Patent Literature

[0005]

Patent literature 1: Japanese Translation of PCT International Application Publication No. 2002-505353

Patent literature 2: WO 03/051892

Patent literature 3: U.S. Publication No. 2004/0254065

Patent literature 4: U.S. Patent No. 5,502,017

Patent literature 5: Japanese Translation of PCT International Application Publication No. 2000-507157

Patent literature 6: Japanese Translation of PCT International Application Publication No. 2003-512515

Patent literature 7: Japanese Translation of PCT International Application Publication No. 2004-513193

Summary ~~of Invention~~

[0005a]

In a first aspect of the present disclosure, there is provided a process for producing an olefin polymer, having a step comprising feeding an olefin polymerization catalyst solution, which is obtained by mixing

(A) a metallocene compound represented by the general formula [A1] and/or a metallocene compound represented by the general formula [A2],

(B) a compound which is a compound that reacts with the

metallocene compound (A) to form an ion pair, and is represented by the general formula [B1], and

(C) an organoaluminum compound (C-1) and/or an organoaluminum oxy compound (C-2),

with (D) a saturated hydrocarbon solvent under the following conditions (i) to (iv),

to a polymerization reactor and solution-polymerizing an olefin in the polymerization reactor;

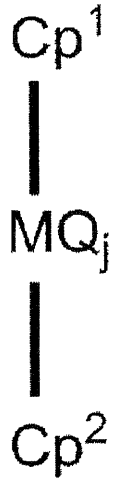
(i) the amount of the metallocene compound (A) added to 1 liter of the saturated hydrocarbon solvent (D) is 0.02 to 0.6 mmol,

(ii) the molar ratio ((C)/(A)) of an aluminum atom in the compound (C) added to the saturated hydrocarbon solvent (D) to the metallocene compound (A) is 33 to 5000,

(iii) the amount of an aluminum atom in the compound (C) added to 1 liter of the saturated hydrocarbon solvent (D) is 3 to 1000 mmol, and

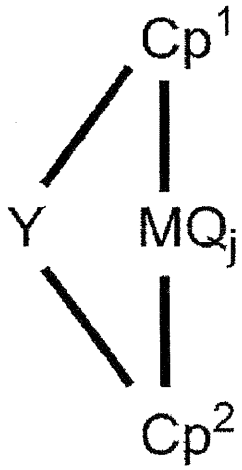
(iv) the molar ratio ((B)/(A)) of the compound (B) added to the saturated hydrocarbon solvent (D) to the metallocene compound (A) is 1 to 15;

[Chem. 1]



[A 1]

[Chem. 2]



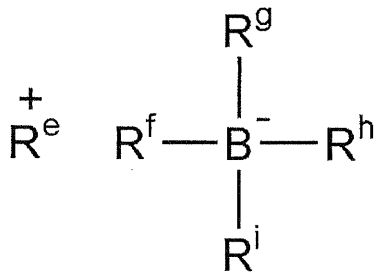
[A 2]

wherein, in the formulas [A1] and [A2], M is an atom of the periodic table Group 4 or Group 5, Q is a halogen atom, a hydrocarbon group, a halogenated hydrocarbon group, a neutral conjugated or non-conjugated diene, an anionic ligand or a neutral ligand capable of being coordinated with a lone electron pair, j is an integer of 1 to 4, when j is an integer of 2 or greater, plural Q are the same as or different from each other, and Cp^1 and Cp^2 are the same as or different from each other and are each a cyclopentadienyl group or a substituted cyclopentadienyl group capable of forming a sandwich

structure together with M; and

Y in the formula [A2] is a divalent hydrocarbon group of 1 to 30 carbon atoms, a divalent halogenated hydrocarbon group of 1 to 20 carbon atoms, a divalent silicon-containing group, a divalent germanium-containing group, a divalent tin-containing group, -O-, -CO-, -S-, -SO-, $-SO_2-$, -Ge-, -Sn-, $-NR^a-$, $-P(R^a)-$, $-P(O)(R^a)-$, $-BR^a-$ or $-AlR^a-$ wherein R^a is a hydrocarbon group of 1 to 20 carbon atoms, a halogenated hydrocarbon group of 1 to 20 carbon atoms, a hydrogen atom, a halogen atom or a nitrogen compound residue in which one or two hydrocarbon groups of 1 to 20 carbon atoms are bonded to a nitrogen atom;

[Chem. 3]



[B 1]

wherein, in the formula [B1], R^{e+} is carbenium cation, and R^f to R^i are each independently a hydrocarbon group of 1 to 20 carbon atoms or a halogenated hydrocarbon group of 1 to 20 carbon atoms.

Technical Problem

[0006]

In order to avoid use of an aromatic hydrocarbon solvent, which is one of the aforesaid problems associated with the background art,

an attempt to use an ionizing ionic compound in a suspended state in an aliphatic hydrocarbon solvent without dissolving it therein was made. In this case, however, olefin polymerization activity was sometimes low. The reason is assumed to be that since the ionizing ionic compound has low solubility in an aliphatic hydrocarbon solvent,

Claims:

1. A process for producing an olefin polymer, having a step comprising feeding an olefin polymerization catalyst solution, which is obtained by mixing

(A) ~~at least one~~ a metallocene compound ~~selected from a compound~~ represented by the general formula [A1] and/or a metallocene compound represented by the general formula [A2],

(B) a compound which is a compound that reacts with the metallocene compound (A) to form an ion pair, and is represented by the general formula [B1], and

(C) ~~at least one compound selected from (C-1)~~ an organoaluminum compound (C-1) and/or ~~(C-2)~~ an organoaluminum oxy compound (C-2),

with (D) a saturated hydrocarbon solvent under the following conditions (i) to (iv),

to a polymerization reactor and solution-polymerizing an olefin in the polymerization reactor;

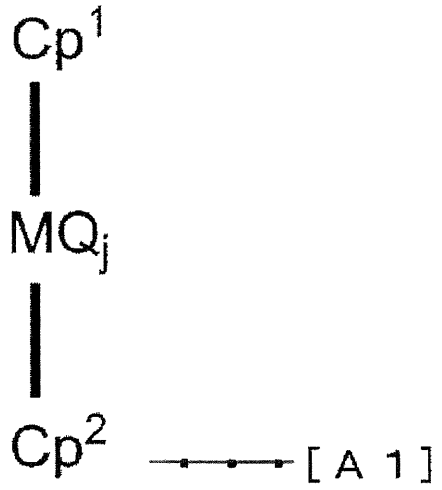
(i) the amount of the metallocene compound (A) added to 1 liter of the saturated hydrocarbon solvent (D) is 0.02 to 0.6 mmol,

(ii) the molar ratio ((C)/(A)) of an aluminum atom in the compound (C) added to the saturated hydrocarbon solvent (D) to the metallocene compound (A) is 33 to 5000,

(iii) the amount of an aluminum atom in the compound (C) added to 1 liter of the saturated hydrocarbon solvent (D) is 3 to 1000 mmol, and

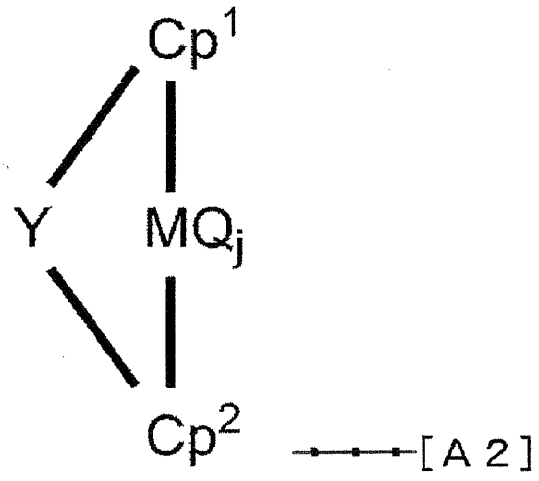
(iv) the molar ratio ((B)/(A)) of the compound (B) added to the saturated hydrocarbon solvent (D) to the metallocene compound (A) is 1 to 15;

[Chem. 1]



[A 1]

[Chem. 2]



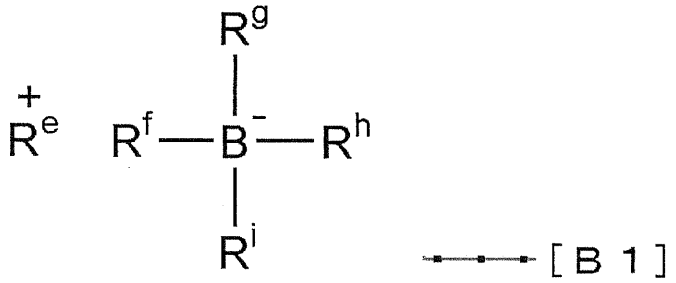
[A 2]

wherein, in the formulas [A1] and [A2], M is an atom of the periodic table Group 4 or Group 5, Q is a halogen atom, a hydrocarbon group, a halogenated hydrocarbon group, a neutral conjugated or non-conjugated diene, an anionic ligand or a neutral ligand capable of being coordinated with a lone electron pair, j is an integer of

1 to 4, when j is an integer of 2 or greater, plural Q ~~may be~~are the same as or different from each other, and Cp^1 and Cp^2 ~~may be~~are the same as or different from each other and are each a cyclopentadienyl group or a substituted cyclopentadienyl group capable of forming a sandwich structure together with M; and

Y in the formula [A2] is a divalent hydrocarbon group of 1 to 30 carbon atoms, a divalent halogenated hydrocarbon group of 1 to 20 carbon atoms, a divalent silicon-containing group, a divalent germanium-containing group, a divalent tin-containing group, -O-, -CO-, -S-, -SO-, $-SO_2-$, -Ge-, -Sn-, $-NR^a-$, $-P(R^a)-$, $-P(O)(R^a)-$, $-BR^a-$ or $-AlR^a-$ ~~(~~wherein R^a is a hydrocarbon group of 1 to 20 carbon atoms, a halogenated hydrocarbon group of 1 to 20 carbon atoms, a hydrogen atom, a halogen atom or a nitrogen compound residue in which one or two hydrocarbon groups of 1 to 20 carbon atoms are bonded to a nitrogen atom~~)~~;

[Chem. 3]



[B 1]

wherein, in the formula [B1], R^{e+} is carbenium cation, and R^f to R^i are each independently a hydrocarbon group of 1 to 20 carbon atoms or a halogenated hydrocarbon group of 1 to 20 carbon atoms.

2. The process for producing an olefin polymer as claimed in claim 1, wherein the compound (C) is a compound represented by the general formula [C1]:

[Chem. 4]

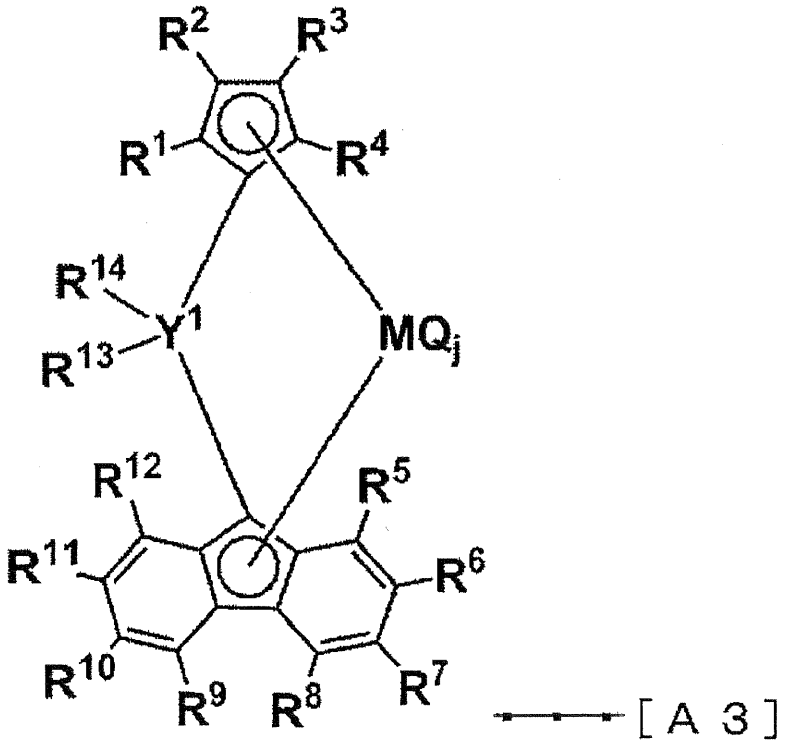


[C 1]

wherein, in the formula [C1], R is a straight-chain or branched alkyl group of 3 to 10 carbon atoms.

3. The process for producing an olefin polymer as claimed in claim 1 ~~or 2~~, wherein the metallocene compound (A) is a compound represented by the general formula [A3]:

[Chem. 5]



[A 3]

wherein, in the formula [A3], R^1, R^2, R^3, R^4, R^5, R^8, R^9 and R^{12} are each independently a hydrogen atom, a hydrocarbon group, a silicon-containing group or a hetero atom-containing group other than a silicon-containing group, and neighboring two groups of R^1 to R^4 ~~may be~~are optionally bonded to each other to form a ring;

R^6 and R^{11} are the same atoms or the same groups selected from hydrogen atoms, hydrocarbon groups, silicon-containing groups and hetero atom-containing groups other than silicon-containing groups, R^7 and R^{10} are the same atoms or the same groups selected from hydrogen atoms, hydrocarbon groups, silicon-containing groups and hetero atom-containing groups other than silicon-containing groups, R^6 and R^7 ~~may be~~are optionally bonded to each other to form a ring, and R^{10} and R^{11} ~~may be~~are optionally bonded to each other to form a ring, with the proviso that there is no case where all of R^6, R^7, R^{10} and R^{11} are hydrogen atoms;

R^{13} and R^{14} are each an alkyl group or an aryl group, and R^{13} and R^{14} ~~may be~~are optionally bonded to each other to form a ring;

M is a titanium atom, a zirconium atom or a hafnium atom;

Y^1 is a carbon atom or a silicon atom; and

Q is a halogen atom, a hydrocarbon group, a halogenated hydrocarbon group, a neutral conjugated or non-conjugated diene of 4 to 20 carbon atoms, an anionic ligand or a neutral ligand capable of being coordinated with a lone electron pair, j is an integer of 1 to 4, ~~and~~ or when j is an integer of 2 or greater, plural Q may be the same as or different from each other.

4. The process for producing an olefin polymer as claimed in ~~any one of~~ claim~~s~~ 1 ~~to 3~~, wherein the ~~reaction~~ saturated hydrocarbon solvent used in the solution polymerization is ~~at least one hydrocarbon solvent selected from~~ an aliphatic hydrocarbon solvent and/or an alicyclic hydrocarbon solvent.

5. The process for producing an olefin polymer as claimed in claim 1, wherein R^f to R^i in the formula [B1] are each independently an aromatic hydrocarbon groups of 6 to 20 carbon atoms or a halogenated aromatic hydrocarbon groups of 6 to 20 carbon atoms.