Claims:

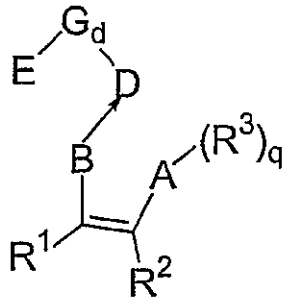
1. A process for producing a supported nonmetallocene catalyst, ~~comprising the step of: contacting a nonmetallocene ligand with a chemical treating agent selected from a Group IVB metal compound in the presence of an alkoxy magnesium spherical carrier, preferably~~ comprising the step of contacting ~~the~~ a nonmetallocene ligand, ~~the~~ a chemical treating agent and ~~the~~ an alkoxy magnesium spherical carrier in the presence of a solvent selected from a C_{5-12} alkane, a C_{5-12} cyclic alkane, a halogenated C_{5-12} alkane and a halogenated C_{5-12} cyclic alkane.

2. The process according to claim 1, wherein in the presence of the solvent, the nonmetallocene ligand contacts the alkoxy magnesium spherical carrier, and then the chemical treating agent is added for a further contact.

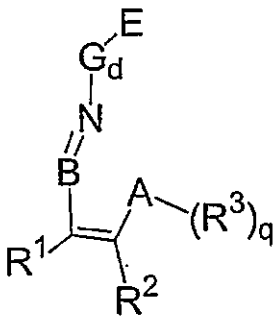
3. The process according to claim 1, wherein the alkoxy magnesium is represented by the formula $Mg(OR_a)(OR_b)$, wherein R_a and R_b are the same as or different from each other, and each independently selected from a C_1-C_{18} straight-chain or branched alkyl, preferably each independently selected from a C_1-C_{10} straight-chain or branched alkyl, more preferably each independently selected from a C_1-C_6 straight-chain or branched alkyl, further preferably each independently selected from a C_1-C_4 straight-chain or branched alkyl, more preferably each independently selected from a C_2-C_4 straight-chain or branched alkyl, most preferably both ethyl.

4. The process according to claim 1, wherein the alkoxy magnesium spherical carrier has a sphericity of 1 to 3, preferably 1 to 1.5, a bulk density of 0.2 to 1.0 g/cm^3, preferably 0.25 to 0.7 g/cm^3, more preferably 0.3 to 0.5 g/cm^3, and an average particle size of 5 to 2000 μm, preferably 50 to 1500 μm, more preferably 100 to 1000 μm.

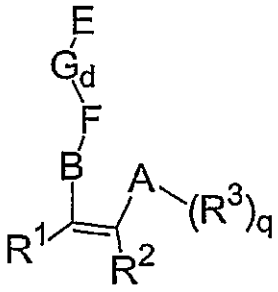
5. The process according to claim 1, wherein the nonmetallocene ligand is one or more selected from the group consisting of the compounds having the following structure,



preferably one or more selected from the group consisting of the following compound (A) and the following compound (B),

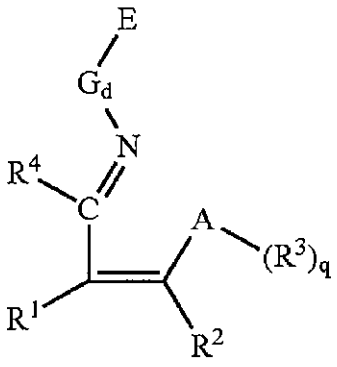


and

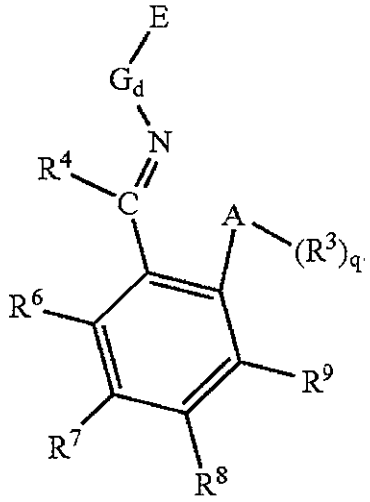


(A) (B)

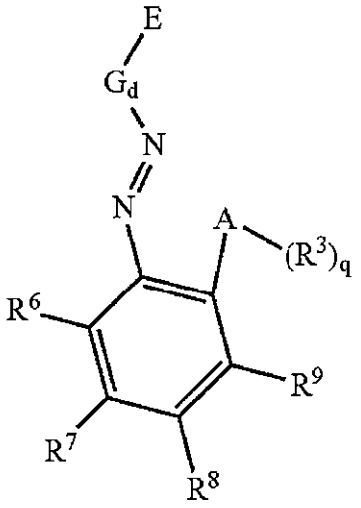
more preferably one or more selected from the group consisting of the following compound (A-1), the following compound (A-2), the following compound (A-3), the following compound (A-4), the following compound (B-1), the following compound (B-2), the following compound (B-3), and the following compound (B-4),



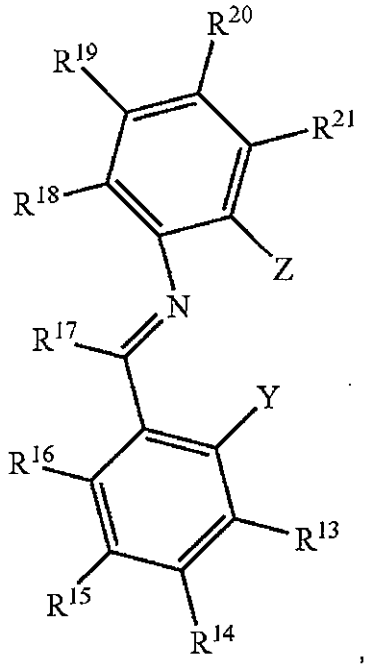
(A-1)



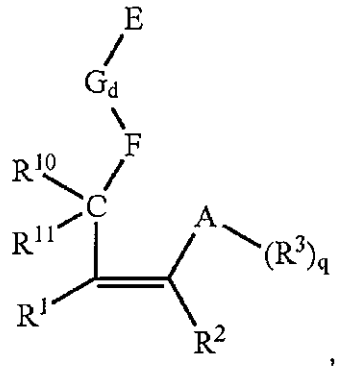
(A-2)


E
G_d
N
N
A
$(R^3)_q$
R^6
R^9
R^7
R^8

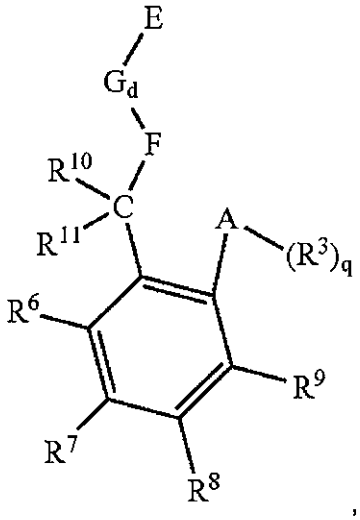
(A-3)


R^{20}
R^{19}
R^{21}
R^{18}
Z
N
R^{17}
Y
R^{16}
R^{13}
R^{15}
R^{14}

(A-4)

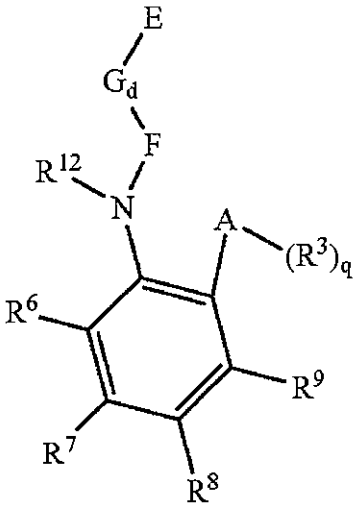

E
G_d
F
R^{10}
C
R^{11}
A
$(R^3)_q$
R^1
R^2

(B-1)


E
G_d
F
R^{10}
C
R^{11}
A
$(R^3)_q$
R^6
R^9
R^7
R^8

(B-2)

5



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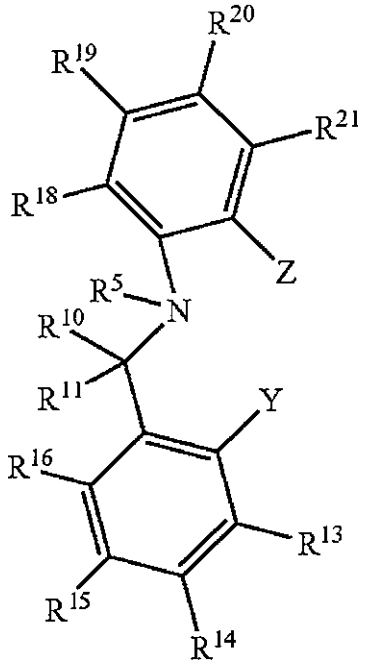


,

(B-3) (B-4)

in all of the aforesaid formulae,

q is 0 or 1;

d is 0 or 1;

A is selected from the group consisting of an oxygen atom, a sulfur atom, a selenium atom, $\overset{\diagdown}{\underset{|}{NR^{22}}}$, $-NR^{23}R^{24}$, $-N(O)R^{25}R^{26}$, $\overset{\diagdown}{\underset{|}{PR^{27}}}$, $-PR^{28}R^{29}$, $-P(O)R^{30}OR^{31}$, a sulfone group, a sulfoxide group and $-Se(O)R^{39}$, wherein N, O, S, Se and P each represents a coordination atom;

B is selected from the group consisting of a nitrogen atom, a nitrogen-containing group, a phosphor-containing group and a C_1-C_{30} hydrocarbyl;

D is selected from the group consisting of a nitrogen atom, an oxygen atom, a sulfur atom, a selenium atom, a phosphor atom, a nitrogen-containing group, a phosphor-containing group, a C_1-C_{30} hydrocarbyl, a sulfone group or a sulfoxide group, wherein N, O, S, Se and P each represents a coordination atom;

E is selected from the group consisting of a nitrogen-containing group, an oxygen-containing group, a sulfur-containing group, a selenium-containing group, a phosphor-containing group and a cyano group, wherein N, O, S, Se and P each represents a coordination atom;

F is selected from the group consisting of a nitrogen atom, a nitrogen-containing group, an oxygen-containing group, a sulfur-containing group, a selenium-containing group and a phosphor-containing group, wherein N, O, S, Se and P each represents a coordination atom;

G is selected from the group consisting of a C_1-C_{30} hydrocarbyl, a substituted C_1-C_{30} hydrocarbyl and an inert functional group;

Y is selected from the group consisting of a nitrogen-containing group, an oxygen-containing group, a sulfur-containing group, a selenium-containing group

and a phosphor-containing group, wherein N, O, S, Se and P each represents a coordination atom;

Z is selected from the group consisting of a nitrogen-containing group, an oxygen-containing group, a sulfur-containing group, a selenium-containing group, a phosphor-containing group and a cyano group, wherein N, O, S, Se and P each represents a coordination atom;

→ represents a single bond or a double bond;

— represents a covalent bond or an ionic bond;

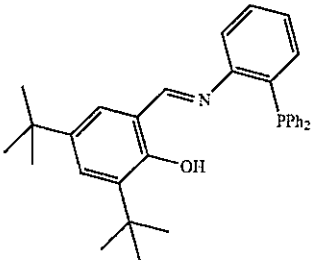
R^1 to R^4, R^6 to R^{21} are each independently selected from the group consisting of a hydrogen atom, a C_1-C_{30} hydrocarbyl, a substituted C_1-C_{30} hydrocarbyl and an inert functional group, R^{22} to R^{36}, R^{38} and R^{39} are each independently selected from the group consisting of a hydrogen atom, a C_1-C_{30} hydrocarbyl and a substituted C_1-C_{30} hydrocarbyl, wherein these groups may be identical to or different from one another, and any adjacent groups may form a bond or a ring (preferably an aromatic ring) with one another;

the inert functional group is selected from the group consisting of a halogen atom, an oxygen-containing group, a nitrogen-containing group, a silicon-containing group, a germanium-containing group, a sulfur-containing group, a tin-containing group, a C_1-C_{10} ester group and a nitro group,

R^5 is selected from the group consisting of the lone pair electron on the nitrogen atom, a hydrogen atom, a C_1-C_{30} hydrocarbyl, a substituted C_1-C_{30} hydrocarbyl, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a selenium-containing group, and a phosphor-containing group, with the proviso that when R^5 is the oxygen-containing group, the sulfur-containing group, the nitrogen-containing group, the selenium-containing group or the phosphor-containing group, N, O, S, P and Se in the group R^5 each can act as a coordination atom; and

the substituted C_1-C_{30} hydrocarbyl is selected from a C_1-C_{30} hydrocarbyl having one or more substituent(s) selected from a halogen atom and a C_1-C_{30} alkyl group,

the nonmetallocene ligand is more preferably one or more selected from the group consisting of the following compounds,



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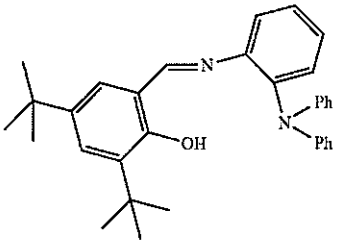

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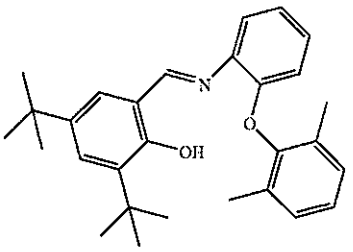
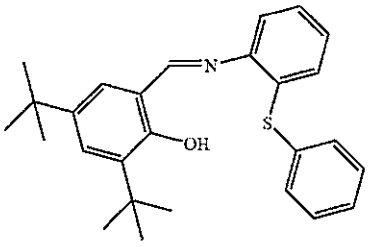
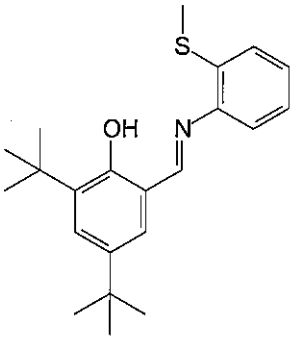
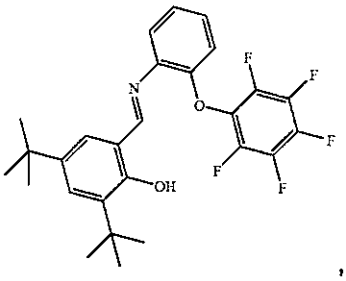



and

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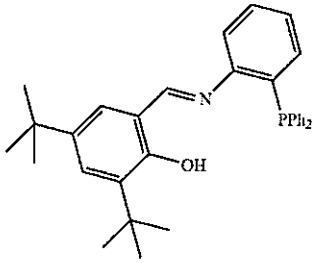
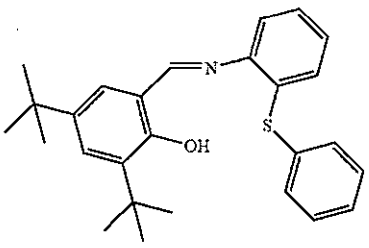
more preferably one or more selected from the group consisting of the following compounds,


and

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6. The process according to claim 5, wherein,

the halogen atom is selected from the group consisting of F, Cl, Br and I,

the nitrogen-containing group is selected from the group consisting of  , $-NR^{23}R^{24}$, $-T-NR^{23}R^{24}$ and $-N(O)R^{25}R^{26}$,

the phosphor-containing group is selected from the group consisting of  , $-PR^{28}R^{29}$, $-P(O)R^{30}R^{31}$ and $-P(O)R^{32}(OR^{33})$,

the oxygen-containing group is selected from the group consisting of hydroxy, $-OR^{34}$ and $-T-OR^{34}$,

the sulfur-containing group is selected from the group consisting of $-SR^{35}$, $-T-SR^{35}$, $-S(O)R^{36}$ and $-T-SO_2R^{37}$,

the selenium-containing group is selected from the group consisting of $-SeR^{38}$, $-T-SeR^{38}$, $-Se(O)R^{39}$ and $-T-Se(O)R^{39}$,

the group T is selected from the group consisting of a C_1-C_{30} hydrocarbyl and a substituted C_1-C_{30} hydrocarbyl,

R^{37} is selected from the group consisting of a hydrogen atom, a C_1-C_{30} hydrocarbyl, and a substituted C_1-C_{30} hydrocarbyl,

the C_1-C_{30} hydrocarbyl is selected from the group consisting of a C_1-C_{30} alkyl

group, a C_7-C_{30} alkylaryl group, a C_7-C_{30} aralkyl group, a C_3-C_{30} cyclic alkyl group, a C_2-C_{30} alkenyl group, a C_2-C_{30} alkynyl group, a C_6-C_{30} aryl group, a C_8-C_{30} fused-ring group and a C_4-C_{30} heterocycle group, wherein the heterocycle group contains 1 to 3 hetero atom(s) selected from the group consisting of a nitrogen atom, an oxygen atom and a sulfur atom,

the silicon-containing group is selected from the group consisting of $-SiR^{42}R^{43}R^{44}$, and $-T-SiR^{45}$,

the germanium-containing group is selected from the group consisting of $-GeR^{46}R^{47}R^{48}$, and $-T-GeR^{49}$,

the tin-containing group is selected from the group consisting of $-SnR^{50}R^{51}R^{52}$, $-T-SnR^{53}$ and $-T-Sn(O)R^{54}$,

R^{42} to R^{54} are each independently selected from the group consisting of a hydrogen atom, the C_1-C_{30} hydrocarbyl and the substituted C_1-C_{30} hydrocarbyl, wherein these groups may be identical to or different from one another, and any adjacent groups may form a bond or a ring with one another, and

the group T is defined as aforesaid.

7. The process according to claim 1, wherein ratio by molar of the alkoxy magnesium spherical carrier (based on Mg) to the nonmetallocene ligand is 1:0.001-0.08, preferably 1:0.005-0.06, more preferably 1:0.01-0.04, and ratio by molar of the alkoxy magnesium spherical carrier (based on Mg) to the chemical treating agent (based on the Group IVB metal) is 1:1-30, preferably 1:2-20, more preferably 1:4-10.

8. The process according to claim 1, wherein the Group IVB metal compound is one or more selected from the group consisting of a Group IVB metal halide, a Group IVB metal alkyl halide, and a Group IVB metal alkoxy halide, preferably one or more of the Group IVB metal halide, more preferably one or more selected from the group consisting of $TiCl_4$, $TiBr_4$, $ZrCl_4$, $ZrBr_4$, $HfCl_4$ and $HfBr_4$, more preferably one or more selected from the group consisting of $TiCl_4$ and $ZrCl_4$.

9. A supported nonmetallocene catalyst, produced in line with the process according to any of claims 1 to 8.

10. ~~An olefin homopolymerization/copolymerization process, wherein~~ Use of the supported nonmetallocene catalyst according to claim 9 ~~is used~~ in olefin homopolymerization/copolymerization as the main catalyst, in combination of one or more selected from the group consisting of an aluminoxane, an alkylaluminum, a halogenated alkyl aluminum, a fluoroborane, an alkylboron and an alkylboron ammonium salt as the co-catalyst, for homopolymerization or copolymerization of the olefin.

11. The use ~~olefin homopolymerization/copolymerization process~~ according to claim 10, wherein a slurry polymerization procedure is involved, and under the conditions of a total polymerization pressure of 0.2 to 2.0 MPa (preferably 0.5 to 1.5 MPa), a partial pressure ratio of hydrogen gas to ethylene of 0.01-0.2:1 (preferable 0.02-0.1:1, most preferably 0.03-0.08:1), a polymerization temperature of 60 to 100 °C (preferably 70 to 95 °C, more preferably 80 to 90 °C), and an amount of an

optional commoner of 0.5 to 10 g per 1mg of the main catalyst (preferably 1 to 5 g per 1mg of the main catalyst), the homopolymerization of ethylene or the copolymerization of ethylene with at least one alpha-olefin(s) selected from a C_3 to C_{12} alpha-olefin (preferably a C_3 to C_8 alpha-olefin) is conducted to obtain an ethylene polymer.

~~12. An ethylene polymer, characterized by having a recurring unit derived from ethylene and optionally a recurring unit derived from at least one alpha-olefin(s) selected from a C_3 to C_{12} alpha-olefin (preferably a C_3 to C_8 alpha-olefin), a bulk density of 0.33 to 0.50 g/cm^3, preferably 0.38 to 0.46 g/cm^3, more preferably 0.40 to 0.44 g/cm^3, an oligomer content of less than 2 g/L, a fine (less than 75 μm) powder content of less than 5 wt%, a melt index (at 190 °C and 2.16 kg load) of 0.02 to 5 g/10min, a molecular weight distribution Mw/Mn of 2.5 to 20 (preferably 4 to 10), a density of 0.94 to 0.96 g/cm^3, an average particle size of 200 to 400 μm, a specific surface area of 0.2 to 3.0 m^2/g, preferably 1.0 to 3.0 m^2/g, more preferably 1.5 to 3.0 m^2/g, a pore volume of 0.001 to 0.15 cm^3/g, preferably 0.01 to 0.15 cm^3/g, more preferably 0.05 to 0.12 cm^3/g, a pore size of 10 to 80 nm, preferably 20 to 70 nm, more preferably 20 to 60 nm, and with respect to the total weight 100 wt% of the ethylene polymer, a content of the recurring unit derived from ethylene of 95 to 100 wt%, and a content of the recurring unit derived from the at least one alpha-olefin(s) of 0 to 5 wt%.~~

~~13. A chlorinated polyethylene, obtained by chlorination of the ethylene polymer according to claim 12 or by chlorination of an ethylene polymer produced in line with the process according to claim 11.~~

Claims:

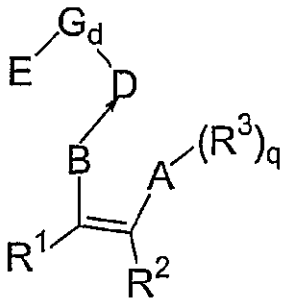
1. A process for producing a supported nonmetallocene catalyst, comprising the step of contacting a nonmetallocene ligand, a chemical treating agent and an alkoxy magnesium spherical carrier in the presence of a solvent selected from a C_{5-12} alkane, a C_{5-12} cyclic alkane, a halogenated C_{5-12} alkane and a halogenated C_{5-12} cyclic alkane.

2. The process according to claim 1, wherein in the presence of the solvent, the nonmetallocene ligand contacts the alkoxy magnesium spherical carrier, and then the chemical treating agent is added for a further contact.

3. The process according to claim 1, wherein the alkoxy magnesium is represented by the formula $Mg(OR_a)(OR_b)$, wherein R_a and R_b are the same as or different from each other, and each independently selected from a C_1-C_{18} straight-chain or branched alkyl, preferably each independently selected from a C_1-C_{10} straight-chain or branched alkyl, more preferably each independently selected from a C_1-C_6 straight-chain or branched alkyl, further preferably each independently selected from a C_1-C_4 straight-chain or branched alkyl, more preferably each independently selected from a C_2-C_4 straight-chain or branched alkyl, most preferably both ethyl.

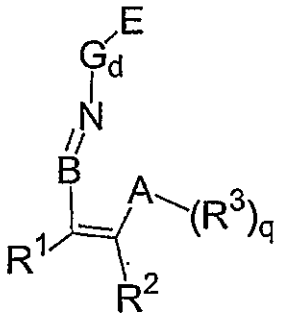
4. The process according to claim 1, wherein the alkoxy magnesium spherical carrier has a sphericity of 1 to 3, preferably 1 to 1.5, a bulk density of 0.2 to 1.0 g/cm^3, preferably 0.25 to 0.7 g/cm^3, more preferably 0.3 to 0.5 g/cm^3, and an average particle size of 5 to 2000 μm, preferably 50 to 1500 μm, more preferably 100 to 1000 μm.

5. The process according to claim 1, wherein the nonmetallocene ligand is one or more selected from the group consisting of the compounds having the following structure,

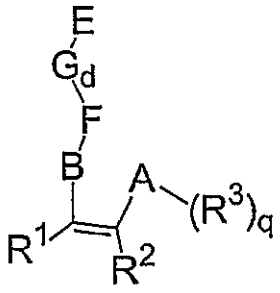


,

preferably one or more selected from the group consisting of the following compound (A) and the following compound (B),

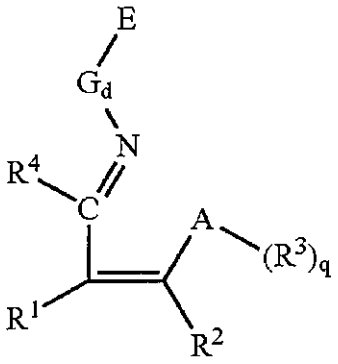


and

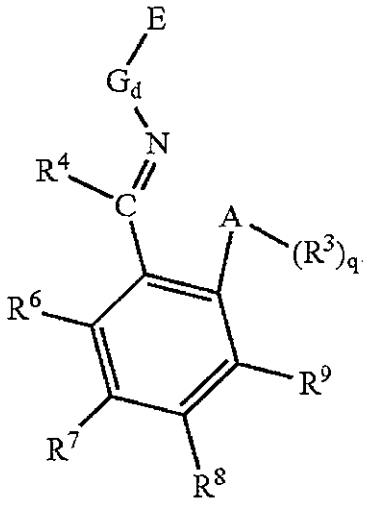


(A) (B)

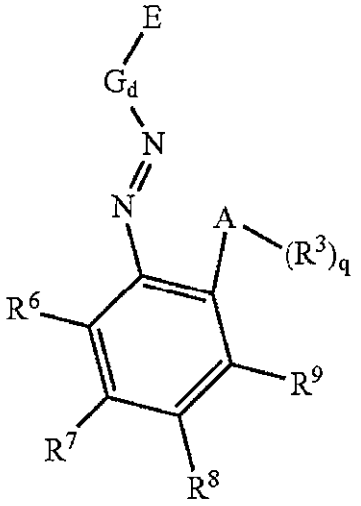
more preferably one or more selected from the group consisting of the following compound (A-1), the following compound (A-2), the following compound (A-3), the following compound (A-4), the following compound (B-1), the following compound (B-2), the following compound (B-3), and the following compound (B-4),



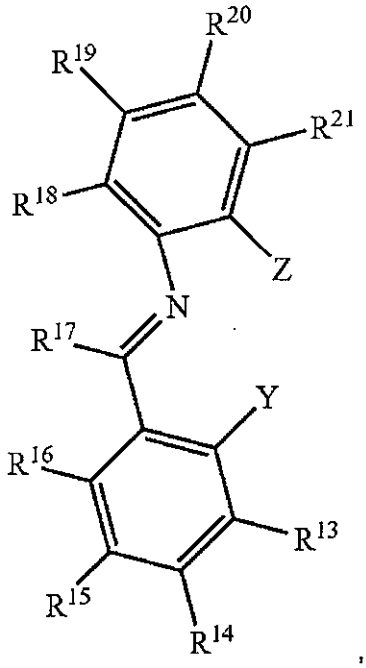
(A-1)



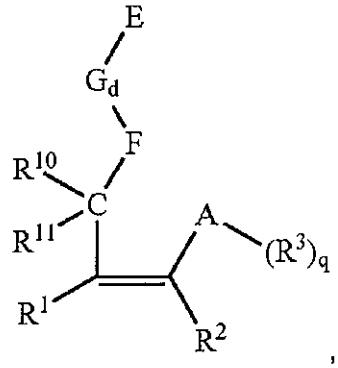
(A-2)



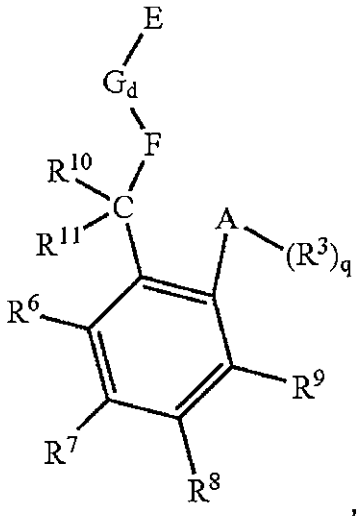
(A-3)



(A-4)



(B-1)



(B-2)

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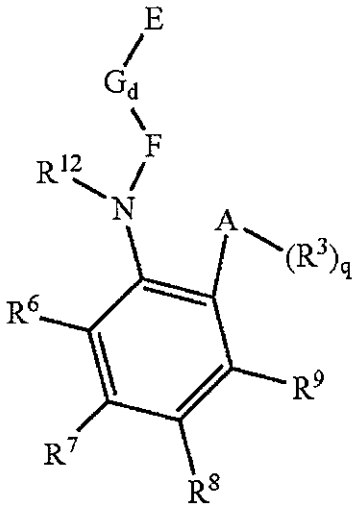

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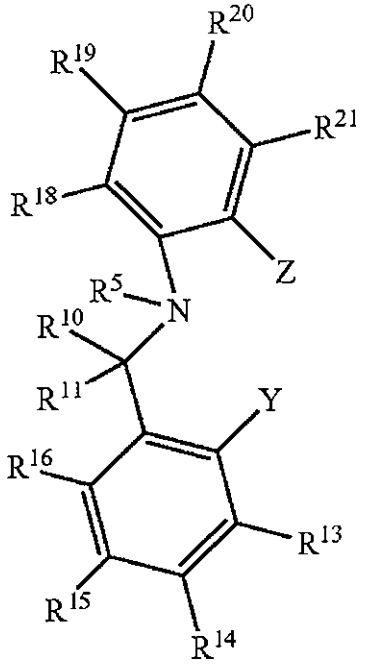


,

(B-3) (B-4)

in all of the aforesaid formulae,

q is 0 or 1;

d is 0 or 1;

A is selected from the group consisting of an oxygen atom, a sulfur atom, a selenium atom, $\overset{\diagdown NR^{22}}{|}$, $-NR^{23}R^{24}$, $-N(O)R^{25}R^{26}$, $\overset{\diagdown PR^{27}}{|}$, $-PR^{28}R^{29}$, $-P(O)R^{30}OR^{31}$, a sulfone group, a sulfoxide group and $-Se(O)R^{39}$, wherein N, O, S, Se and P each represents a coordination atom;

B is selected from the group consisting of a nitrogen atom, a nitrogen-containing group, a phosphor-containing group and a C_1-C_{30} hydrocarbyl;

D is selected from the group consisting of a nitrogen atom, an oxygen atom, a sulfur atom, a selenium atom, a phosphor atom, a nitrogen-containing group, a phosphor-containing group, a C_1-C_{30} hydrocarbyl, a sulfone group or a sulfoxide group, wherein N, O, S, Se and P each represents a coordination atom;

E is selected from the group consisting of a nitrogen-containing group, an oxygen-containing group, a sulfur-containing group, a selenium-containing group, a phosphor-containing group and a cyano group, wherein N, O, S, Se and P each represents a coordination atom;

F is selected from the group consisting of a nitrogen atom, a nitrogen-containing group, an oxygen-containing group, a sulfur-containing group, a selenium-containing group and a phosphor-containing group, wherein N, O, S, Se and P each represents a coordination atom;

G is selected from the group consisting of a C_1-C_{30} hydrocarbyl, a substituted C_1-C_{30} hydrocarbyl and an inert functional group;

Y is selected from the group consisting of a nitrogen-containing group, an oxygen-containing group, a sulfur-containing group, a selenium-containing group

and a phosphor-containing group, wherein N, O, S, Se and P each represents a coordination atom;

Z is selected from the group consisting of a nitrogen-containing group, an oxygen-containing group, a sulfur-containing group, a selenium-containing group, a phosphor-containing group and a cyano group, wherein N, O, S, Se and P each represents a coordination atom;

→ represents a single bond or a double bond;

— represents a covalent bond or an ionic bond;

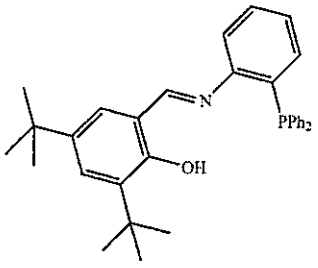
R^1 to R^4, R^6 to R^{21} are each independently selected from the group consisting of a hydrogen atom, a C_1-C_{30} hydrocarbyl, a substituted C_1-C_{30} hydrocarbyl and an inert functional group, R^{22} to R^{36}, R^{38} and R^{39} are each independently selected from the group consisting of a hydrogen atom, a C_1-C_{30} hydrocarbyl and a substituted C_1-C_{30} hydrocarbyl, wherein these groups may be identical to or different from one another, and any adjacent groups may form a bond or a ring (preferably an aromatic ring) with one another;

the inert functional group is selected from the group consisting of a halogen atom, an oxygen-containing group, a nitrogen-containing group, a silicon-containing group, a germanium-containing group, a sulfur-containing group, a tin-containing group, a C_1-C_{10} ester group and a nitro group,

R^5 is selected from the group consisting of the lone pair electron on the nitrogen atom, a hydrogen atom, a C_1-C_{30} hydrocarbyl, a substituted C_1-C_{30} hydrocarbyl, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a selenium-containing group, and a phosphor-containing group, with the proviso that when R^5 is the oxygen-containing group, the sulfur-containing group, the nitrogen-containing group, the selenium-containing group or the phosphor-containing group, N, O, S, P and Se in the group R^5 each can act as a coordination atom; and

the substituted C_1-C_{30} hydrocarbyl is selected from a C_1-C_{30} hydrocarbyl having one or more substituent(s) selected from a halogen atom and a C_1-C_{30} alkyl group,

the nonmetallocene ligand is more preferably one or more selected from the group consisting of the following compounds,



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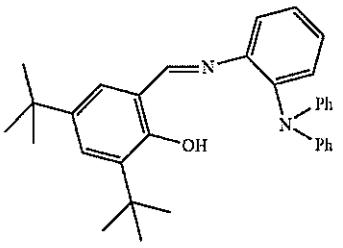

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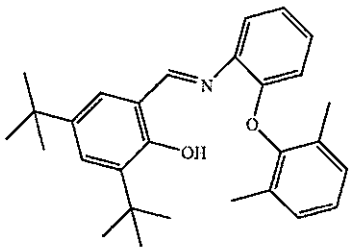
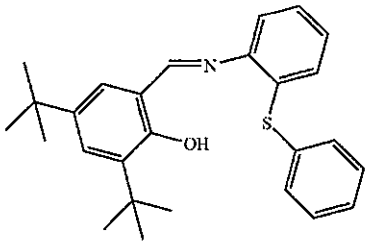
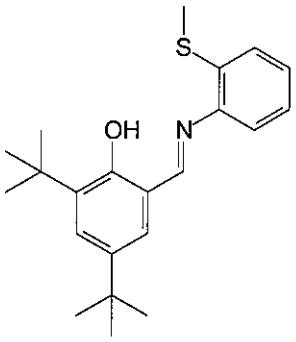
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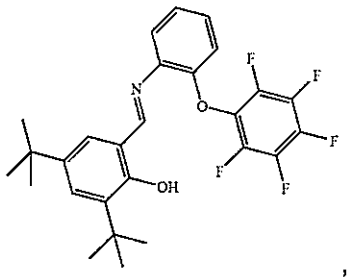
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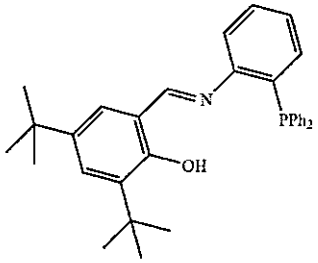
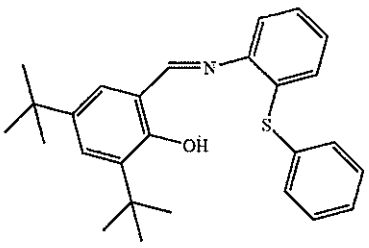
more preferably one or more selected from the group consisting of the following compounds,



and .

6. The process according to claim 5, wherein,

the halogen atom is selected from the group consisting of F, Cl, Br and I,

the nitrogen-containing group is selected from the group consisting of  , $-NR^{23}R^{24}$, -T-$NR^{23}R^{24}$ and $-N(O)R^{25}R^{26}$,

the phosphor-containing group is selected from the group consisting of  , $-PR^{28}R^{29}$, $-P(O)R^{30}R^{31}$ and $-P(O)R^{32}(OR^{33})$,

the oxygen-containing group is selected from the group consisting of hydroxy, $-OR^{34}$ and -T-OR^{34},

the sulfur-containing group is selected from the group consisting of $-SR^{35}$, -T-SR^{35}, $-S(O)R^{36}$ and -T-SO_2R^{37},

the selenium-containing group is selected from the group consisting of $-SeR^{38}$, -T-SeR^{38}, $-Se(O)R^{39}$ and -T-$Se(O)R^{39}$,

the group T is selected from the group consisting of a C_1-C_{30} hydrocarbyl and a substituted C_1-C_{30} hydrocarbyl,

R^{37} is selected from the group consisting of a hydrogen atom, a C_1-C_{30} hydrocarbyl, and a substituted C_1-C_{30} hydrocarbyl,

the C_1-C_{30} hydrocarbyl is selected from the group consisting of a C_1-C_{30} alkyl

group, a C_7-C_{30} alkylaryl group, a C_7-C_{30} aralkyl group, a C_3-C_{30} cyclic alkyl group, a C_2-C_{30} alkenyl group, a C_2-C_{30} alkynyl group, a C_6-C_{30} aryl group, a C_8-C_{30} fused-ring group and a C_4-C_{30} heterocycle group, wherein the heterocycle group contains 1 to 3 hetero atom(s) selected from the group consisting of a nitrogen atom, an oxygen atom and a sulfur atom,

the silicon-containing group is selected from the group consisting of $-SiR^{42}R^{43}R^{44}$, and $-T-SiR^{45}$,

the germanium-containing group is selected from the group consisting of $-GeR^{46}R^{47}R^{48}$, and $-T-GeR^{49}$,

the tin-containing group is selected from the group consisting of $-SnR^{50}R^{51}R^{52}$, $-T-SnR^{53}$ and $-T-Sn(O)R^{54}$,

R^{42} to R^{54} are each independently selected from the group consisting of a hydrogen atom, the C_1-C_{30} hydrocarbyl and the substituted C_1-C_{30} hydrocarbyl, wherein these groups may be identical to or different from one another, and any adjacent groups may form a bond or a ring with one another, and

the group T is defined as aforesaid.

7. The process according to claim 1, wherein ratio by molar of the alkoxy magnesium spherical carrier (based on Mg) to the nonmetallocene ligand is 1:0.001-0.08, preferably 1:0.005-0.06, more preferably 1:0.01-0.04, and ratio by molar of the alkoxy magnesium spherical carrier (based on Mg) to the chemical treating agent (based on the Group IVB metal) is 1:1-30, preferably 1:2-20, more preferably 1:4-10.

8. The process according to claim 1, wherein the Group IVB metal compound is one or more selected from the group consisting of a Group IVB metal halide, a Group IVB metal alkyl halide, and a Group IVB metal alkoxy halide, preferably one or more of the Group IVB metal halide, more preferably one or more selected from the group consisting of $TiCl_4$, $TiBr_4$, $ZrCl_4$, $ZrBr_4$, $HfCl_4$ and $HfBr_4$, more preferably one or more selected from the group consisting of $TiCl_4$ and $ZrCl_4$.

9. A supported nonmetallocene catalyst, produced in line with the process according to any of claims 1 to 8.

10. Use of the supported nonmetallocene catalyst according to claim 9 in olefin homopolymerization/copolymerization as the main catalyst, in combination of one or more selected from the group consisting of an aluminoxane, an alkylaluminum, a halogenated alkyl aluminum, a fluoroborane, an alkylboron and an alkylboron ammonium salt as the co-catalyst, for homopolymerization or copolymerization of the olefin.

11. The use according to claim 10, wherein a slurry polymerization procedure is involved, and under the conditions of a total polymerization pressure of 0.2 to 2.0 MPa (preferably 0.5 to 1.5 MPa), a partial pressure ratio of hydrogen gas to ethylene of 0.01-0.2:1 (preferable 0.02-0.1:1, most preferably 0.03-0.08:1), a polymerization temperature of 60 to 100 °C (preferably 70 to 95 °C, more preferably 80 to 90 °C), and an amount of an optional commoner of 0.5 to 10 g per 1mg of the main catalyst (preferably 1 to 5 g per 1mg of the main catalyst), the

homopolymerization of ethylene or the copolymerization of ethylene with at least one alpha-olefin(s) selected from a C_3 to C_{12} alpha-olefin (preferably a C_3 to C_8 alpha-olefin) is conducted to obtain an ethylene polymer.