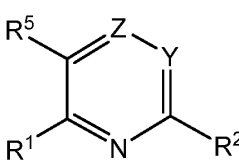
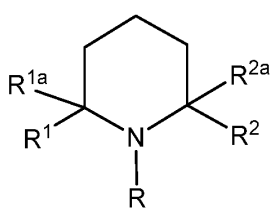


CLAIMS

1. A procatalyst system suitable for making an olefin polymerization catalyst and consisting essentially of a blend of (A) a pre-made solid procatalyst and (B) an azaheterocycle; wherein the (A) pre-made solid procatalyst consists essentially of a titanium compound, magnesium chloride solids, and optionally a silica; wherein the magnesium chloride solids consist essentially of MgCl_2 and, optionally, at least one of a cyclic ($\text{C}_2\text{-C}_6$)ether, a ($\text{C}_1\text{-C}_6$)alcohol, or a hydroxyl-substituted cyclic ($\text{C}_3\text{-C}_7$)ether; and wherein the procatalyst system is free of any other electron donor organic compound.
2. The procatalyst system of claim 1 wherein the (B) azaheterocycle is -an aromatic

azaheterocycle of formula (I):  (I) or a saturated azaheterocycle of

formula (II):  (II); wherein Y is N or C-R³; wherein Z is N or C-R⁴;

wherein R is H or an unsubstituted ($\text{C}_1\text{-C}_{10}$)alkyl; wherein each of R^1 , R^2 , R^3 , R^4 , R^5 , R^{1a} , and R^{2a} independently is H, a halogen atom, -OH, an unsubstituted ($\text{C}_1\text{-C}_{10}$)alkyl group, a halo-substituted ($\text{C}_1\text{-C}_{10}$)alkyl group, or a hydroxyl-substituted ($\text{C}_1\text{-C}_{10}$)alkyl group, or formula (I) is defined by any one of limitations (i) to (iv): (i) R^1 and R^5 are taken together to be a divalent group that is 1,3-butadien-1,4-diyl, (ii) when Y is C-R³, R^2 and R^3 are taken together to be a divalent group that is 1,3-butadien-1,4-diyl, (iii) wherein in formula (I) when Z is C-R⁴, R^4 and R^5 are taken together to be a divalent group that is 1,3-butadien-1,4-diyl, or (iv) both limitation (i) and (ii). In some embodiments at least one of R^1 , R^2 , R^3 , R^4 , R^5 , R^{1a} , and R^{2a} , alternatively at least R^1 is a halogen atom, -OH, an unsubstituted ($\text{C}_1\text{-C}_{10}$)alkyl group, a halo-substituted ($\text{C}_1\text{-C}_{10}$)alkyl group, or a hydroxyl-substituted ($\text{C}_1\text{-C}_{10}$)alkyl group; alternatively at least one of R^1 , R^2 , R^3 , R^4 , R^5 , R^{1a} , and R^{2a} , alternatively at least R^1 is a halogen atom or -OH; alternatively at least one of R^1 , R^2 , R^3 , R^4 , R^5 , R^{1a} , and R^{2a} , alternatively at least R^1 is an unsubstituted ($\text{C}_1\text{-C}_{10}$)alkyl group, a halo-substituted ($\text{C}_1\text{-C}_{10}$)alkyl group, or a hydroxyl-substituted ($\text{C}_1\text{-C}_{10}$)alkyl group; alternatively at least one of R^1 , R^2 , R^3 , R^4 , R^5 ,

R^{1a}, and R^{2a}, alternatively at least R¹ is an unsubstituted (C₁-C₁₀)alkyl group.

3. The procatalyst system of any one of claims 1 to 2 wherein the magnesium chloride solids are free of the at least one of a cyclic (C₂-C₆)ether, a (C₁-C₆)alcohol, or a hydroxyl-substituted cyclic (C₃-C₇)ether.

4. The procatalyst system of any one of claims 1 to 2 wherein the magnesium chloride, solids consist essentially of MgCl₂ and the at least one of a cyclic (C₂-C₆)ether, a (C₁-C₆)alcohol, or a hydroxyl-substituted cyclic (C₃-C₇)ether

5. The procatalyst system of any one of claims 1 to 4 wherein the titanium compound is at least one compound of formula (III): TiX₄ (III), wherein each X independently is Cl, Br, I, or a (C₁-C₆)alkoxy.

6. The procatalyst system of any one of claims 1 to 5 further consisting essentially of a ligand-metal complex of formula (IV): MX₄ (IV), wherein M is Hf or Zr and each X independently is Cl, Br, I, or a (C₁-C₆)alkoxy.

7. A method of synthesizing a procatalyst system, the method comprising drying a mixture consisting essentially of a solution and, optionally, a silica, and being free of (B) an azaheterocycle and any other electron donor organic compound, wherein the solution consists essentially of a titanium compound, magnesium chloride, and, optionally, at least one of a cyclic (C₂-C₆)ether and a (C₁-C₆)alcohol mixed in a hydrocarbon solvent; thereby removing the hydrocarbon solvent from the mixture and crystallizing the magnesium chloride so as to give (A) a pre-made solid procatalyst; and contacting the (A) pre-made solid procatalyst with the (B) azaheterocycle; thereby making the blend of the procatalyst system of any one of claims 1 to 6. The titanium compound, magnesium chloride, and any cyclic (C₂-C₆)ether and/or a (C₁-C₆)alcohol are all mixed in the hydrocarbon solvent.

8. A method of making a catalyst system suitable for polymerizing an olefin, the method comprising contacting the procatalyst system of any one of claims 1 to 6, or the procatalyst system made by the method of claim 7, with an activating effective amount of (C) an activator, thereby making the catalyst system; wherein the catalyst system is free of the any other electron donor organic compound and is suitable for polymerizing an olefin.

9. A method of making a catalyst system suitable for polymerizing an olefin, the method comprising contacting (A) a pre-made solid procatalyst, (B) an azaheterocycle, and an activating effective amount of (C) an activator, thereby making the catalyst system; wherein the (A) pre-made solid procatalyst consists essentially of a titanium compound, magnesium chloride solids, and optionally a silica; wherein the magnesium chloride solids consist essentially of MgCl₂ and, optionally, at least one of a cyclic (C₂-C₆)ether, a (C₁-C₆)alcohol,

or a hydroxyl-substituted cyclic (C₃-C₇)ether; and wherein the catalyst system is free of the any other electron donor organic compound and is suitable for polymerizing an olefin.

10. A catalyst system made by the method of claim 8 or claim 9.

11. A method of synthesizing a polyolefin polymer, the method comprising contacting at least one olefin monomer with the catalyst system of claim 10 under effective polymerization conditions in a polymerization reactor, thereby making the polyolefin polymer.