each R group is independently a substituted or unsubstituted aryl group or a substituted or unsubstituted cyclic alkyl group containing, optionally, at least one heteroatom; and

two R groups attached to the same Al can be optionally covalently linked together.

[0004] In further examples, this disclosure relates to a process for preparing a capped dual-headed organoaluminum composition of formula (I), the process comprising: (a) combining an aluminum compound, a linking agent, a capping agent, and an optional solvent, and (b) obtaining the capped dual-headed organoaluminum composition of formula (I), wherein:

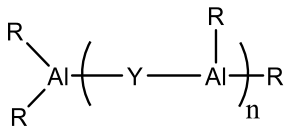
the aluminum compound has the formula $Al(J)_3$, wherein each J group is independently hydrogen, a substituted or unsubstituted alkyl group, or a substituted or unsubstituted aryl or heteroaryl group, wherein at least one J group is hydrogen or an acyclic alkyl group, and, optionally, two J groups can be covalently linked together;

the linking agent is a C_4 to C_{100} hydrocarbon comprising either at least two vinyl groups or a vinyl group and a cyclic olefin group and, optionally, includes at least one heteroatom; and

the capping agent is a substituted or unsubstituted cyclic olefin.

What is claimed is:

1. A composition of formula (I):



(I), wherein:

n is a number from 1 to 100;

Y has the formula (III):

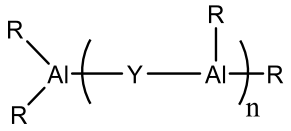
$$-CH_2CH_2-Z-CH_2CH_2- \quad \text{(III)},$$

wherein Z is a C_4 to C_{100} hydrocarbylene group comprising at least one aliphatic or aromatic ring and, optionally, includes at least one heteroatom,

each R group is independently a substituted or unsubstituted aryl group or a substituted or unsubstituted cyclic alkyl group containing, optionally, at least one heteroatom; and

two R groups attached to the same Al can be optionally covalently linked together.

2. A composition of formula (I):



(I), wherein:

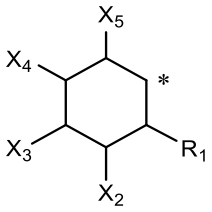
n is a number from 1 to 100;

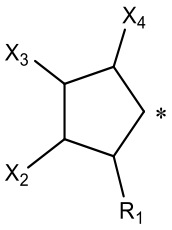
Y is a derivative of a linking agent selected from the group consisting of 1,9-decadiene, 1,4-pentadiene, divinylbenzene, divinyldiphenylsilane, divinyldimethylsilane, 1,4-bis(dimethyl(vinyl)silyl)benzene, 1,5-bis(dimethyl(vinyl)silyl)pentane, and 1,3-divinylcyclopentane;

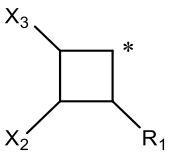
each R group is independently a substituted or unsubstituted aryl group or a substituted or unsubstituted cyclic alkyl group containing, optionally, at least one heteroatom; and

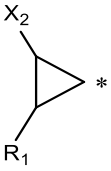
two R groups attached to the same Al can be optionally covalently linked together.

3. The composition of Claim 1 or 2, wherein each R group is independently selected from the group consisting of the following structures CG1 to CG4:



(CG1),


(CG2),


(CG3), and


(CG4),

wherein:

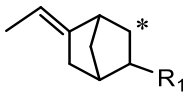
each R_1 is independently hydrogen or a C_1 to C_{20} alkyl group;

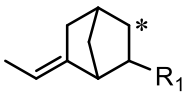
each X_2, X_3, X_4, and X_5 is independently hydrogen, a substituted or unsubstituted C_1 to C_{20} alkyl, alkylene or alkylidene group, or a substituted or unsubstituted C_6 to C_{20} aryl group;

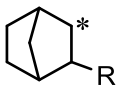
each X_2, X_3, X_4, and X_5 optionally includes at least one heteroatom; and

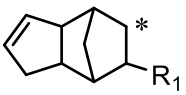
in each of structures CG1 to CG3, two of the groups selected from X_2, X_3, X_4, and X_5 may optionally join to form cyclic structures.

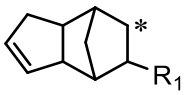
4. The composition of any of the preceding claims, wherein each R group is independently selected from the group consisting of the following structures CG5 to CG13:

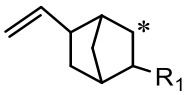


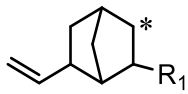
(CG5),


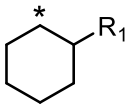
(CG6),


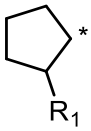
(CG7),


(CG8),


(CG9),


(CG10),


(CG11),


(CG12), and


(CG13),

wherein each R_1 is independently hydrogen or a C_1 to C_{20} alkyl group.

5. The composition of any of the preceding claims, wherein each R group is CG5 or CG12.

6. The composition of any of the preceding claims, wherein n is a number from 1 to 10.

7. The composition of claim 6, wherein n is a number from 1 to 3.