[0028] FIG. 10 provides a DSC of PAO produced using 1-octene according to Experiment 8 - Run 12. The DSC indicates that there is no discernable crystallization according to the DSC method described herein.

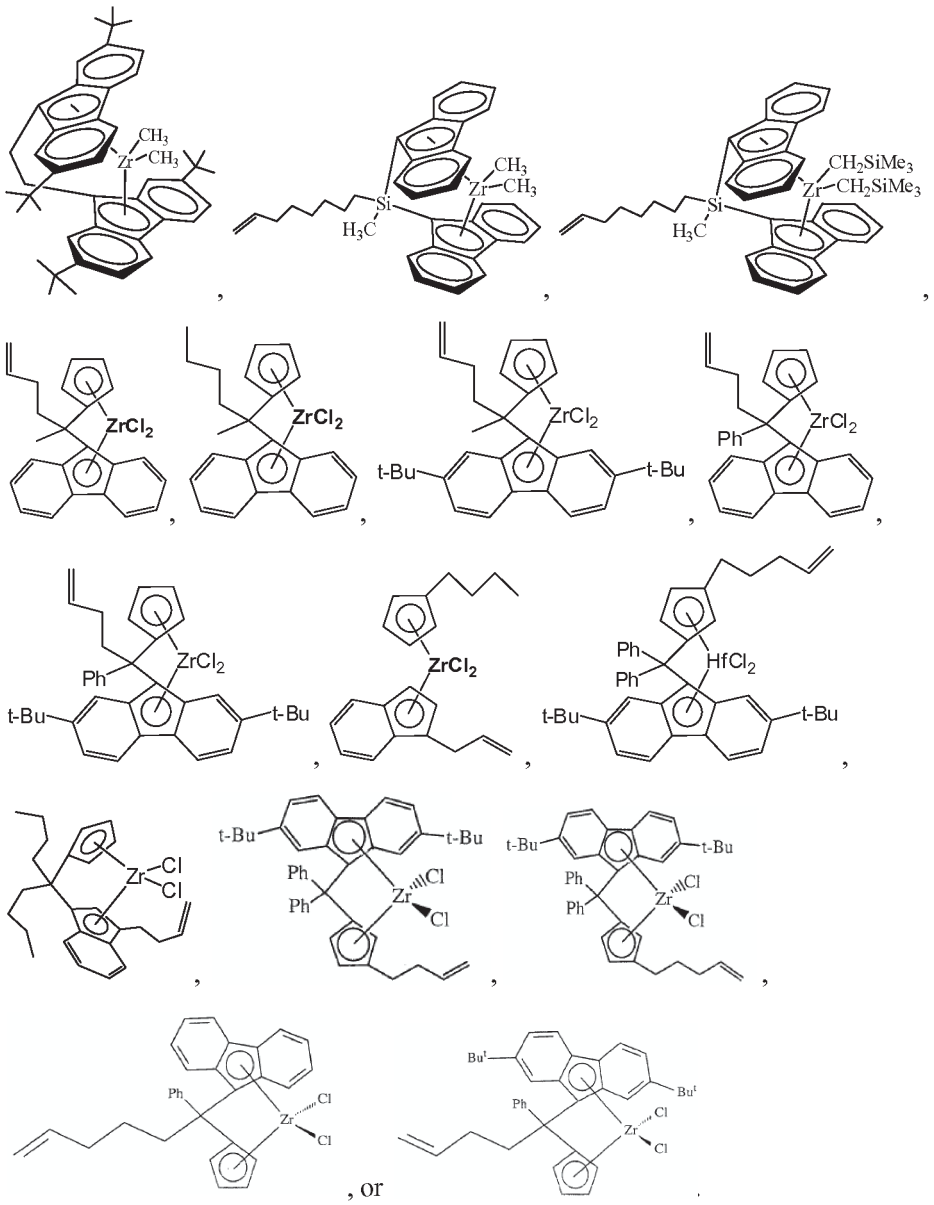
[0029] FIG. 11 provides a DSC of a commercial PAO 100. The DSC indicates that there is a discernable crystallization according to the DSC method described herein.

DETAILED DESCRIPTION OF THE INVENTION

General Description

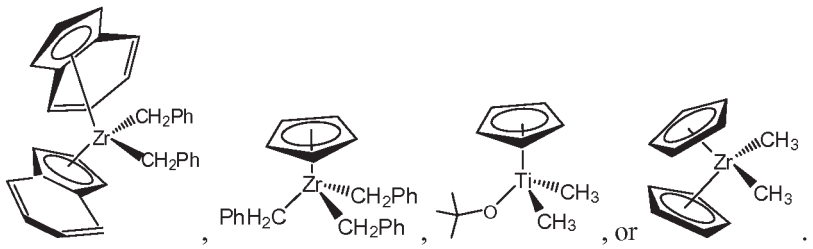
[0030] This disclosure provides for oligomers derived from alpha olefin (also referred to as alpha olefin oligomers), hydrogenated oligomer (also described throughout as polyalphaolefins or PAOs), methods of making the alpha olefin oligomers, methods for making PAOs, catalyst systems, and methods making catalyst systems. In particular, this disclosure encompasses oligomerizing one or more alpha olefins using a catalyst system that comprises a metallocene. The catalyst system can further comprise one or more activators. One type of activator that can be particularly useful is a solid oxide that has been chemically-treated with an electron withdrawing anion, which is fully described herein. The solid oxide that has been chemically-treated with an electron withdrawing anion can also be referred to throughout this disclosure as a chemically treated solid oxide (CTSO), a solid super acid (SSA), or an activator-support, and these terms are used interchangeably. Other activators can be used with the metallocenes in the catalyst system, either alone, in combination with the SSA, or in any combination with at least one other activator. Thus, by way of example, the catalyst system can comprise at least one metallocene, a first activator, and a second activator. In an aspect, the first activator can comprise, consist essentially of, or consist of, a chemically-treated solid oxide and the second activator can comprise, consist essentially of, or consist of, an organoaluminum compound. In a non-limiting embodiment, the chemically-treated solid oxide can be fluorided silica-alumina, and the second activator can be a trialkylaluminum compound (e.g. triethyl aluminum and/or triisobutyl aluminum).

[0031] These metallocene-based alpha olefin oligomerizations provide olefin oligomers and ultimately polyalphaolefins with particularly useful properties. The metallocene-based alpha olefin oligomerizations allow for variability in the properties of the oligomers and PAOs on the basis of the catalyst system and/or oligomerization conditions, among other factors described herein. For example, certain properties of the 1-octene homooligomers prepared according to this disclosure, and PAOs produced by hydrogenation the homooligomers, can be selected by adjusting the temperature at which the oligomerization is carried out. Moreover, this control extends to



, or .

[00188] Another aspect an any embodiment disclosed herein, the metallocene can comprise, consist essentially of, or consist of, singly or in any combination:



, or .