[0004] The composition distribution of an ethylene alpha-olefin copolymer refers to the distribution of comonomer, which form short chain branches, among the molecules that comprise the polyethylene polymer. When the amount of short chain branches varies among the polyethylene molecules, the resin is said to have a "broad" composition distribution. When the amount of comonomer per 1000 carbons is similar among the polyethylene molecules of different chain lengths, the composition distribution is said to be "narrow".

[0005] The composition distribution is known to influence the properties of copolymers, for example, stiffness, toughness, extracTable content, environmental stress crack resistance, and heat sealing, among other properties. The composition distribution of a polyolefin may be readily measured by methods known in the art, for example, Temperature Raising Elution Fractionation (TREF) or Crystallization Analysis Fractionation (CRYSTAF).

[0006] It is generally known in the art that a polyolefin's composition distribution is largely dictated by the type of catalyst used and is typically invariable for a given catalyst system. Ziegler-Natta catalysts and chromium based catalysts produce resins with broad composition distributions (BCD), whereas metallocene catalysts normally produce resins with narrow composition distributions (NCD).

[0007] Resins having a broad orthogonal composition distribution (BOCD) in which the comonomer is incorporated predominantly in the high molecular weight chains can lead to improved physical properties, for example toughness properties and environmental stress crack resistance (ESCR). Because of the improved physical properties of resins with orthogonal composition distributions needed for commercially desirable products, there exists a need for controlled techniques for forming polyethylene copolymers having a broad orthogonal composition distribution.

SUMMARY

[0008] An example described herein provides a method of selecting catalysts for making a product specific polyolefin using a blend polydispersity index (bPDI) map. The method includes generating a number of polymers for at least two catalysts, wherein each polymer is generated at a different hydrogen to ethylene ratio. One of the catalysts generates a higher molecular weight (hmw) polymer and another of the at least two catalysts generates a lower molecular weight (lmw) polymer. The weight averaged molecular weight and PDI is measured for each polymer. The relationship between the molecular weight of the polymers generated by each of the at least two catalysts and the ratio of hydrogen to ethylene is generated. A family of bPDI curves for polymers that would be made using a number of ratios of a blend of

the at least two catalysts for each of a number of ratios of hydrogen to ethylene is generated. A ratio for a blend of the catalysts is selected that generates a polymer having a bPDI that matches a polymer fabrication process. The ratio of the catalysts is confirmed by generating a polymer at each of the number of ratios of hydrogen to ethylene.

[0009] Another example provides a method of making a product specific polyolefin. The method includes selecting a catalyst blend based, at least in part, on a polydispersity index (PDI) map. The polydispersity map is generated by generating a number of polymers for at least two catalysts, wherein each polymer is generated at a different hydrogen to ethylene ratio. At least one of the catalysts generates a higher molecular weight polymer and another of the catalysts generates a lower molecular weight polymer. The molecular weight is measured for each polymer. The relationship between the molecular weight of the polymers generated by each of the at least two catalysts and the ratio of hydrogen to ethylene is determined. A family of bPDI curves for polymers that would be made using a number of ratios of a blend of the catalysts for each of a number of ratios of hydrogen to ethylene is generated. A ratio for the catalyst blend of the at least two catalysts that generates a polymer having a bPDI that matches a polymer fabrication process is selected. The product specific polyolefin is generated using the catalyst blend.

[0009a] In one aspect, the present disclosure refers to a method of selecting a blend of at least two catalysts for a polymerization catalyst for forming a polyethylene copolymer, wherein the polymerization catalyst comprises: a catalyst support; and the blend of at least two catalysts; wherein the method comprises: generating a plurality of polymers for the at least two catalysts, wherein each polymer is generated at a different hydrogen to ethylene ratio, wherein one of the at least two catalysts generates a polymer with a higher weight average molecular weight (hmw) and another of the at least two catalysts generates a polymer with a lower weight average molecular weight (lmw), wherein the ratio of hmw to lmw is greater than 5.0 at a weight average molecular weight of between 30,000 and 150,000; measuring the molecular weight for each polymer; determining the relationship between the molecular weight of the polymers generated by each of the at least two catalysts and the ratio of hydrogen to ethylene; generating a family of bPDI curves for polymers that would be made using a plurality of ratios of a blend of the at least two catalysts for each of a plurality of ratios of hydrogen to ethylene; and selecting a ratio for the catalyst blend of the at least two catalysts that generates a polymer having a bPDI that matches a polymer fabrication process.

[0010] Another example provides a polymerization catalyst for forming a polyethylene copolymer. The polymerization catalyst includes a catalyst support and a blend of at least two catalysts. The catalysts are selected by generating a number of polymers

for the catalysts, wherein each polymer is generated at a different hydrogen to ethylene ratio. One of the catalysts generates a polymer with a higher weight average molecular weight (hmw) and another of the catalysts generates a polymer with a lower weight average molecular weight (lmw). The ratio of hmw to lmw is greater than about 5.0 at a weight average molecular weight of between about 30,000 and about 150,000. The molecular weight is measured for each polymer and the relationship between the molecular weight of the polymers generated by each of the at least two catalysts and the ratio of hydrogen to ethylene is determined. A family of bPDI curves for polymers that would be made using a number of ratios of a blend of the catalysts for each of a number of ratios of hydrogen to ethylene is generated. A ratio for the catalyst blend of the catalysts that generates a polymer having a bPDI that matches a polymer fabrication process is selected.

[0011] Another example provides a polymerization catalyst for forming a polyethylene copolymer. The polymerization catalyst includes a catalyst support and a first catalyst that is impregnated on the catalyst support, wherein the first catalyst generates polymers

CLAIMS

What is claimed is:

1. A method of selecting a blend of at least two catalysts for a polymerization catalyst for forming a polyethylene copolymer, wherein the polymerization catalyst comprises:

a catalyst support; and

the blend of at least two catalysts;

wherein the method comprises:

generating a plurality of polymers for the at least two catalysts, wherein each polymer is generated at a different hydrogen to ethylene ratio, wherein one of the at least two catalysts generates a polymer with a higher weight

average molecular weight (hmw) and another of the at least two catalysts generates a polymer with a lower weight average molecular weight (lmw), wherein the ratio of hmw to lmw is greater than 5.0 at a weight average molecular weight of between 30,000 and 150,000;

measuring the molecular weight for each polymer;

determining the relationship between the molecular weight of the polymers generated by each of the at least two catalysts and the ratio of hydrogen to ethylene;

generating a family of bPDI curves for polymers that would be made using a plurality of ratios of a blend of the at least two catalysts for each of a plurality of ratios of hydrogen to ethylene; and

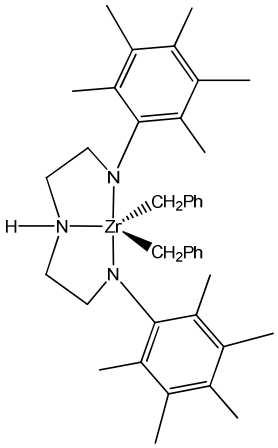
selecting a ratio for the catalyst blend of the at least two catalysts that generates a polymer having a bPDI that matches a polymer fabrication process.

2. The method of claim 1, wherein a catalyst impregnated on the catalyst support is bis(n-propylcyclopentadienyl) hafnium $(CH_3)_2$, bis(n-propylcyclopentadienyl) hafnium F_2, bis(n-propylcyclopentadienyl) hafnium Cl_2, or any combinations thereof.

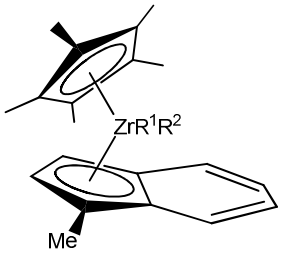
3. The method of claim 1, wherein a catalyst impregnated on the catalyst support is bis(n-butyl, methyl cyclopentadienyl) zirconium $(CH_3)_2$, bis(n-butyl, methyl cyclopentadienyl) zirconium Cl_2, bis(n-butyl, methyl cyclopentadienyl) zirconium F_2, or any combinations thereof.

4. The method of claim 1, wherein a catalyst impregnated on the catalyst support is bis(1-ethylindenyl) zirconium $(CH_3)_2$, bis(1-ethylindenyl) zirconium F_2, bis(1-ethylindenyl) zirconium Cl_2, or any combinations thereof.

5. The method of claim 1, wherein a catalyst impregnated on the catalyst support is represented by the formula:



6. The method of claim 1, wherein a catalyst impregnated on the catalyst support is any one, or any combination, of the compounds represented by the following formulas:



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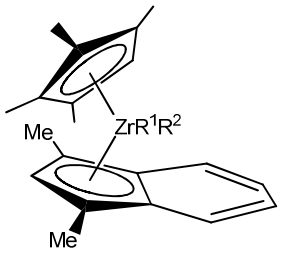

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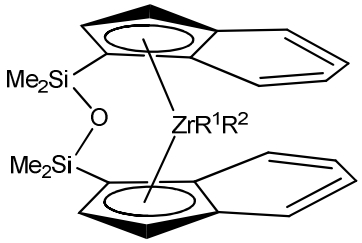
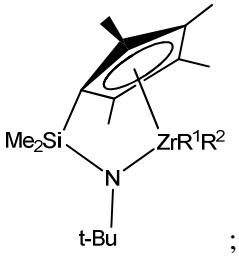


, or


; wherein R^1 and R^2 are each, independently, methyl, chloro, fluoro, or a hydrocarbyl group.