

CLAIMS

1. A method of polymerizing an olefin monomer to make a first polyolefin composition comprising a first polyolefin polymer, the method comprising steps (A) to (C): (A) contacting a solution of a first alkane-soluble non-metallocene precatalyst dissolved in an alkane solvent with an activator so as to make a first trim catalyst comprising a first alkane-soluble non-metallocene catalyst; (B) feeding the first trim catalyst into a polymerization reactor; and (C) polymerizing the olefin monomer with the first trim catalyst in the polymerization reactor; thereby making the first polyolefin composition comprising the first polyolefin polymer; wherein the first alkane-soluble non-metallocene precatalyst is characterized by solubility in hexanes containing at least 60 weight percent n-hexane of at least 0.10 weight percent, based on total weight of the first alkane-soluble non-metallocene precatalyst and hexanes, measured using Solubility Test Method.
2. The method of claim 1 wherein the first trim catalyst comprises a solution of the first alkane-soluble non-metallocene catalyst dissolved in an alkane solvent and step (B) comprises feeding the solution into the reactor, the solution being free of a support material.
3. The method of claim 1 or 2 further comprising steps (a) and (b): (a) contacting, separately from step (A), a first metallocene precatalyst with an activator and, optionally, a support material so as to make a first metallocene catalyst, optionally free of the support material or disposed on and/or in the support material; and (b) feeding, separately from step (B), the first metallocene catalyst, into the polymerization reactor; and wherein step (C) further comprises polymerizing the olefin monomer with the first metallocene catalyst in the polymerization reactor; thereby making a first bimodal polyolefin composition comprising the first polyolefin polymer and a second polyolefin polymer.
4. The method of claim 3 wherein step (B) comprises feeding the first trim catalyst as a solution of the first alkane-soluble non-metallocene catalyst dissolved in a first alkane solvent into the polymerization reactor; and wherein the step (b) comprises separately feeding a solution of the first metallocene catalyst dissolved in a second alkane solvent into the polymerization reactor; wherein the first and second alkane solvents are the same or different; and wherein the solutions are free of a support material.
5. The method of claim 3 or 4 further comprising, after the step (C), (D) transitioning the method from the steps (a) and (b) to steps (a1) and (b1), respectively: (a1) contacting a second metallocene precatalyst, which is different than the first metallocene precatalyst in structure of at least one cyclopentadienyl ligand, with an activator, and, optionally, a support material so as to make a second metallocene catalyst, which is different than the first metallocene catalyst, wherein the second metallocene catalyst is free of a support material or is disposed on and/or in the support material; and (b1) decreasing the feeding of the first metallocene catalyst from a steady-state value until the first metallocene catalyst is no longer being fed into the

polymerization reactor and independently initiating and increasing feeding of the second metallocene catalyst into the polymerization reactor until the second metallocene catalyst is being fed into the polymerization reactor at a steady-state value; and wherein step (C) further comprises polymerizing the olefin monomer with the second metallocene catalyst in the polymerization reactor; thereby making a second multimodal polyolefin composition comprising the first polyolefin polymer made by the first trim catalyst and a third polyolefin polymer made by the second metallocene catalyst, wherein the third polyolefin polymer is different than each of the first and second polyolefin polymers.

6. The method of claim 1 wherein the first trim catalyst further comprises a support material on which the first alkane-soluble non-metallocene catalyst is disposed.

7. A method of polymerizing an olefin monomer to make a first bimodal polyolefin composition comprising a first higher molecular weight (HMW) polyolefin component and a first lower molecular weight (LMW) polyolefin component, the method comprising steps (1) to (5): (1) contacting a solution of a first alkane-soluble non-metallocene precatalyst dissolved in an alkane solvent with an activator so as to make a first trim catalyst comprising a first alkane-soluble non-metallocene catalyst; (2) contacting a first metallocene precatalyst and an additional amount of the first alkane-soluble non-metallocene precatalyst with an activator and, optionally, a support material so as to make a first bimodal catalyst system comprising a first metallocene catalyst and an additional amount of the first alkane-soluble non-metallocene catalyst, optionally free of the support material or disposed on and/or in the support material; (3) contacting the first bimodal catalyst system with the first trim catalyst to make a first mixed catalyst system comprising a mixture of the first bimodal catalyst system and the first trim catalyst; (4) feeding the first mixed catalyst system into a polymerization reactor; and (5) polymerizing the olefin monomer with the first mixed catalyst system in the polymerization reactor; thereby making the first HMW polyolefin component and the first LMW polyolefin component of the first bimodal polyolefin composition; wherein the first ASNM Precatalyst is characterized by solubility in hexanes containing at least 60 weight percent n-hexane of at least 0.10 weight percent based on total weight of the first ASNM Precatalyst and hexanes, as measured using Solubility Test Method.

8. The method of claim 7 further comprising, after step (5), (6) transitioning the method from steps (2) to (5) to steps (2a) to (5a), respectively: (2a) contacting a second metallocene precatalyst and a second additional amount of the first alkane-soluble non-metallocene precatalyst with an activator and, optionally, a support material so as to make a second bimodal catalyst system comprising the second metallocene catalyst and the second additional amount of the first alkane-soluble non-metallocene catalyst, optionally free of the support material or disposed on and/or in the support material; (3a) contacting the second bimodal catalyst system with the same trim catalyst of step (1) to make a second mixed

catalyst system comprising a mixture of the second bimodal catalyst system and the first trim catalyst; (4a) decreasing the feeding of the first mixed catalyst system from a steady-state value until the first mixed catalyst system is no longer being fed into the polymerization reactor and independently initiating and increasing feeding of the second mixed catalyst system into the polymerization reactor until the second mixed catalyst is being fed into the polymerization reactor at a steady-state value; and (5a) polymerizing the olefin monomer with the second mixed catalyst system in the polymerization reactor; thereby making a second bimodal polyolefin composition comprising the first HMW polyolefin component and a second LMW polyolefin component, which is different than each of the first HMW polyolefin component and the first LMW polyolefin component.

9. The method of any one of claims 1 to 8 wherein the olefin monomer is any one of (i) to (vii): (i) ethylene; (ii) propylene; (iii) a (C₄-C₂₀)alpha-olefin; (iv) 1,3-butadiene; (v) a combination of (i) and (ii); (vi) a combination of (i) and (iii); and (vii) a combination of (i), (ii), and (iv); and wherein the first polyolefin polymer or the HMW polyolefin component respectively comprises any one of (a) to (g): (a) a polyethylene homopolymer; (b) a polypropylene homopolymer; (c) a poly(C₄-C₂₀)alpha-olefin polymer; (d) a polybutadiene polymer; (e) an ethylene-propylene copolymer; (f) a poly(ethylene-co-(C₄-C₂₀)alpha-olefin) copolymer; and (g) an ethylene-propylene-butadiene copolymer.

10. The method of any one of claims 1 to 9 wherein the first polyolefin polymer or the HMW polyolefin component has a weight-average molecular weight of at least 110,000 grams per mole (g/mol).

11. The method of any one of claims 1 to 10 wherein the polymerizing is a gas phase polymerizing process and the reactor is a single gas phase polymerization reactor.

12. The method of any one of claims 1 to 11 further comprising transitioning from step (B) to step (B1) feeding to the polymerization reactor a second trim catalyst, which is made by contacting a solution of a second alkane-soluble non-metallocene precatalyst dissolved in an alkane solvent with an activator to make a second alkane-soluble non-metallocene catalyst; wherein the second alkane-soluble non-metallocene precatalyst is different than the first alkane-soluble non-metallocene precatalyst in structure of at least one non-metallocene ligand and the second alkane-soluble non-metallocene catalyst is different than the first alkane-soluble non-metallocene catalyst in structure of the at least one non-metallocene ligand; wherein the second alkane-soluble non-metallocene precatalyst is characterized by solubility in hexanes containing at least 60 weight percent n-hexane of at least 0.10 weight percent based on total weight of the second alkane-soluble non-metallocene precatalyst and hexanes, as measured using Solubility Test Method; and wherein the transitioning comprises decreasing the feeding of the first trim catalyst from a steady-state value until the first trim

catalyst is no longer being fed into the polymerization reactor and independently initiating and increasing the feeding of the second trim catalyst into the polymerization reactor until the second trim catalyst is being fed into the polymerization reactor at a steady-state value.

13. The method of any one of claims 1 to 12 wherein the first alkane-soluble non-metallocene precatalyst, and any second alkane-soluble non-metallocene precatalyst, independently is characterized by solubility in hexanes containing at least 60 weight percent n-hexane ($\text{CH}_3(\text{CH}_2)_4\text{CH}_3$) of from 0.50 to 24 wt% based on total weight thereof.