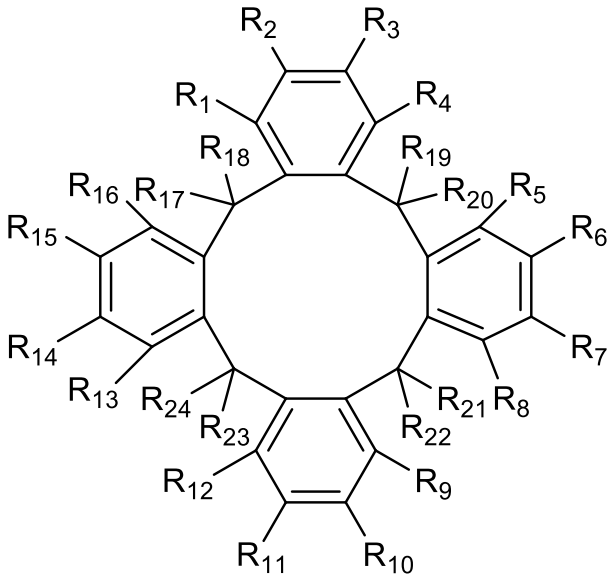
Claims

1. A catalyst system for olefin polymerization, comprising a main catalyst and a cocatalyst, wherein the cocatalyst comprises a twelve-membered ring compound represented by formula (M),



Formula (M)

wherein in the formula (M), R_1, R_4, R_5, R_8, R_9, R_{12}, R_{13} and R_{16} are each independently selected from a group consisting of hydrogen, halogen and C_1-C_6 alkyl; R_2, R_3, R_6, R_7, R_{10}, R_{11}, R_{14} and R_{15} are each independently selected from a group consisting of hydroxyl, amino, halogen, C_1-C_6 aldehyde, C_1-C_6 alkoxyl and halogen substituted C_1-C_6 alkoxyl; R_{17} to R_{24} are each independently selected from a group consisting of hydrogen and C_1-C_{10} alkyl;

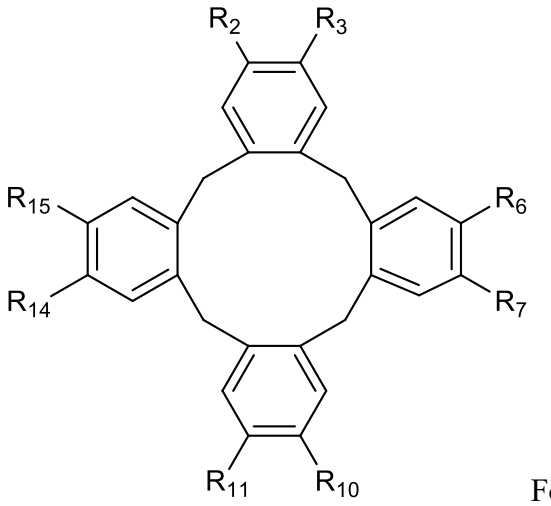
wherein the main catalyst comprises (i) a solid catalyst component containing magnesium, titanium, halogen and an internal electron donor compound; (ii) an organic aluminum compound; and optionally (iii) an external electron donor compound.

2. The catalyst system according to claim 1, characterized in that a molar ratio of the external electron donor compound to the titanium element in the solid catalyst component is (0-500):1, preferably (0.01-200):1, and more preferably (0.1-100):1.

3. The catalyst system according to claim 1 or 2, characterized in that, in the formula (M), R_{17} to R_{24} are each independently selected from a group consisting of

hydrogen and C_1-C_6 alkyl, and preferably selected from a group consisting of hydrogen and C_1-C_4 alkyl.

4. The catalyst system according to any one of claims 1 to 3, characterized in that, the twelve-membered ring compound represented by the formula (M) is represented by formula (N),



Formula (N)

and preferably, the twelve-membered ring compound represented by the formula (M) is selected from one or more of the following compounds:

Compound A: in the formula (N), R_2=R_3=R_6=R_7=R_{10}=R_{11}=R_{14}=R_{15}=OCH_3;

Compound B: in the formula (N), R_2=R_3=R_6=R_7=R_{10}=R_{11}= R_{14}=R_{15}=OCH_2CH_3;

Compound C: in the formula (N), R_2=R_3=R_6=R_7=R_{10}=R_{11}=R_{14}=R_{15}=$OCH_2CH_2CH_3$;

Compound D: in the formula (N), R_2=R_3=R_6=R_7=R_{10}=R_{11}=R_{14}=R_{15}=$OCH(CH_3)_2$;

Compound E: in the formula (N), R_2=R_3=R_6=R_7=R_{10}=R_{11}=R_{14}=R_{15}=$OCH_2CH_2CH_2CH_3$;

Compound F: in the formula (N), R_2=R_6=R_{10}=R_{14}=OCH_3 and R_3=R_7=R_{11}=R_{15}=OCH_2CH_3;

Compound G: in the formula (N), R_2=R_6=R_{10}=R_{14}=OCH_3 and R_3=R_7=R_{11}=R_{15}=$OCH_2CH_2CH_3$;

Compound H: in the formula (N), R_2=R_6=R_{10}=R_{14}=OCH_3 and R_3=R_7=R_{11}=R_{15}=$OCH_2CH_2CH_2CH_3$;

Compound I: in the formula (N), R_2=R_3=R_6=R_7=R_{10}=R_{11}=R_{14}=R_{15}=OH;

Compound J: in the formula (N), R_2=R_6=R_{10}=R_{14}=OCH_3 and

R_3=R_7=R_{11}=R_{15}=OH;

Compound K: in the formula (N), R_2=R_6=R_{10}=R_{14}=OCH_3 and R_3=R_7=R_{11}=R_{15}=NH_2;

Compound L: in the formula (N), R_2=R_6=R_{10}=R_{14}=OCH_3 and R_3=R_7=R_{11}=R_{15}=Cl;

Compound M: in the formula (N), R_2=R_6=R_{10}=R_{14}=OCH_3 and R_3=R_7=R_{11}=R_{15}=Br;

Compound N: in the formula (N), R_2=R_6=R_{10}=R_{14}=OCH_3 and R_3=R_7=R_{11}=R_{15}=I;

Compound O: in the formula (N), R_2=R_6=R_{10}=R_{14}=OCH_3 and R_3=R_7=R_{11}=R_{15}=CHO;

Compound P: in the formula (N), R_2=R_6=R_{10}=R_{14}=OCH_3 and R_3=R_7=R_{11}=R_{15}=$OCH_2CH_2CH_2Br$;

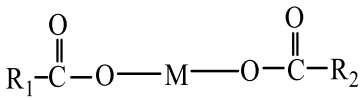
Compound Q: in the formula (N), R_2=R_3=R_6=R_7=R_{10}=R_{11}=R_{14}=R_{15}=OCH_2CH_2Cl; and

Compound R: in the formula (N), R_2=R_6=R_{10}=R_{14}=OH and R_3=R_7=R_{11}=R_{15}=OCH_2CH_3.

5. The catalyst system according to any one of claims 1 to 4, characterized in that the internal electron donor compound is selected from one or more of a diether compound, an alcohol ester compound, an aromatic carboxylic acid ester compound, a succinate compound or a ketone compound.

6. The catalyst system according to claim 5, characterized in that,

the alcohol ester compound is a glycol ester compound represented by formula B,

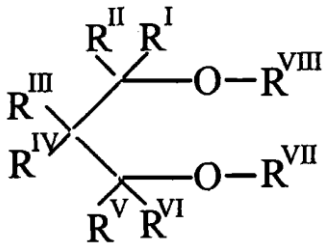


Formula B

wherein, in the formula B, R_1 and R_2 are the same or different, each independently selected from a group consisting of C_1-C_{20} alkyl, C_2-C_{20} alkenyl, C_3-C_{20} cycloalkyl, C_6-C_{20} aryl, C_7-C_{20} alkaryl, C_7-C_{20} aralkyl and C_{10}-C_{20} fused ring aryl, and preferably each independently selected from a group consisting of C_1-C_{10} alkyl, C_2-C_{10} alkenyl, C_3-C_{10} cycloalkyl, C_6-C_{10} aryl, C_7-C_{10} alkaryl, C_7-C_{10} aralkyl

and C_{10}-C_{15} fused ring aryl, the alkyl, alkenyl, cycloalkyl, aryl, alkaryl, aralkyl and fused ring aryl optionally substituted by one or more substituents selected from a group consisting of C_1-C_{10} alkyl, C_1-C_{10} alkoxyl, hydroxyl, halogen, cyano, nitro, amino, mono-C_1-C_6 alkyl amine, bis-C_1-C_6 alkyl amine, aldehyde, carboxyl and a heteroatom; and M is a divalent linking group, preferably selected from a group consisting of C_1-C_{20} alkylene, C_3-C_{20} cycloalkylene and C_6-C_{20} arylene, the alkylene, cycloalkylene and/or arylene substituted by a substituent selected from a group consisting of C_1-C_{20} alkyl, C_1-C_{20} alkoxyl and halogen, the substituent optionally bonded to form one or more rings, and a carbon atom or/and a hydrogen atom in M optionally substituted by a nitrogen, oxygen, sulfur, silicon, phosphorus or halogen atom;

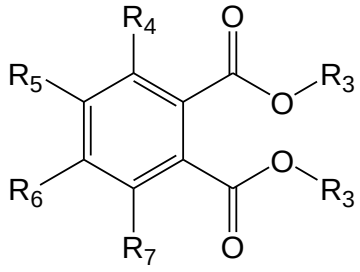
the diether compound is a 1,3-diether compound represented by formula E,



Formula E

wherein, in the formula E, R^{I}, R^{II}, R^{III}, R^{IV}, R^{V} and R^{VI} are the same or different, and are each independently selected from a group consisting of hydrogen, halogen, C_1-C_{20} alkyl, C_3-C_{20} cycloalkyl, C_6-C_{20} aryl, C_7-C_{20} aralkyl and C_7-C_{20} alkaryl; R^{VII} and R^{VIII} are the same or different, and are each independently selected from a group consisting of C_1-C_{20} alkyl, C_3-C_{20} cycloalkyl, C_6-C_{20} aryl, C_7-C_{20} aralkyl and C_7-C_{20} alkaryl, wherein any one of the alkyl, cycloalkyl, aryl, aralkyl and alkaryl may be optionally substituted by one or more substituents which are selected from a group consisting of hydroxyl, halogen, cyano, nitro, amino, mono-C_1-C_{10} alkyl amine, bis-C_1-C_{10} alkyl amine, aldehyde, carboxyl and a heteroatom; or, two or more of R^{I}, R^{II}, R^{III}, R^{IV}, R^{V} and R^{VI} are bonded to each other to form a saturated or unsaturated monocyclic or polycyclic ring, such as a fluorene ring;

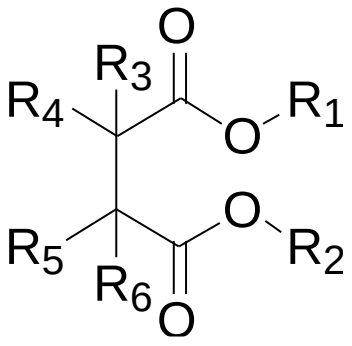
a structure of the aromatic carboxylic acid ester compound is as shown in formula F:



Formula F

wherein, in the formula F, each R_3 is the same or different, which is independently C_1-C_8 alkyl, C_5-C_{10} cycloalkyl, C_6-C_{15} aryl, C_7-C_{15} alkaryl or C_7-C_{15} aralkyl, and hydrogen on carbon of the C_1-C_8 alkyl, C_5-C_{10} cycloalkyl, C_6-C_{15} aryl, C_7-C_{15} alkaryl or C_7-C_{15} aralkyl may be optionally substituted by a substituent selected from a group consisting of an alkane and a halogen atom, and preferably substituted by one or more substituents selected from a group consisting of C_1-C_6 alkyl, a fluorine atom, a chlorine atom, a bromine atom and an iodine atom; and R_4-R_7 may be the same or different, which are hydrogen, halogen, C_1-C_6 alkyl, C_5-C_{10} cycloalkyl, C_6-C_{20} aryl, C_7-C_{20} alkaryl or C_7-C_{20} aralkyl, and hydrogen on carbon of the C_1-C_8 alkyl, C_5-C_{10} cycloalkyl, C_6-C_{15} aryl, C_7-C_{15} alkaryl or C_7-C_{15} aralkyl may be optionally substituted by a substituent selected from a group consisting of an alkane and a halogen atom, and preferably substituted by one or more substituents selected from a group consisitng of C_1-C_6 alkyl, a fluorine atom, a chlorine atom, a bromine atom, and an iodine atom; and

a structure of the succinate compound is as shown in formula G,



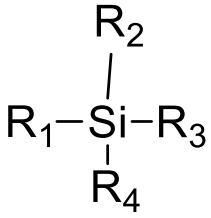
Formula G

wherein, in the formula G, R_1 and R_2 are the same or different, each independently selected from a group consisting of a C_1-C_{20} alkyl group, a C_3-C_{20} cycloalkyl group, a C_6-C_{20} aryl group, a C_7-C_{20} arylalkyl group or a C_7-C_{20} alkylaryl group, and optionally containing a heteroatom; and R_3, R_4, R_5 and R_6 are the same or

different, each independently selected from a group consisting of hydrogen, a C_1-C_{20} alkyl group, a cycloalkyl group, an aryl group, an arylalkyl group or an alkylaryl group, and optionally containing a heteroatom, and groups may be connected to form a ring.

7. The catalyst system according to any one of claims 1 to 6, characterized in that, the external electron donor compound is selected from one or more of a silane compound, an ester compound, an ether compound or a ketone compound.

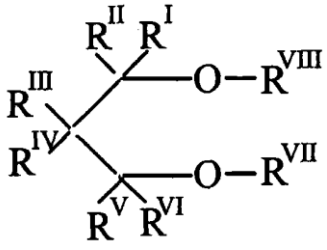
8. The catalyst system according to claim 7, characterized in that, a structure of the silane compound is shown in formula D:



Formula D

wherein in the formula D, R_1 to R_4 are the same or different, each independently selected from a group consisting of hydrogen, C_1-C_{10} alkyl, C_2-C_{10} alkenyl, C_1-C_{10} alkoxyl, C_2-C_{10} enyloxy, C_2-C_{10} alkynyl, C_2-C_{10} ynoxy, C_3-C_{10} cycloalkyl, C_6-C_{15} aryl, C_3-C_{10} cycloalkoxyl, C_6-C_{15} aryloxyl and amino, wherein the alkyl, alkenyl, alkynyl, alkoxyl, enyloxy, ynoxy, cycloalkyl, aryl, cycloalkoxyl, aryloxyl and amino may be optionally subsitituted by one or more substituents selected from a group consisting of halogen, C_1-C_6 alkyl, C_3-C_6 cycloalkyl, C_6-C_{10} aryl and amino; and

the ether compound is the 1,3-diether compound represented by the formula E,



Formula E

wherein, in the formula E, $R^{I,}$ R^{II}, R^{III}, R^{IV}, R^{V} and R^{VI} are the same or different, and are each independently selected from a group consisting of hydrogen, halogen, C_1-C_{20} alkyl, C_3-C_{20} cycloalkyl, C_6-C_{20} aryl, C_7-C_{20} aralkyl and C_7-C_{20} alkaryl; R^{VII}

and R^{VIII} are the same or different, and are each independently selected from a group consisting of C_1-C_{20} alkyl, C_3-C_{20} cycloalkyl, C_6-C_{20} aryl, C_7-C_{20} aralkyl and C_7-C_{20} alkaryl, wherein any one of the alkyl, cycloalkyl, aryl, aralkyl and alkaryl may be optionally substituted by one or more substituents which are selected from a group consisting of hydroxyl, halogen, cyano, nitro, amino, mono-C_1-C_{10} alkyl amine, bis-C_1-C_{10} alkyl amine, aldehyde, carboxyl and a heteroatom; or, two or more of R^I, R^{II}, R^{III}, R^{IV}, R^V and R^{VI} are bonded to each other to form a saturated or unsaturated monocyclic or polycyclic ring, such as a fluorene ring.

9. The catalyst system according to any one of claims 1 to 8, characterized in that, a molar ratio of the twelve-membered ring compound represented by the formula (M) to the external electron donor compound is 1:100-100:1, preferably 1:50-50:1, and more preferably 1:20-20:1.

10. The catalyst system according to any one of claims 1 to 9, characterized in that, the organic aluminum compound is an alkyl aluminum compound; prerferably, a general formula of the alkyl aluminum compound is AlR_3, wherein each R is independently selected from a group cponsisting of hydrogen, halogen, C_1-C_{20} alkyl, C_1-C_{20} alkoxyl or halogenated C_1-C_{20} alkyl, and at least one of three Rs is C_1-C_{20} alkyl; more preferably, the general formula of the alkyl aluminum compound is AlR_3, wherein each R is independently selected from a group consisting of hydrogen, halogen, C_1-C_{10} alkyl, C_1-C_{10} alkoxyl or halogenated C_1-C_{10} alkyl, and at least one of the three Rs is C_1-C_{10} alkyl; and

further preferably, the alkyl aluminum compound is one or more of triethyl aluminum, tri-n-propyl aluminum, tri-isopropyl aluminum, tri-n-butyl aluminum, tri-isobutyl aluminum, tri-n-hexyl aluminum, tri-n-octyl aluminum, diethyl aluminum monohydrogen, diisobutyl aluminum monohydrogen, diethyl aluminum chloride, diisobutyl aluminum chloride, ethyl aluminum dichloride, $Al(n\text{-}C_6H_{13})_3$ and $Al(n\text{-}C_8H_{17})_3$.

11. The catalyst system according to any one of claims 1 to 10, characterized in that, a molar ratio of the twelve-membered ring compound represented by the formula (M) to the organic aluminum compound in terms of aluminum is 1:(0.1-500), and preferably 1:(1-200); and

a molar ratio of the solid catalyst component in terms of the titanium element to the organic aluminum compound in terms of aluminum is 1:(5-5000), and preferably 1:(20-2000).

12. A prepolymerized catalyst composition for olefin polymerization, which comprises the catalyst system according to any one of claims 1 to 11 and a prepolymer obtained by the olefin prepolymerization, preferably a prepolymerization multiple of the prepolymer being 0.1-1000 g olefin polymer/g solid catalyst component.

13. A method for olefin polymerization, comprising: polymerizing an olefin having a general formula of CH_2=CHR in the presence of the catalyst system according to any one of claims 1 to 11 and/or the prepolymerized catalyst composition according to claim 12, wherein R is hydrogen or C_1-C_8 alkyl, and preferably hydrogen or C_1-C_6 alkyl.

14. The method according to claim 13, characterized in that, the olefin is selected from one or more of ethylene, propylene, 1-butene, 4-methyl-1-pentene and 1-hexene; and preferably ethylene, propylene, or a mixture of the ethylene and the propylene.