Table 3

IED	(M-) EED				Activity (kg/g-hr)	H_2 (mmol)	MFR (g/10 min)	XS (%)
	IPM (mol%)	TEOS (mol%)	PTES (mol%)	D (mol%)				
DiBP	60			40	28.3	134	8.8	4.2
	60			40	36.6	670	57.1	3.6
	60	20		20	21.9	670	70.7	3.1
	60		20	20	17.3	670	66.0	3.5
AAE	60	30		10	17.5	134	24.8	6.7
	60	25		15	13.9	134	22.4	6.3
	60	20		20	19.8	134	20.8	6.0
	60			40	17.1	134	9.5	5.3
	60	30		10	8.9	670	269	3.8
	60	25		15	11.8	670	211	3.5
	60	20		20	22.3	670	153	3.8
	60			40	19	670	110	3.4
	60		30	10	14.5	134	24.4	6.1
	60		25	15	20.9	134	20.8	6.6
	60		20	20	16.8	134	15.3	5.7
	60			40	17.7	134	12.0	5.2
	60		30	10	13.3	670	231	3.7
	60		25	15	28.4	670	194	4.1
	60		20	20	19.6	670	180	3.8
AAE-OnPr	60			40	19.9	670	125	3.6
	60	30		10	21.7	781	532	4.3
	60		20	20	27.5	781	323	3.8

D = Dicyclopentyldimethoxysilane, IPM = Isopropyl myristate, TEOS = Tetraethoxysilane

[00144] For DiBP catalyst, there is a moderate increase in MFR when H_2 was increased from 134 mmol to 670 mmol (~6.5 times). The increase in MFR with introduction of TEOS or PTES in M-EED is relatively small at 670 mmol of H_2.

[00145] For AAE catalyst, there is a large increase in MFR when H_2 is increased from 134 mmol to 670 mmol (~11 times). The increase in MFR with the introduction of TEOS and/or PTES in M-EED is much larger at 670 mmol of H_2. Very high MFR (MFR greater than 100 g/10 min) can be achieved by using AAE catalyst with M-EEDs containing trialkoxysilane, tetraalkoxysilane, or ethoxysilane.

[00146] Much higher MFR can be obtained using the same M-EEDs at slightly higher H_2 concentration with AAE-OnPr catalyst.

[00147] It is specifically intended that the present disclosure not be limited to the embodiments and illustrations contained herein, but include modified forms of those embodiments including portions of the embodiments and combinations of elements of different embodiments as come within the scope of the following claims.

CLAIMS

1. A catalyst composition comprising:

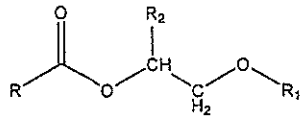
a procatalyst composition comprising a combination of a magnesium moiety, a titanium moiety, and greater than 4.5 wt % of a compounded alkoxyalkyl ester;

a cocatalyst; and

an external electron donor.

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

(I)

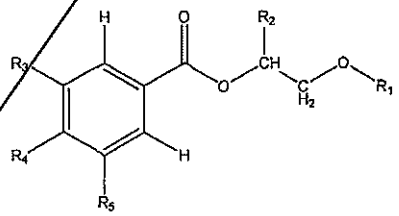


wherein R, R_1 and R_2 are the same or different each of R and R_1 is selected from the group consisting of a C_1-C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group; and

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)

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

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.

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 (SCA1), 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 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.

10. A polymeric composition comprising:

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

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

12. The polymeric composition of claim 10 wherein propylene-based polymer is selected from the group consisting of a propylene homopolymer and a propylene copolymer.

Table 3

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	60	20		20	22.3	670	153	3.8
	60			40	19	670	110	3.4
	60		30	10	14.5	134	24.4	6.1
	60		25	15	20.9	134	20.8	6.6
	60		20	20	16.8	134	15.3	5.7
	60			40	17.7	134	12.0	5.2
	60		30	10	13.3	670	231	3.7
	60		25	15	28.4	670	194	4.1
	60		20	20	19.6	670	180	3.8
AAE-OnPr	60			40	19.9	670	125	3.6
	60	30		10	21.7	781	532	4.3
	60		20	20	27.5	781	323	3.8

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[00146] Much higher MFR can be obtained using the same M-EEDs at slightly higher H_2 concentration with AAE-OnPr catalyst.

CLAIMS

1. A catalyst composition comprising:

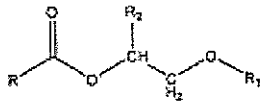
a procatalyst composition comprising a combination of a magnesium moiety, a titanium moiety, and greater than 4.5 wt % of a compounded alkoxyalkyl ester;

a cocatalyst; and

an external electron donor.

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

(I)

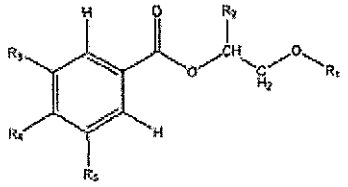


wherein R, R_1 and R_2 are the same or different each of R and R_1 is selected from the group consisting of a C_1-C_{20} primary alkyl group, a substituted C_1-C_{20} primary alkyl group, and a C_2-C_{20} alkene group; and

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.

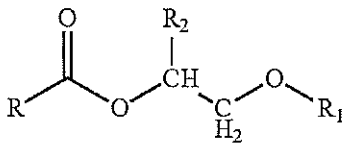
6. The catalyst composition of claim 1 comprising a mixed external electron donor (M-EED) comprising an activity limiting agent (ALA) and a selectivity control agent (SCA).

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)

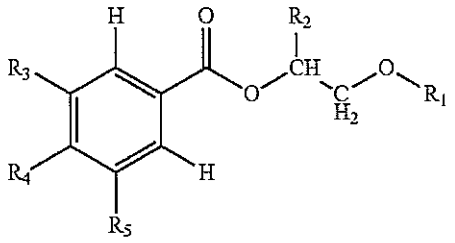
(I)



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.

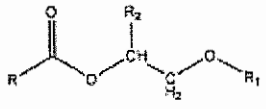
26. The polymeric composition of claim 18 wherein the propylene-based polymer has a melt flow rate of greater than 100 g/10 min to 400 g/10 min.

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.

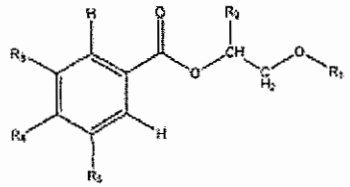
29. The polymeric composition of claim 18 comprising isopropyl myristate, a methoxysilane and an ethoxysilane.

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)

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

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.