CLAIMS

1. A method for producing a propylene-based block copolymer, the method comprising:

forming a copolymerization catalyst

contacting propylene and an α-olefin with said copolymerization catalyst

copolymerizing said propylene and said α-olefin by said contacting,

wherein said copolymerization catalyst comprises:

(I) a solid catalyst component that comprises titanium, magnesium, a halogen, and a compound represented by formula (1),

$R^1O—C(=O)—O—Z—OR^2$ (1),

wherein R^1 and R^2 are a linear alkyl group having 1 to 20 carbon atoms, a branched alkyl group having 3 to 20 carbon atoms, a vinyl group, a linear or branched alkenyl group having 3 to 20 carbon atoms, a linear halogen-substituted alkyl group having 1 to 20 carbon atoms, a branched halogen-substituted alkyl group having 3 to 20 carbon atoms, a linear halogen-substituted alkenyl group having 2 to 20 carbon atoms, a branched halogen-substituted alkenyl group having 3 to 20 carbon atoms, a cycloalkyl group having 3 to 20 carbon atoms, a cycloalkenyl group having 3 to 20 carbon atoms, a halogen-substituted cycloalkyl group having 3 to 20 carbon atoms, a halogen-substituted cycloalkenyl group having 3 to 20 carbon atoms, an aromatic hydrocarbon group having 6 to 24 carbon atoms, and Z is a bidentate linking group selected from an ethylene group having 2 carbon atoms, a branched alkylene group having 3 to 12 carbon atoms, a vinylene group, a linear or branched alkenylene group having 3 to 12 carbon atoms, a cycloalkylene group having 3 to 12 carbon atoms, or a cycloalkenylene group having 3 to 12 carbon atoms, and the two oxygen atoms bonded to Z are bonded through a carbon chain, and the carbon chain includes two carbon atoms;

(II) an organoaluminum compound represented by formula (2),

$R^3_pAlQ_{3-p}$ (2)

wherein R^3 is a hydrocarbyl group having 1 to 6 carbon atoms, wherein a plurality of R^3 are either identical or different when a plurality of R^3 are present, Q is a hydrogen atom, a hydrocarbyloxy group having 1 to 6 carbon atoms, or a halogen atom, and p is a real number that satisfies $0<p\leq3$; and

(III) an electron donor other than the compound represented by formula (1).

2. The method according to claim 1,

wherein the electron donor other than the compound represented by formula (1) is at least one compound selected from the group consisting of an organosilicon compound represented by formula (3) and an aminosilane compound represented by formula (4),

$R^4_qSi(OR^5)_{4-q}$ (3)

wherein R^4 is an alkyl group having 1 to 12 carbon atoms, a vinyl group, an alkenyl group having 3 to 12 carbon atoms, a cycloalkyl group having 3 to 12 carbon atoms, a cycloalkenyl group having 3 to 12 carbon atoms, an aromatic hydrocarbon group having 6 to 15 carbon atoms, or a substituted aromatic hydrocarbon group, wherein plurality of R^4 are either identical or different when a plurality of R^4 are present, R^5 is an alkyl group having 1 to 4 carbon atoms, a vinyl group, an alkenyl group having 3 to 12 carbon atoms, a cycloalkyl group having 3 to 6 carbon atoms, an aromatic hydrocarbon group having 6 to 12 carbon atoms, or a substituted aromatic hydrocarbon group having 7 to 12 carbon atoms, wherein each R^5 is either identical or different when a plurality of R^5 are present, and q is an integer from 0 to 3, and

$(R^6R^7N)_8SiR^8_{4-s}$ (4)

wherein R^6 and R^7 are a hydrogen atom, an alkyl group having 1 to 20 carbon atoms, a vinyl group, an alkenyl group having 3 to 20 carbon atoms, a cycloalkyl group having 3 to 20 carbon atoms, a cycloalkenyl group having 3 to 20 carbon atoms, or an aryl group

having 6 to 20 carbon atoms, wherein R^6 and R^7 are either identical or different, and optionally bond to each other to form a ring, R^8 is an alkyl group having 1 to 20 carbon atoms, a vinyl group, an alkenyl group having 3 to 12 carbon atoms, an alkoxy group having 1 to 20 carbon atoms, a vinyloxy group, an alkenyloxy group having 3 to 20 carbon atoms, a cycloalkyl group having 3 to 20 carbon atoms, a cycloalkyloxy group having 3 to 20 carbon atoms, an aryl group having 6 to 20 carbon atoms, or an aryloxy group having 6 to 20 carbon atoms, wherein a plurality of R^8 are either identical or different when a plurality of R^8 are present, and s is an integer from 1 to 3.

3. The method according to claim 1,

wherein the electron donor other than the compound represented by formula (1) is phenyltrimethoxysilane, n-butyltrimethoxysilane, cyclopentyltrimethoxysilane, cyclohexyltrimethoxysilane, phenyltriethoxysilane, n-butyltriethoxysilane, cyclopentyltriethoxysilane, cyclohexyltriethoxysilane, t-butylmethyldimethoxysilane, t-butylethyldimethoxysilane, diisopropyldimethoxysilane, diisobutyldimethoxysilane, diisopentyldimethoxysilane, diphenyldimethoxysilane, dicyclopentyldimethoxysilane, cyclohexylmethyldimethoxysilane, cyclohexylcyclopentyldimethoxysilane, tetramethoxysilane, tetraethoxysilane, t-butylmethylbis(ethylamino)silane, dicyclohexylbis(ethylamino)silane, dicyclopentbis(ethylamino)silane, bis(perhydroisoquinolino)dimethoxysilane, diethylaminotrimethoxysilane, or diethylaminotriethoxysilane.

4. The method according to claim 1,

wherein the electron donor other than the compound represented by formula (1) is a 1,3-diether compound represented by formula (5),

$R^9OCH_2CR^{10}R^{11}CH_2OR^{12}$ (5)

wherein R^{10} and R^{11} are a hydrogen atom, a halogen atom, an alkyl group having 1 to 12

carbon atoms, a vinyl group, an alkenyl group having 3 to 12 carbon atoms, a cycloalkyl group having 3 to 12 carbon atoms, a cycloalkenyl group having 3 to 12 carbon atoms, an aromatic hydrocarbon group having 6 to 12 carbon atoms, a halogen-substituted aromatic hydrocarbon group having 6 to 12 carbon atoms, a substituted aromatic hydrocarbon group having 7 to 12 carbon atoms, an alkylamino group having 1 to 12 carbon atoms, or a dialkylamino group having 2 to 12 carbon atoms, wherein R^{10} and R^{11} are either identical or different, and optionally bond to each other to form a ring, and R^{9} and R^{12} are an alkyl group having 1 to 12 carbon atoms, a vinyl group, an alkenyl group having 3 to 12 carbon atoms, a cycloalkyl group having 3 to 6 carbon atoms, an aromatic hydrocarbon group having 6 to 12 carbon atoms, a halogen-substituted aromatic hydrocarbon group having 6 to 12 carbon atoms, or a substituted aromatic hydrocarbon group having 7 to 12 carbon atoms, wherein R^{9} and R^{12} are either identical or different.

5. The method according to claim 4,
wherein the 1,3-diether compound is 2-isopropyl-2-isobutyl-1,3-dimethoxypropane, 2-isopropyl-2-isopentyl-1,3-dimethoxypropane, or 9,9-bis(methoxymethyl)fluorene.

6. The method according to claim 1, wherein said copolymerizing comprises: homopolymerizing propylene and then copolymerizing propylene and ethylene.

7. The method according to claim 6, wherein said copolymerizing propylene and ethylene further comprises copolymerizing with at least one α-olefin other than said propylene and ethylene.

8. The method according to claim 7, wherein said at least one α-olefin other than said propylene and ethylene is 1-butene.

9. The method according to claim 1, wherein said copolymerizing comprises: copolymerizing propylene and a small amount of an α-olefin and then further copolymerizing with an additional amount of an α-olefin.

10. The method according to claim 9, wherein said α-olefin is ethylene.

11. The method according to claim 10, further comprising copolymerizing with at least one α-olefin other than said propylene and ethylene.

12. The method according to claim 11, wherein said at least one α-olefin other than said propylene and ethylene is 1-butene.