CLAIMS

1. An ethylene polymer comprising a higher molecular weight component and a lower molecular weight component, wherein the polymer has:

a ratio of the Mp of the higher molecular weight component to the Mp of the lower molecular weight component in a range from about 5:1 to about 100:1;

a number of LCB of the lower molecular weight component in a range from about 5 to about 50 LCB per million total carbon atoms; and

a number of LCB of the higher molecular weight component of less than or equal to about 5 LCB per million total carbon atoms.

2. The polymer of claim 1, wherein:

the lower molecular weight component has a Mp in a range from about 15 to about 80 kg/mol;

the higher molecular weight component has a Mp in a range from about 150 to about 800 kg/mol;

a ratio of the number of LCB of the ethylene polymer to the number of LCB of the higher molecular weight component, per millions total carbon atoms, in a range from about 2:1 to about 100:1; and

a number of LCB of the ethylene polymer in a range from about 2 to about 30 LCB per million total carbon atoms.

3. The polymer of claim 1, wherein the amount of the higher molecular weight component, based on the weight of the ethylene polymer, is in a range from about 10 to about 60 area %.

4. The polymer of claim 1, wherein the polymer has:

a melt index of less than or equal to about 0.4 g/10 min;

a high load melt index in a range from about 4 to about 30 g/10 min; and

a density in a range from about 0.915 to about 0.935 g/cm^3.

5. The polymer of claim 4, wherein the polymer has:

a ratio of Mw/Mn in a range from about 8 to about 35;

a ratio of Mz/Mw in a range from about 3 to about 6;

a Mw in a range from about 120 to about 500 kg/mol;

a Mn in a range from about 10 to about 50 kg/mol; or

any combination thereof.

6. The polymer of claim 1, wherein the polymer has:

a zero-shear viscosity at 190 °C in a range from about 10,000 to about 500,000 Pa-sec;

a CY-a parameter at 190 °C in a range from about 0.20 to about 0.45; and

a Tau(η) parameter at 190 °C in a range from about 0.2 to about 2 sec.

7. The polymer of claim 1, wherein the polymer is an ethylene/1-butene copolymer, an ethylene/1-hexene copolymer, or an ethylene/1-octene copolymer.

8. The polymer of claim 7, wherein the polymer has a reverse comonomer distribution.

9. An article comprising the polymer of claim 8.

10. A film comprising the polymer of claim 8.

11. A blown film comprising an ethylene polymer having a melt index less than or equal to about 0.4 g/10 min, wherein the film has a dart impact strength greater than or equal to about 300 g/mil.

12. The film of claim 11, wherein the polymer comprises a higher molecular weight component and a lower molecular weight component, wherein:

a ratio of the Mp of the higher molecular weight component to the Mp of the lower molecular weight component in a range from about 5:1 to about 100:1;

the lower molecular weight component has a Mp in a range from about 15 to about 80 kg/mol; and

the higher molecular weight component has a Mp in a range from about 150 to about 800 kg/mol.

13. The film of claim 12, wherein the polymer comprises a higher molecular weight component and a lower molecular weight component, wherein:

a number of LCB of the lower molecular weight component is in a range from about 5 to about 50 LCB per million total carbon atoms;

a number of LCB of the higher molecular weight component is less than or equal to about 5 LCB per million total carbon atoms;

a number of LCB of the ethylene polymer is in a range from about 2 to about 30 LCB per million total carbon atoms; and

a ratio of the number of LCB of the ethylene polymer to the number of LCB of the higher molecular weight component, per millions total carbon atoms, is in a range from about 2:1 to about 100:1.

14. The film of claim 11, wherein the polymer is an ethylene/1-butene copolymer, an ethylene/1-hexene copolymer, or an ethylene/1-octene copolymer, and is characterized by:

a melt index of less than or equal to about 0.4 g/10 min;

a high load melt index in a range from about 4 to about 30 g/10 min;

a density in a range from about 0.915 to about 0.935 g/cm^3; and

a ratio of Mw/Mn in a range from about 8 to about 35.

15. The film of claim 14, wherein the film has:

a dart impact strength in a range from about 400 to about 2000 g/mil;

a haze of greater than or equal to about 55%;

a MD shrink at 250 °F in a range from about 20 to about 70%;

a MD Elmendorf tear strength in a range from about 10 to about 150 g/mil; and

a kinetic COF in a range from about 0.3 to about 0.5.

16. A catalyst composition comprising:

catalyst component I comprising a two carbon bridged metallocene compound containing two cyclopentadienyl groups, two indenyl groups, or a cyclopentadienyl and an indenyl group;

catalyst component II comprising a single atom bridged metallocene compound containing a fluorenyl group;

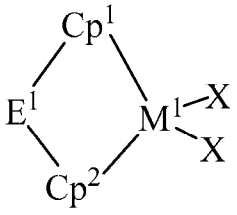
an activator; and

optionally, a co-catalyst;

wherein a weight percentage of catalyst component I is in a range from about 25 to about 98%, based on the total weight of catalyst component I and catalyst component II.

17. The composition of claim 16, wherein:

catalyst component I comprises a metallocene compound having formula (A):



(**A**); wherein:

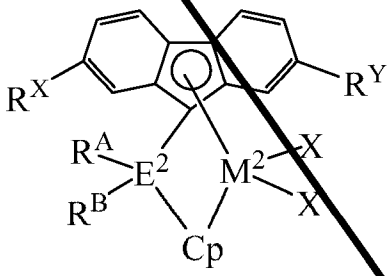
M^1 is Zr or Hf;

Cp^1 and Cp^2 independently are a cyclopentadienyl or indenyl group;

E^1 is a bridging group having the formula $—CR^{1A}R^{1B}—CR^{2A}R^{2B}—$, wherein R^{1A}, R^{1B}, R^{2A}, and R^{2B} independently are H or a hydrocarbyl group having up to 10 carbon atoms (e.g., any C_1-C_{10} hydrocarbyl group disclosed herein); and

each X independently is a monoanionic ligand; and

catalyst component II comprises a metallocene compound having formula (**B**):



(**B**); wherein:

M^2 is Zr or Hf;

Cp is a cyclopentadienyl group;

E^2 is carbon or silicon;

R^A and R^B independently are H or a C_1 to C_{18} hydrocarbyl group;

R^X and R^Y independently are H, a halide, a C_1 to C_{36} hydrocarbyl group, a C_1 to C_{36} halogenated hydrocarbyl group, a C_1 to C_{36} hydrocarboxy group, or a C_1 to C_{36} hydrocarbylsilyl group; and

each X independently is a monoanionic ligand.

18. The composition of claim 17, wherein the activator comprises an aluminoxane compound, an organoboron or organoborate compound, an ionizing ionic compound, or any combination thereof.

19. An olefin polymerization process, the process comprising contacting the catalyst composition of claim 17 with an olefin monomer and an optional olefin comonomer in a polymerization reactor system under polymerization conditions to produce an olefin polymer.

20. The process of claim 19, wherein:

the activator comprises an activator-support comprising a fluorided solid oxide and/or a sulfated solid oxide;

the catalyst composition comprises an organoaluminum co-catalyst;

the catalyst composition is contacted with ethylene and an olefin comonomer comprising 1-butene, 1-hexene, 1-octene, or a mixture thereof; and

the polymerization reactor system comprises a slurry reactor, gas-phase reactor, solution reactor, or a combination thereof.

CLAIMS

We claim:

1. An ethylene polymer composition comprising a higher molecular weight component and a lower molecular weight component, wherein:

a ratio of the Mp of the higher molecular weight component to the Mp of the lower molecular weight component is in a range from about 5:1 to about 100:1;

a number of LCB of the lower molecular weight component is in a range from about 5 to about 50 LCB per million total carbon atoms; and

a number of LCB of the higher molecular weight component is less than or equal to about 5 LCB per million total carbon atoms.

2. The polymer composition of claim 1, wherein:

the lower molecular weight component has a Mp in a range from about 15 to about 80 kg/mol;

the higher molecular weight component has a Mp in a range from about 150 to about 800 kg/mol;

a ratio of the number of LCB of the ethylene polymer composition to the number of LCB of the higher molecular weight component, per millions total carbon atoms, is in a range from about 2:1 to about 100:1; and

a number of LCB of the ethylene polymer composition is in a range from about 2 to about 30 LCB per million total carbon atoms.

3. The polymer composition of claim 1, wherein the amount of the higher molecular weight component, based on the weight of the ethylene polymer composition, is in a range from about 10 to about 60 area %.

4. The polymer composition of claim 1, wherein the polymer composition has:

a melt index of less than or equal to about 0.4 g/10 min;

a high load melt index in a range from about 4 to about 30 g/10 min; and

a density in a range from about 0.915 to about 0.935 g/cm^3.

5. The polymer composition of claim 4, wherein the polymer composition has:

a ratio of Mw/Mn in a range from about 8 to about 35;

a ratio of Mz/Mw in a range from about 3 to about 6;

a Mw in a range from about 120 to about 500 kg/mol;

a Mn in a range from about 10 to about 50 kg/mol; or any combination thereof.

6. The polymer composition of claim 1, wherein the polymer composition has:

a zero-shear viscosity at 190° C. in a range from about 10,000 to about 500,000 Pa-sec;

a CY-a parameter at 190° C. in a range from about 0.20 to about 0.45; and

a Tau(η) parameter at 190° C. in a range from about 0.2 to about 2 sec.

7. The polymer composition of claim 1, wherein the polymer composition is an ethylene/1-butene copolymer, an ethylene/1-hexene copolymer, or an ethylene/1-octene copolymer.

8. The polymer composition of claim 7, wherein the polymer composition has a reverse comonomer distribution.

9. An article comprising the polymer composition of claim 8.

10. A film comprising the polymer composition of claim 8.

11. A blown film comprising the polymer composition of claim 1.

12. The film of claim 11, wherein the film has a dart impact strength greater than or equal to about 300 g/mil.

13. The film of claim 12, wherein the polymer composition comprises an ethylene/1-butene copolymer, an ethylene/1-hexene copolymer, an ethylene/1-octene copolymer, or a combination thereof, and is characterized by:

a reverse comonomer distribution;

a density in a range from about 0.915 to about 0.935 g/cm^3; and

a ratio of Mw/Mn in a range from about 8 to about 35.

14. The film of claim 12, wherein the film has:

a dart impact strength in a range from about 400 to about 2000 g/mil;

a haze of greater than or equal to about 55%;

a MD shrink at 250° F. in a range from about 20 to about 70%;

a MD Elmendorf tear strength in a range from about 10 to about 150 g/mil; and

a kinetic COF in a range from about 0.3 to about 0.5.

15. The polymer composition of claim 1, wherein the polymer composition has:

a density in a range from about 0.913 to about 0.93 g/cm^3;

a ratio of Mw/Mn in a range from about 6 to about 20; and

a Mn in a range from about 10 to about 25 kg/mol.

16. An article comprising the polymer composition of claim 15.

17. A blown film comprising the polymer composition of claim 15, wherein the film has a dart impact strength greater than or equal to about 300 g/mil.

18. The polymer composition of claim 15, wherein the polymer composition is an ethylene/α-olefin copolymer characterized by:

a reverse comonomer distribution; and

a high load melt index in a range from about 3 to about 60 g/10 min.

19. The polymer composition of claim 18, wherein:

the ratio of the Mp of the higher molecular weight component to the Mp of the lower molecular weight component is in a range from about 7:1 to about 20:1;

the number of LCB of the lower molecular weight component is in a range from about 5 to about 15 LCB per million total carbon atoms; and

the number of LCB of the higher molecular weight component is less than or equal to about 3 LCB per million total carbon atoms.

20. An article comprising the polymer composition of claim 19.

21. A blown film comprising the polymer composition of claim 19, wherein the film has a dart impact strength in a range from about 400 to about 2000 g/mil.