*Competitor resins were tested as comparisons. The Exxon Resins were obtained from ExxonMobil. Equistar Resin is a LyondellBasell Petrothene product.

[00223] The data summarized in Table 35 are plotted in the graphs of FIG. 31 and FIG. 32. The data illustrates the difference in the "Ladder Branched" polymers in comparison to LDPE, LLDPE, ULDPE, and ethylene resins containing diene monomers. In FIG. 31 and FIG. 32, the "Ladder Branched" polymers (Ladder-PE in the legend of the graph) of this disclosure are clustered together, thus indicating that the "Ladder Branched" polymers have unique polymeric properties in comparison to other ethylene-based resins. As shown in the graph of FIG. 31, the "Ladder Branched" polymers have a rheology ratio at least 10, and an average g' less than 0.86. In FIG. 31, the LDPE resins plotted have an average g' of less than 0.65; the prior art ethylene-diene resins (listed as Prior Art ET-Diene in the legend) do not cluster together.

[00224] In FIG. 33, the melt strength (centiNewtons, cN) was measured as a function of the melt index (Log I_2). The polymers produced from the dual chain catalyst, as indicated by the triangles and the circles, were compared to a polymer produced from a single chain catalyst, and literature based curves of autoclave LDPE, tubular LDPE, and linear polyethylene. The melt strengths of the polymers produced from the dual chain catalysts were less than the melt strength of the autoclave LDPE, tubular LDPE, and the polymer produced from the single chain catalysts, but significantly greater than the linear polyethylene. This would indicate that the polymers produced from the dual chain catalysts have entangled, long-chain branching.

Table 36: Rheology Ratio and g' value as shown in FIG. 31

Example	g'	Rheology Ratio $V_{0.1}/V_{100}$
8.1	0.74	28.2
11.1	0.69	20.6
13.C	0.87	1.5
13.12	0.75	121.4
13.16	0.80	28.2
13.17	0.73	110.4
13.22	0.75	101.4
26.C.1	1.00	1.4
26.C.2	1.00	1.3
26.1	0.96	8.4
26.2	0.93	45.8
26.3	0.90	117.8
26.4	0.80	297.6

[00225] It should be apparent to those skilled in the art that various modifications can be made to the described embodiments without departing from the spirit and scope of the claimed subject matter. Thus, it is intended that the specification cover modifications and variations of the described embodiments provided such modification and variations come within the scope of the appended claims and their equivalents.

CLAIMS

1. A process of synthesizing long-chain branched copolymers, the process comprising:

contacting together one or more C_2-C_{14} alkene monomers, at least one diene, optionally a solvent, and a dual-chain catalyst, wherein the dual-chain catalyst comprises two polymerization sites, wherein the dual-chain catalyst comprises a monoanionic ligand, a Group IV Metal, and has two polymer chains on the same metal and the diene is selected from 2-methyl-1,4-pentadiene, 3-methyl-1,4-pentadiene, 1,3-divinylcyclopentane, 2-methyl-1,5-hexadiene, 1,4-pentadiene, 1,5-hexadiene, 1,7-octadiene, 1,8-nonadiene, 1,9-decadiene, 1,11-dodecadiene, and 1,15-hexadecadiene; ;

producing two polymer chains of the C_2-C_{14} alkene monomers, each polymer chain polymerizing at one of the polymerization sites; and

synthesizing the long-chain branched polymers by connecting the two polymer chains with the diene, the connecting of the two polymer chains being performed in a concerted manner during the polymerization.

2. The process of claim 1, wherein ethylene is added to such an extent that the resulting copolymer content is greater than 50 mol% ethylene.

3. The process of claims 1 or 2, wherein the diene comonomer is incorporated at such level to achieve at least one bridging juncture per 100 copolymer chains.

4. The process of any one of claims 1-3, wherein the diene is unconjugated.

5. The process of any one of the preceding claims, wherein the long-chain branched copolymer M_w is at least 20% greater than the M_w of the polymer synthesized without the diene or wherein the long-chain branched copolymer M_p is at least 20% greater than the M_p of the polymer synthesized without the diene.

6. The process of any one of the preceding claims, wherein the long-chain branched polymer has from 0.01 to 0.5 diene junctures per number average copolymer chain or 0.02 to 1.0 diene junctures per weight average copolymer chain.

7. The process of any one of the proceeding claims, wherein the polymerization occurs in a solution polymerization reactor or a particle forming polymerization reactor such as a

slurry reactor or a gas phase reactor, wherein the molecular or solid-supported catalyst is delivered to the reaction media or developed in the reaction media, wherein the reactor system is batch or continuous or a hybrid such as semi-batch, wherein the reactor residence time distribution is narrow such as in non-backmixed reactors or broad such as in backmixed reactor and series and recycle reactors.