CLAIMS

We claim:

1. An ionomer comprising: a copolymer comprising:

C_2-C_{60} α-olefin monomer units;

optional C_2-C_{60} α-olefin comonomer units different than the monomer units;

optional diene units, and

0.1 wt% to 20 wt% aluminum alkenyl units, based on the weight of the copolymer, wherein the aluminum alkenyl units have the formula —R(A^-)—, wherein R is an alkyl group containing 2 to 10 carbon atoms, and A^- is a carboxylate; and

one or more metal cations derived from the group consisting of alkali metals, alkaline earth metals, group 3-12 metals, and combination(s) thereof,

wherein the ionomer has a glass transition temperature of -60 to 5°C, and a weight average (Mw) of 50 to 5,000 kg/mol.

2. The ionomer of claim 1, wherein the metal cation is an alkali or alkaline earth metal.

3. The ionomer of claim 1, wherein the metal cation comprises Na or Zn, preferably Zn.

4. The ionomer of claim 1, wherein the ionomer has a tensile strength, at 25°C, of from about 0.1 MPa to about 10 MPa; and a Young's modulus, at 40°C of from about 0.5 MPa to about 10 MPa.

5. A process for making an ionomer, comprising:

providing a copolymer comprising:

C_2-C_{60} α-olefin monomer units;

optional C_2-C_{60} α-olefin comonomer units different than the monomer units; optional diene units; and

0.1 wt% to 10 wt% aluminum vinyl (AV) units, based on the weight of the copolymer;

wherein the copolymer has AV units randomly incorporated within the copolymer chain, a glass transition temperature of -30°C or less, and crystallinity of less than 10%;

introducing an oxidizing agent to the copolymer to form a copolymer comprising anion alkenyl groups; and

introducing a metal cation to the copolymer comprising anion alkenyl groups to form the ionomer, wherein the metal cation is selected from the group consisting of an alkali metal, an alkaline earth metal, a group 12 metal, and combination(s) thereof,

wherein the ionomer has a tensile strength of greater than 1 MPa, due to ionomeric physical crosslinks, a glass transition temperature of -30°C or less, and a crystallinity of less than 10%).

6. The process of claim 5, wherein providing the copolymer comprises:

introducing the C_2-C_{60} α-olefin and the metal alkenyl to a catalyst system comprising an activator and a catalyst compound; and

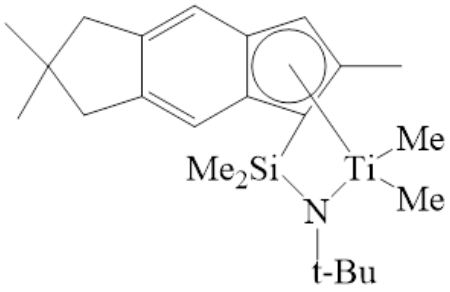
forming the copolymer under reaction conditions.

7. The process of claim 5, wherein the oxidizing agent is selected from the group consisting of CO_2, sulfonic acid, acetyl sulfate, phosphonic acid, and combination(s) thereof.

8. The process of claim 7, wherein the CO_2 is introduced at a pressure of from about 50 psi to about 150 psi, wherein introducing the oxidizing agent to the copolymer is performed at a temperature of about 50°C to about 100°C, and for a time of about 5 min. to about 30 min.

9. The process of claim 6, wherein the activator comprises N,N-Dimethylanilinium tetrakis(pentafluorophenyl)borate.

10. The process of claim 6, wherein the catalyst system comprises:



11. The process of claim 5, wherein the aluminum vinyl units have the formula $Al(R')_{3-v}(R)_v$, wherein R is a hydrocarbenyl group containing 4 to 12 carbon atoms having a vinyl chain end, wherein R' is a hydrocarbyl group containing 3 carbon atoms or greater, and wherein *v* is between 1 and 3.

12. The process of claim 5, wherein the aluminum vinyl comprises di(isobutyl)(7-octen-1-yl)aluminum.

13. The process of claim 5, wherein the diene is present and is selected from the group consisting of vinylnorbornene, norbornadiene, 5-ethylidene-2-norbornene, 5-vinyl-2-norbornene, divinylbenzene, dicyclopentadiene, and combination(s) thereof.

14. The process of claim 6, wherein the catalyst comprises ($Me_2Si(\eta^5$-2,6,6-trimethyl-1,5,6,7-tetrahydro-*s*-indacen-1-yl)(η^1-N^{t}Bu)$TiMe_2$) and the activator comprises N,N-dimethylanilinium tetrakis(pentafluorophenyl)borate.