solid at ambient temperature. After the solvent is removed by filtration, the solid is dried by N_2 flow or under vacuum.

[00142] AAE-OnPr (1-methoxy-2-propoxyethyl benzoate) procatalyst preparation: 3.00 g of MagTi-1 is charged into a flask equipped with mechanical stirring and with bottom filtration. 60 ml of a mixed solvent of $TiCl_4$ and chlorobenzene (1/1 by volume) is introduced into the flask followed immediately by addition of 2.42 mmol of AAE-OnPr. The mixture is heated to 115°C in 15 minutes and remains at 115°C for 60 minutes with stirring at 250 rpm before filtering off the liquid. 60 ml of mixed solvent and 2.42 mmol of AAE-OnPr are added again and the reaction is allowed to continue at the same desired temperature for 30 minutes with stirring followed by filtration. Afterward, 60 ml of mixed solvent and 3.63 mmol of AAE-OnPr are added again and the reaction is allowed to continue at the same desired temperature for 30 minutes with stirring followed by filtration. 70 ml of iso-octane is used to wash the resultant solid at ambient temperature. After the solvent is removed by filtration, the solid is dried by N_2 flow or under vacuum.

[00143] Polymerization is performed in liquid propylene in a 1-gallon autoclave. The procatalyst composition is MagTi-based. After conditioning, the reactor is charged with 1375 g of propylene and 0.781 mol of hydrogen and brought to 62°C. 0.25 mmol of dicyclopentyldimethoxysilane or M-EED is added to 7.2 ml of a 0.27 M triethylaluminum solution in isooctane, followed by addition 0.21 ml of a 5.0 wt% procatalyst slurry in mineral oil. The mixture is premixed at ambient temperature for 20 minutes before being injected into the reactor to initiate the polymerization. The premixed catalyst components are flushed into the reactor with isooctane using a high pressure catalyst injection pump. After the exotherm, the temperature is maintained at 67°C. Total polymerization time is 1 hour. Results are set forth in Table 3 below.

CLAIMS

1. A catalyst composition comprising:

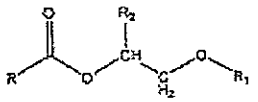
a procatalyst composition comprising a combination of a magnesium moiety, a titanium moiety, and greater than 4.5 wt % of a compounded alkoxyalkyl ester;

a cocatalyst; and

an external electron donor.

2. The catalyst composition of claim 1 wherein the alkoxyalkyl ester has the structure (I)

(I)

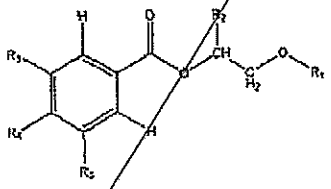


wherein R, R_1 and R_2 are the same or different each of R and R_1 is selected from the group consisting of a C_1-C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group; and

R_2 is selected from the group consisting of hydrogen, a C_1-C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group.

3. The catalyst composition of claim 1 wherein the alkoxyalkyl ester has the structure (III)

(III)



wherein R_1 and R_2 are the same or different, R_1 is selected from the group consisting of a C_1-C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group;

R_2 is selected from the group consisting of hydrogen, a C_1-C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group; and

R_3, R_4, R_5 are the same or different, each of R_3, R_4, R_5 is selected from the group consisting of a heteroatom, a C_1-C_{20} hydrocarbyl group, a substituted C_1-C_{20} hydrocarbyl group, and a C_1-C_{20} hydrocarbyloxy group.

4. The catalyst composition of claim 2 wherein R_1 and R_2 are selected from a C_2-C_{20} alkene group with the structure (II)

$C(H)=C(R_{11})(R_{12})$ (II)

wherein $R_{11}$and R_{12} are the same or different, each of R_{11} and R_{12} is selected from the group consisting of hydrogen and a C_1-C_{18} hydrocarbyl group.

5. The catalyst composition of claim 4 wherein the procatalyst composition comprises greater than 10 wt % of the alkoxyalkyl ester.

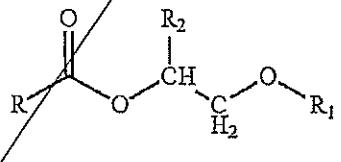
6. The catalyst composition of claim 1 comprising a mixed external electron donor (M-EED) comprising an activity limiting agent (ALA) and a selectivity control agent (SCA).

7. The catalyst composition of claim 1 comprising a mixed external electron donor (M-EED) comprising an activity limiting agent (ALA), a first selectivity control agent (SCAl), and a second selectivity control agent (SCA2).

8. A polymerization process comprising:
contacting, under polymerization conditions, propylene and optionally one or more comonomers with a catalyst composition comprising a procatalyst composition with a greater than 4.5 wt % of a compounded alkoxyalkyl ester, a cocatalyst, and an external electron donor; and
forming a propylene-based polymer.

9. The process of claim 8 wherein the alkoxyalkyl ester has the structure (I)

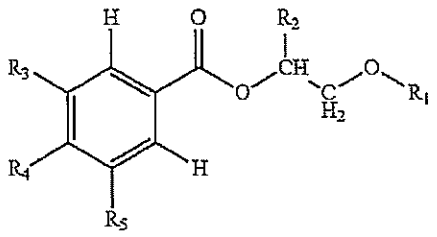
(I)



wherein R, R_1 and R_2 are the same or different each of R and R_1 is selected from the group consisting of a C_1-C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group; and R_2 is selected from the group consisting of hydrogen, a C_1-C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group.

10. The process of claim 8 wherein the alkoxyalkyl ester has the structure (III)

(III)



wherein R_1 and R_2 are the same or different, R_1 is selected from the group consisting of a C_1-C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group; R_2 is selected from the group consisting of hydrogen, a C_1-C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group; and R_3, R_4, R_5 are the same or different, each of R_3, R_4, R_5 is selected from the group consisting of a heteroatom, a C_1-C_{20} hydrocarbyl group, a substituted C_1-C_{20} hydrocarbyl group, and a C_1-C_{20} hydrocarbyloxy group.

11. The process claim 9 wherein R_1 and R_2 are selected from a C_2-C_{20} alkene group with the structure (II)

$$C(H)=C(R_{11})(R_{12}) \qquad (II)$$

wherein R_{11} and R_{12} are the same or different, each of R_{11} and R_{12} is selected from the group consisting of hydrogen and a C_1-C_{18} hydrocarbyl group.

12. The process of claim 11 wherein the procatalyst composition comprises greater than 10 wt % of the alkoxyalkyl ester.

13. The process of claim 8 comprising a mixed external electron donor (M-EED) comprising an activity limiting agent (ALA) and a selectivity control agent (SCA).

14. The process of claim 13 comprising a mixed external electron donor (M-EED) comprising an activity limiting agent (ALA), a first selectivity control agent (SCA1), and a second selectivity control agent (SCA2).

15. The process of claim 8 wherein the catalyst composition comprises a mixed external electron donor (M-EED) comprising an activity limiting agent (ALA), a first selectivity

control agent (SCA1), and a second selectivity control agent (SCA2), the process comprising forming a propylene-based polymer comprising an alkoxyalkyl ester and having a melt flow rate greater than 10 g/10 min.

16. The process of claim 8 comprising forming a propylene-based polymer having a melt flow rate greater than 100 g/10 min.

17. The process of claim 8 wherein propylene-based polymer is selected from the group consisting of a propylene homopolymer and a propylene copolymer.

18. A polymeric composition comprising:
a propylene-based polymer comprising an alkoxyalkyl ester and a C_{1-4} alkyl ester of an aliphatic C_{8-20} monocarboxylic acid, the propylene-based polymer having a melt flow rate greater than 10 g/10 min.

19. The polymeric composition of claim 18 having a melt flow rate greater than 100 g/10 min.

20. The polymeric composition of claim 18 wherein propylene-based polymer is selected from the group consisting of a propylene homopolymer and a propylene copolymer.

21. The polymeric composition of claim 18 wherein the alkoxyalkyl ester is 2-methoxy methylethyl benzoate.

22. The polymeric composition of claim 18 wherein the alkoxyalkyl ester is 1-methoxy-2-propoxyethyl benzoate.

23. The polymeric composition of claim 18 wherein the propylene-based polymer is a propylene impact copolymer.

24. The polymeric composition of claim 18 comprising a methoxysilane.

25. The polymeric composition of claim 18 comprising an ethoxysilane.

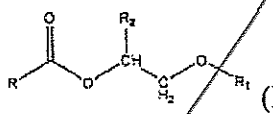
26. The polymeric composition of claim 18 wherein the propylene-based polymer has a melt flow rate of greater than 100 g/10 min to 400 g/10 min.

27. The polymeric composition of claim 18 wherein the propylene-based polymer is a propylene/ethylene copolymer.

28. The polymeric composition of claim 18 comprising isopropyl myristate.

29. The polymeric composition of claim 18 comprising isopropyl myristate, a methoxysilane and an ethoxysilane.

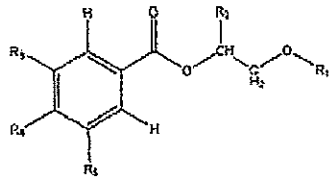
30. The polymeric composition of claim 18 wherein the alkoxyalkyl ester has the structure (I)



(I)

wherein R, R_1 and R_2 are the same or different each of R and R_1 is selected from the group consisting of a C_1-C_{20} primary alkyl group, a substituted C_1 -C_{20} primary alkyl group, and a C_2 –C_{20} alkene group; and R_2 is selected from the group consisting of hydrogen, a C_1 -C_{20} primary alkyl group, a substituted C_1 –C_{20} primary alkyl group, and a C_2 –C_{20} alkene group.

31. The polymeric composition of claim 18 wherein the alkoxyalkyl ester has the structure (III)



(III)

wherein R_1 and R_2 are the same or different, R_1 is selected from the group consisting of a C_1 –C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group; R_2 is selected from the group consisting of hydrogen, a C_1-C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group; and R_3, R_4, R_5 are the same or different, each of R_3, R_4, R_5 is selected from the group consisting of a heteroatom, a

C_1-C_{20} hydrocarbyl group, a substituted C_1-C_{20} hydrocarbyl group, and a C_1-C_{20} hydrocarbyloxy group.

32. The polymeric composition of claim 31 wherein R_1 and R_2 are selected from a C_2 –C_{20} alkene group with the structure (II)

$$C(H)=C(R_{11})(R_{12}) \text{ (II)}$$

wherein R_{11} and R_{12} are the same or different, each of R_{11} and R_{12} is selected from the group consisting of hydrogen and a C_1 –C_{18} hydrocarbyl group.

solid at ambient temperature. After the solvent is removed by filtration, the solid is dried by N_2 flow or under vacuum.

[00142] AAE-OnPr 1-methyl-2-propoxyethyl benzoate procatalyst preparation: 3.00 g of MagTi-1 is charged into a flask equipped with mechanical stirring and with bottom filtration. 60 ml of a mixed solvent of $TiCl_4$ and chlorobenzene (1/1 by volume) is introduced into the flask followed immediately by addition of 2.42 mmol of AAE-OnPr. The mixture is heated to 115°C in 15 minutes and remains at 115°C for 60 minutes with stirring at 250 rpm before filtering off the liquid. 60 ml of mixed solvent and 2.42 mmol of AAE-OnPr are added again and the reaction is allowed to continue at the same desired temperature for 30 minutes with stirring followed by filtration. Afterward, 60 ml of mixed solvent and 3.63 mmol of AAE-OnPr are added again and the reaction is allowed to continue at the same desired temperature for 30 minutes with stirring followed by filtration. 70 ml of iso-octane is used to wash the resultant solid at ambient temperature. After the solvent is removed by filtration, the solid is dried by N_2 flow or under vacuum.

[00143] Polymerization is performed in liquid propylene in a 1-gallon autoclave. The procatalyst composition is MagTi-based. After conditioning, the reactor is charged with 1375 g of propylene and 0.781 mol of hydrogen and brought to 62°C. 0.25 mmol of dicyclopentyldimethoxysilane or M-EED is added to 7.2 ml of a 0.27 M triethylaluminum solution in isooctane, followed by addition 0.21 ml of a 5.0 wt% procatalyst slurry in mineral oil. The mixture is premixed at ambient temperature for 20 minutes before being injected into the reactor to initiate the polymerization. The premixed catalyst components are flushed into the reactor with isooctane using a high pressure catalyst injection pump. After the exotherm, the temperature is maintained at 67°C. Total polymerization time is 1 hour. Results are set forth in Table 3 below.

CLAIMS

1. A catalyst composition comprising:

a procatalyst composition comprising a combination of a magnesium moiety, a titanium moiety, and greater than 4.5 wt % of a compounded alkoxyalkyl ester;

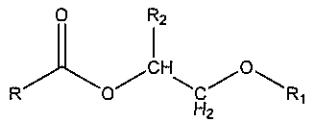
a cocatalyst; and

an external electron donor which is a mixed external electron donor (M-EED) comprising an activity limiting agent (ALA) which is isopropyl myristate, a first selectivity control agent (SCA1) which is dicyclopentyldimethoxysilane, and a second selectivity control agent (SCA2) selected from the group consisting of methylcyclohexyldiethoxysilane, diisobutyldiethoxysilane, di-n-butyl-dimethoxysilane, n-propyltriethoxysilane, benzyltriethoxysilane, but-3-enyltriethoxysilane, 1-(triethoxysilyl)-2-pentene, (triethoxysilyl)cyclohexane, tetraethoxysilane, 1-ethoxy-2-(6-(2-ethoxyphenoxy)hexyloxy)benzene, 1-ethoxy-2-n-pentoxybenzene, and combinations thereof;

wherein:

(a) the alkoxyalkyl ester has the structure (I)

(I)



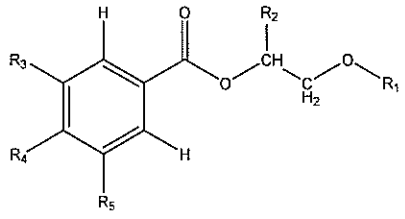
wherein R, R_1 and R_2 are the same or different;

each of R and R_1 is selected from the group consisting of a C_1-C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group; and

R_2 is selected from the group consisting of hydrogen, a C_1-C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group; or

(b) the alkoxyalkyl ester has the structure (III)

(III)



wherein:

(i) R_1 and R_2 are the same or different;

R_1 is selected from a C_1-C_{20} primary alkyl group and a substituted C_1-C_{20} primary alkyl group;

R_2 is selected from hydrogen, a C_1-C_{20} primary alkyl group, and a substituted C_1-C_{20} primary alkyl group; and

R_3, R_4, R_5 are the same or different, and each of R_3, R_4, R_5 is selected from hydrogen, a heteroatom, a C_1-C_{20} hydrocarbyl group, a substituted C_1-C_{20} hydrocarbyl group, a C_1-C_{20} hydrocarbyloxy group, and any combination thereof; or

(ii) R_1 and R_2 are the same or different, and each of R_1 and R_2 is selected from a substituted or unsubstituted C_1-C_{20} primary alkyl group or from a substituted or unsubstituted alkene group with the structure (II)

(II)

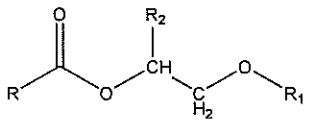
$$C(H)=C(R_{11})(R_{12})$$

wherein R_{11} and R_{12} are the same or different, and each of R_{11} and R_{12} is selected from hydrogen and a C_1-C_{18} hydrocarbyl group; and

R_3, R_4, R_5 are the same or different, and each of R_3, R_4, R_5 is selected from hydrogen, a heteroatom, a C_1-C_{20} hydrocarbyl group, a substituted C_1-C_{20} hydrocarbyl group, a C_1-C_{20} hydrocarbyloxy group, and any combination thereof.

2. The catalyst composition of claim 1 wherein the alkoxyalkyl ester has the structure (I)

(I)



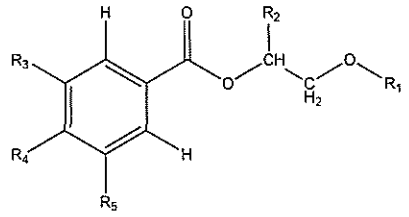
wherein R, R_1 and R_2 are the same or different;

each of R and R_1 is selected from the group consisting of a C_1-C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group; and

R_2 is selected from the group consisting of hydrogen, a C_1-C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group.

3. The catalyst composition of claim 1 wherein the alkoxyalkyl ester has the structure (III)

(III)



wherein R_1 and R_2 are the same or different;

R_1 is selected from the group consisting of a C_1-C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group;

R_2 is selected from the group consisting of hydrogen, a C_1-C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group; and

R_3, R_4, R_5 are the same or different, and each of R_3, R_4, R_5 is selected from the group consisting of a heteroatom, a C_1-C_{20} hydrocarbyl group, a substituted C_1-C_{20} hydrocarbyl group, and a C_1-C_{20} hydrocarbyloxy group.

4. The catalyst composition of claim 2 wherein R_1 and R_2 are selected from a C_2-C_{20} alkene group with the structure (II)

(II)

$$C(H)=C(R_{11})(R_{12})$$

wherein R_{11} and R_{12} are the same or different, and each of R_{11} and R_{12} is selected from the group consisting of hydrogen and a C_1-C_{18} hydrocarbyl group.

5. The catalyst composition of claim 4 wherein the procatalyst composition comprises greater than 10 wt % of the alkoxyalkyl ester.

6. The catalyst composition of claim 1 wherein the alkoxyalkyl ester is 2-methoxy-1-methylethyl benzoate.

7. The catalyst composition of claim 1 wherein the alkoxyalkyl ester is 1-methyl-2-propoxyethyl benzoate.

8. A polymerization process comprising:

contacting, under polymerization conditions, propylene and optionally one or more comonomers with the catalyst composition of claim 1; and

forming a propylene-based polymer comprising the alkoxyalkyl ester and having a melt flow greater than 10 g/10 min.

9. A polymeric composition comprising:

a propylene-based polymer comprising an alkoxyalkyl ester and isopropyl myristate, the propylene-based polymer having a melt flow rate greater than 10 g/10 min.

10. The polymeric composition of claim 9 wherein the propylene-based polymer has a melt flow rate greater than 100 g/10 min.

11. The polymeric composition of claim 9 wherein the propylene-based polymer is selected from the group consisting of a propylene homopolymer and a propylene copolymer.

12. The polymeric composition of claim 9 comprising a selectivity control agent.

13. The polymeric composition of claim 9 comprising a first selectivity control agent (SCA1) and a second selectivity control agent (SCA2).