half of the TREF curve. The polymer also has a value for Tw1 – Tw2 of less than about -15 °C, wherein Tw1 – Tw2 is a difference of a weight average elution temperature (Tw) for the first half of the TREF curve to a Tw for the second half of the TREF curve.

[0008a] In one aspect, there is provided a polymer, comprising ethylene and at least one alpha olefin having from 4 to 20 carbon atoms, wherein the polymer has:

a melt index ratio (MIR) greater than about 40;

a value for Mw1/Mw2 of at least about 2.0, wherein Mw1/Mw2 is a ratio of a weight average molecular weight (Mw) for a first half of a temperature rising elution (TREF) curve from a cross-fraction (CFC) analysis to a Mw for a second half of the TREF curve; and

a value for Tw1 – Tw2 of less than about -15°C, wherein Tw1 – Tw2 is a difference of a weight average elution temperature (Tw) for the first half of the TREF curve to a Tw for the second half of the TREF curve.

**[0009]** Another embodiment provides a polymer that includes ethylene and at least one alpha olefin having from 4 to 20 carbon atoms. The polymer has a density between about 0.915 and about 0.935, an average modulus of greater than about 30,000 psi, a dart impact strength of greater than about 100 g/mil, and a melt index ratio (MIR) greater than about 40. The polymer also lacks a negative inflection point in a van Gurp Palmen (vGP) plot at a frequency of between about 0.1 rad/s and 200 rad/s at 190 °C.

**[0010]** Another embodiment provides a polymer that includes ethylene and at least one alpha olefin having from 4 to 20 carbon atoms. The polymer lacks a negative inflection point in a van Gurp Palmen (vGP) plot at a frequency of between about 0.1 rad/s and 300 rad/s at 190 °C. The polymer also has a melt index ratio (MIR) greater than about 30 and a relationship between average modulus (M) and dart impact strength in g/mil (DIS) complying with the formula $DIS \geq 0.8x[100 + e^{(11.71-0.000268xM+2.183x10^{-9}xM^2)}$.

[0010a] In another aspect, there is provided a polymer, comprising ethylene and at least one alpha olefin having 4 carbon atoms, wherein the polymer has:

a total haze of less than about 30 %;

an average modulus of greater than about 30,000 psi;

a dart impact strength of greater than about 120 g for a 1 mil film;

a melt index ratio (MIR) greater than about 25; and

an Elmendorf machine direction tear of greater than about 170 g at 1 mil film gauge.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0011]** Fig. 1 is a schematic of a gas-phase reactor system, showing the addition of at least two catalysts, at least one of which is added as a trim catalyst.

**[0012]** Fig. 2 is a plot comparing stiffness, toughness, and processability for a number of different polymers.

**[0013]** Fig. 3 is a van Gurp-Palmen (vGP) plot showing a comparison of products generated in the first pilot plant run.

**[0014]** Fig. 4 is a plot of the first derivative of the results shown in the vGP plot of Fig. 3.

**[0015]** Fig. 5 is a plot of the first derivative of the vGP plot for resins made in the second pilot plant run.

**[0016]** Figs. 6A and 6B are plots that illustrate the calculations used to determine the CFC result.

**[0017]** Fig. 7 is a plot of (Mw1/Mw2) vs. (Tw1 – Tw2) for the experimental polymers versus a variety of competitive polymers on the market.