

CLAIMS

1. An activator-nucleator formulation comprising an activating effective amount of (A) an alkylaluminum(chloride) compound of formula (I): $\text{Al}((\text{C}_1\text{-C}_6)\text{alkyl})_m(\text{chloro})_n$ (I), wherein subscript m is an integer from 1 to 3, subscript n is an integer from 2 to 0, the sum of subscripts $m + n = 3$, and each chloro is a chlorine atom (compound (A)); and a nucleating effective amount of a compound (B) selected from at least one of compounds (B1) to (B3): (B1) calcium (1R,2S)-*cis*-cyclohexane-1,2-dicarboxylate (1:1); (B2) calcium stearate (1:2), and (B3) zinc stearate (1:2).
2. The activator-nucleator formulation of claim 1, wherein the compound (A) is the alkylaluminum(chloride) compound of formula (I) characterized by any one of limitations (i) to (iii): (i) subscript m is 3 and subscript n is 0; (ii) each (C₁-C₆)alkyl is ethyl, butyl, or hexyl; and (iii) each (C₁-C₆)alkyl is ethyl.
3. The activator-nucleator formulation of claim 1 or 2, wherein the compound (B) is any one of limitations (i) to (iii): (i) (B1) calcium (1R,2S)-*cis*-cyclohexane-1,2-dicarboxylate (1:1); (ii) (B2) calcium stearate (1:2); and (iii) (B3) zinc stearate (1:2).
4. A Ziegler-Natta procatalyst system comprising the compound (B) and (C) a Ziegler-Natta procatalyst; and, optionally, the compound (A).
5. A Ziegler-Natta catalyst system comprising the compound (B) and (D) a Ziegler-Natta catalyst.
6. A method of polymerizing ethylene, and optionally 0, 1, or more alpha-olefin comonomers, in a gas phase or liquid phase polymerization process conducted in a gas phase or liquid phase polymerization reactor, the method comprising contacting ethylene, and optionally 0, 1, or more alpha-olefin comonomers, with the Ziegler-Natta catalyst system of claim 5 to give a semicrystalline polyethylene polymer.
7. The method of claim 6 wherein the Ziegler-Natta catalyst system is a spray-dried Ziegler-Natta catalyst system further comprising at least one of a carrier material and an organic modifier that is tetrahydrofuran.
8. The method of claim 7 comprising the gas phase polymerization of the ethylene and the (C₃-C₂₀)alpha-olefin in the presence of molecular hydrogen gas (H₂) and, optionally, an induced condensing agent (ICA) in one, two or more gas phase polymerization reactors under polymerizing conditions, thereby making the semicrystalline polyethylene polymer; wherein the polymerizing conditions comprise a reaction temperature from 80 degrees (°) to 110° Celsius (C.); a molar ratio of the molecular hydrogen gas to the ethylene (H₂/C₂ molar ratio) from 0.001 to 0.050; and a molar ratio of the comonomer to the ethylene (Comonomer/C₂ molar ratio) from 0.005 to 0.10.

9. A semicrystalline polyethylene polymer made by the method of polymerizing of any one of claims 6 to 8.
10. A manufactured article comprising the semicrystalline polyethylene polymer of claim 9.
11. The method of claim 6 comprising the liquid phase polymerization process conducted in a liquid phase polymerization reactor.
12. The method of claim 11 wherein the liquid phase polymerization process is a slurry phase polymerization process and the liquid phase polymerization reactor is a slurry phase polymerization reactor.
13. A semicrystalline polyethylene polymer made by the method of polymerizing of claim 11 or 12.
14. A manufactured article comprising the semicrystalline polyethylene polymer of claim 13.