhanced non-metallocene catalyst made by the method of any one of claims 1 to 10, or the multimodal catalyst system of claim 14, in a slurry-phase, solution-phase, or gas-phase polymerization reactor under polymerizing conditions, thereby making the polyolefin polymer.
16. A polyolefin polymer made by the method of making a polyolefin polymer of claim 15.
17. A manufactured article made from the polyolefin polymer of claim 16.