[0008a] In one aspect, there is provided a method of forming a catalyst composition while substantially normalizing stereochemical configuration, comprising:

slurrying an organometallic compound in dimethoxyethane (DME);

adding a solution of RMgBr in DME, wherein R is a methyl group or a benzyl group, and wherein the RMgBr is greater than about 2.3 equivalents relative to the organometallic compound;

mixing for at least about four hours to form an alkylated organometallic compound; and

isolating the alkylated organometallic, wherein the alkylated species has a ratio of meso / rac enantiomers that is between about 0.9 and about 1.2.

[0009] Another exemplary embodiment described herein provides a method of alkylating an organometallic compound while substantially normalizing stereochemical configuration. The method includes slurrying the organometallic compound in ether, and adding a solution of RLi in ether, wherein R is a methyl group or a benzyl group, and wherein the RMgBr is greater than about 2.3 equivalents relative to the organometallic compound. After the addition of the RMgBr, the slurry is mixed for at least about four hours. An alkylated organometallic is isolated, wherein the methylated species has a meso / rac ratio that is between about 0.9 and about 1.2.

[0009a] In another aspect, there is provided a method of alkylating an organometallic compound while substantially normalizing stereochemical configuration, comprising:

slurrying the organometallic compound in ether;

adding a solution of RLi in ether, wherein R is a methyl group or a benzyl group, and wherein the RLi is greater than about 2.3 equivalents relative to the organometallic compound;

mixing for at least about four hours to form an alkylated organometallic compound; and

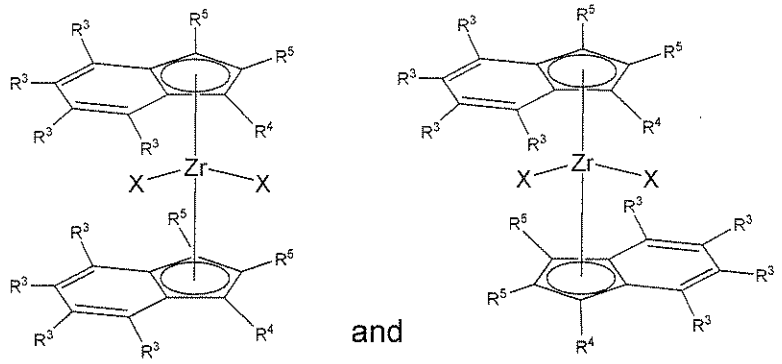
isolating the alkylated organometallic, wherein the alkylated species has a meso / rac ratio that is between about 0.9 and about 1.2.

[0010] Another exemplary embodiment provides a catalyst composition including a first catalyst compound and a second catalyst compound that are co-supported forming a commonly supported catalyst system, wherein the first catalyst compound includes the following formula:

$$(C_5H_aR^1{}_b)(C_5H_cR^2{}_d)HfX_2$$

Each R^1 is independently H, a hydrocarbyl group, a substituted hydrocarbyl group, or a heteroatom group. Each R^2 is independently H, a hydrocarbyl group, a substituted hydrocarbyl

group, or a heteroatom group. The values for a and c are ≥ 3; a+b = c+d = 5. At least one R^1 and at least one R^2 is a hydrocarbyl or substituted hydrocarbyl group. Adjacent groups R^1 and R^2 groups may be coupled to form a ring. Each X is independently a leaving group selected from a labile hydrocarbyl, substituted hydrocarbyl, or heteroatom group. The second catalyst compound includes a mixture of enantiomers:



MESO RAC

The ratio of the meso enantiomer to the rac enantiomer is substantially normalized during alkylation to between about 1.0 and about 1.2. Each R^3 is independently H, a hydrocarbyl group, a substituted hydrocarbyl group, or a heteroatom group. R^4 is a hydrocarbyl group, a

adding the toluene solution to the slurry to form a catalyst;

filtering the catalyst from the slurry; and

drying the catalyst.

6. A method of alkylating an organometallic compound while substantially normalizing stereochemical configuration, comprising:

slurrying the organometallic compound in ether;

adding a solution of RLi in ether, wherein R is a methyl group or a benzyl group, and wherein the RLi is greater than about 2.3 equivalents relative to the organometallic compound;

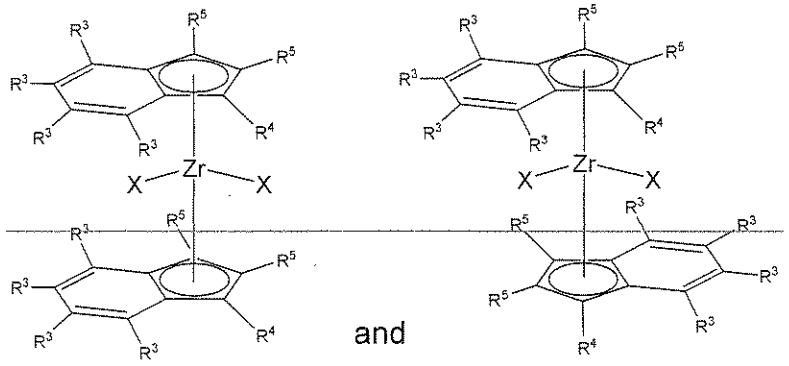
mixing for at least about four hours to form an alkylated organometallic compound; and

isolating the alkylated organometallic, wherein the alkylated species has a meso / rac ratio that is between about 0.9 and about 1.2.

~~7. A catalyst composition comprising a first catalyst compound and a second catalyst compound that are co-supported forming a commonly supported catalyst system, wherein the first catalyst compound comprises the following formula:~~

~~$(C_5H_aR^1_b)(C_5H_eR^2_d)HfX_2$~~

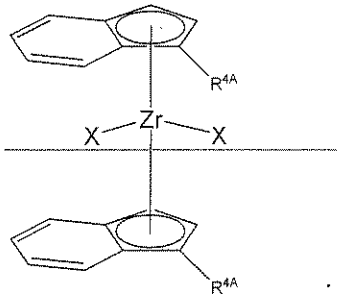
~~wherein each R^1 is independently H, a hydrocarbyl group, a substituted hydrocarbyl group, or a heteroatom group; each R^2 is independently H, a hydrocarbyl group, a substituted hydrocarbyl group, or a heteroatom group; a and e are $\geq$ 3; a+b = e+d = 5; at least one R^1 and at least one R^2 is a hydrocarbyl or substituted hydrocarbyl group; adjacent groups R^1 and R^2 groups may be coupled to form a ring; and each X is independently a leaving group selected from a labile hydrocarbyl, substituted hydrocarbyl, or heteroatom group; and the second catalyst compound comprises a mixture of enantiomers:~~



MESO RAC

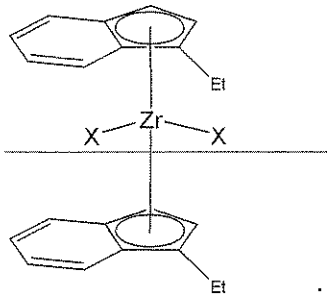
wherein the ratio of the meso enantiomer to the rac enantiomer is substantially normalized during alkylation to between about 1.0 and about 1.2, wherein each R^3 is independently H, a hydrocarbyl group, a substituted hydrocarbyl group, or a heteroatom group; R^4 is a hydrocarbyl group, a substituted hydrocarbyl group, or a heteroatom group; each R^5 is independently H, a hydrocarbyl group, a substituted hydrocarbyl group, or a heteroatom group; wherein R^3, R^4, and R^5 may be the same or different; and each X is a methyl group.

8. The catalyst composition of claim 7, wherein the second catalyst compound comprises at least one compound with the following formula:



wherein each R^{4A} is independently a methyl, ethyl, propyl, pentyl, hexyl, octyl, nonyl, dodecyl, phenethyl, or other hydrocarbyl.

9. The catalyst composition of claim 7, wherein the second catalyst compound comprises at least one compound with the following formula:



10. The catalyst composition of claim 7, comprising a third catalyst.