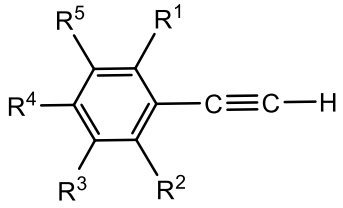
Claims

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):



(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≡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-(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; each of R^5 and R^3 is a halogen or haloalkyl:

each of R^2 and R^1 is H;

R^4 is a halogen or H; or

each of R^2 and R^1 is H and R^4 is a halogen or H.

3. 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-difluoorobenzene, 4-ethynl-

1,2-difluorobenzene, 1-ethynyl-3,5-bis(trifluoromethyl)benzene, and 3,4,5-trifluorophenylacetylene.

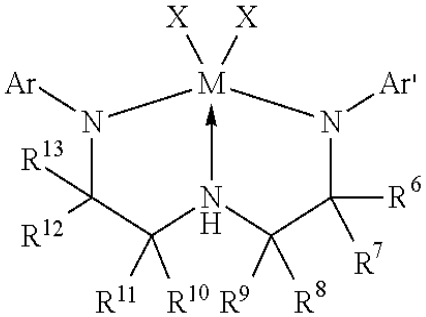
4. The method of any one of claims 1 to 3 wherein:

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; or.

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.

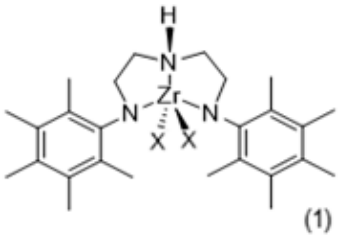
5. The method of any one of claims 1 to 3 wherein:

the first non-metallocene precatalyst is a non-metallocene precatalyst of formula (I)



(I); wherein M is a group 4 element, each of R^6- R^{13} 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; or

the first non-metallocene precatalyst of formula (I) is of compound (1):



(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.

6. A productivity enhanced non-metallocene catalyst made by the method of claim 1.

7. The productivity enhanced non-metallocene catalyst of claim 6 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.

8. 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 claim 1, 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.

9. A multimodal catalyst system comprising the enhanced productivity non-metallocene catalyst made by the method of claim 1, and at least one second catalyst selected from a metallocene catalyst and a different non-metallocene catalyst.

10. 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 claim 1 in a slurry-phase, solution-phase, or gas-phase polymerization reactor under polymerizing conditions, thereby making the polyolefin polymer.