Claims

1. An ethylene copolymer, wherein the ethylene copolymer comprises an ethylene structural unit derived from ethylene and a conjugated diene structural unit derived from a conjugated diene; based on the total amount of the ethylene copolymer, the content of the conjugated diene structural unit is 30-45 mol%, and the content of a 1,2-polymerized vinyl structural unit formed by 1,2-polymerization of the conjugated diene and having side chain double bonds is 20-40 mol%; the total amount of a 1,2-polymerized structural unit is 95 mol% or more based on the total amount of the conjugated diene structural unit in the ethylene copolymer, and the ethylene copolymer has a weight average molecular weight of 30,000 to 300,000.

2. The ethylene copolymer according to claim 1, wherein the content of the 1,2-polymerized vinyl structural unit is 20-35 mol% based on the total amount of the ethylene copolymer, or
the content of the 1,2-polymerized vinyl structural unit is 21-30 mol% based on the total amount of the ethylene copolymer.

3. The ethylene copolymer according to claim 1 or 2, wherein the content of the 1,2-polymerized vinyl structural unit is 55-90% based on the content of the conjugated diene structural unit, or
the content of the 1,2-polymerized vinyl structural unit is 60-88% based on the content of the conjugated diene structural unit, or
the content of the 1,2-polymerized vinyl structural unit is 63-85% based on the content of the conjugated diene structural unit.

4. The ethylene copolymer according to any one of claims 1 to 3, wherein the total amount of the 1,2-polymerized structural unit is 98 mol% or more based on the total amount of the conjugated diene structural unit in the ethylene copolymer, or
the total amount of the 1,2-polymerized structural unit is 100 mol% based on the total amount of the conjugated diene structural unit in the ethylene copolymer.

5. The ethylene copolymer according to any one of claims 1 to 4, wherein the content of the conjugated diene structural unit is 25-40 mol% based on the total amount of the ethylene

copolymer, or
the content of the conjugated diene structural unit is 30-35 mol% based on the total amount of the ethylene copolymer.

6. The ethylene copolymer according to any one of claims 1 to 5, wherein a molar ratio of a 1,2-cyclopentane ring structural unit to a 1,2-cyclopropane ring structural unit in the conjugated diene structural unit of the copolymer is 0.1-3:1, or
a molar ratio of a 1,2-cyclopentane ring structural unit to a 1,2-cyclopropane ring structural unit in the conjugated diene structural unit of the copolymer is 0.3-2.5:1, or
a molar ratio of a 1,2-cyclopentane ring structural unit to a 1,2-cyclopropane ring structural unit in the conjugated diene structural unit of the copolymer is 0.4-2:1, or
a molar ratio of a 1,2-cyclopentane ring structural unit to a 1,2-cyclopropane ring structural unit in the conjugated diene structural unit of the copolymer is 0.5-1.8:1.

7. The ethylene copolymer according to any one of claims 1 to 6, wherein the ethylene copolymer has a weight average molecular weight of 30,000 to 250,000, or
the ethylene copolymer has a weight average molecular weight of 30,000 to 200,000, or
the ethylene copolymer has a weight average molecular weight of 40,000 to 150,000, or
the copolymer has a molecular weight distribution index of 3.5 or less, or
the copolymer has a molecular weight distribution index of 3.2 or less, or
the copolymer has a molecular weight distribution index of 1.5-3.

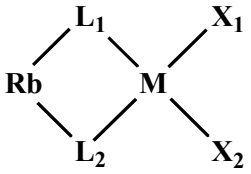
8. The ethylene copolymer according to any one of claims 1 to 7, wherein the glass transition temperature of the ethylene copolymer is in the range of -50°C to -15°C, or
the glass transition temperature of the ethylene copolymer is in the range of -40°C to -20°C.

9. The ethylene copolymer according to any one of claims 1 to 8, wherein the conjugated diene is butadiene.

10. A method for the preparation of the ethylene copolymer according to claim 1, comprising

contacting ethylene with a conjugated diene in the presence of a polymerization catalyst, wherein the polymerization catalyst comprises a component A and a component B,

the component A is selected from metal compounds represented by a formula 1,



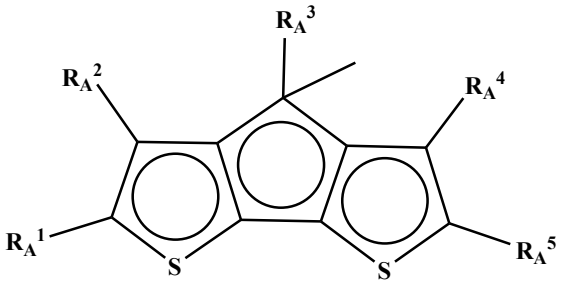
(Formula 1)

in the formula 1, M is a metal atom selected from a Group IVB,

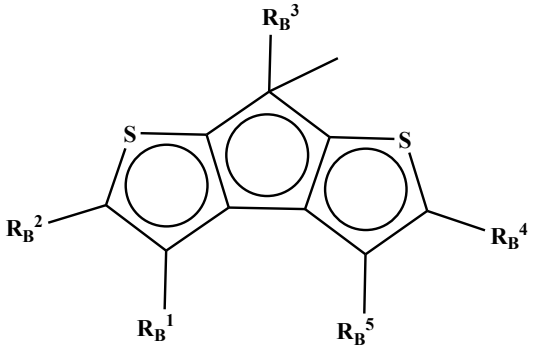
X_1 and X_2 are the same or different, and are each independently a halogen atom,

Rb is a Group IVA element-containing divalent group,

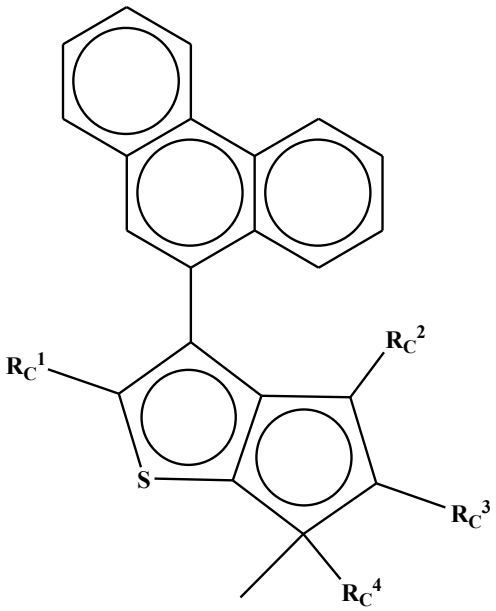
L_1 and L_2 are the same or different, and are each independently selected from groups represented by formulae 3 to 6,



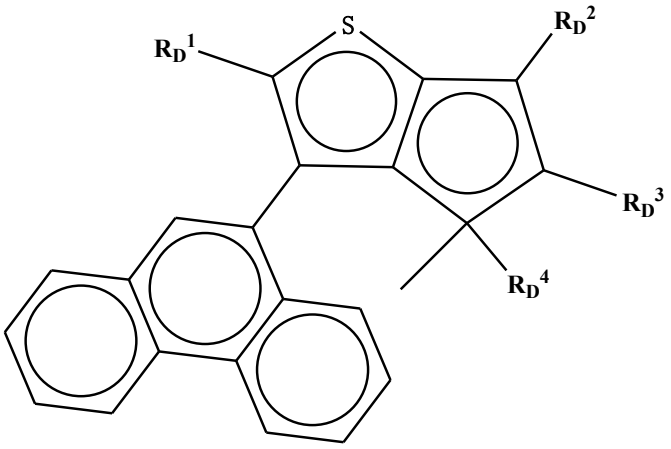
Formula 3



Formula 4



Formula 5



Formula 6

in the formula 3, R_A^1, R_A^2, R_A^3, R_A^4 and R_A^5 are the same or different, and are each

independently a hydrogen atom or C_1-C_{20} alkyl,

in the formula 4, R_B^1, R_B^2, R_B^3, R_B^4 and R_B^5 are the same or different, and are each independently a hydrogen atom or C_1-C_{20} alkyl,

in the formula 5, R_C^1, R_C^2, R_C^3 and R_C^4 are the same or different, and are each independently a hydrogen atom or C_1-C_{20} alkyl, and

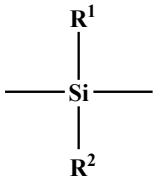
in the formula 6, R_D^1, R_D^2, R_D^3 and R_D^4 are the same or different, and are each independently a hydrogen atom or C_1-C_{20} alkyl; and

the component B comprises an aluminoxane.

11. The method according to claim 10, wherein in the formula 1, M is a zirconium atom; and/or in the formula 1, X_1 and X_2 are each independently a chlorine atom.

12. The method according to claim 10 or 11, wherein in the formula 1, Rb is a divalent group containing silicon, or

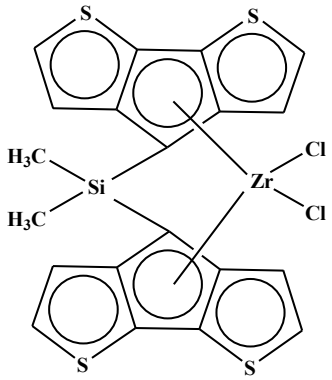
in the formula 1, Rb is a divalent group represented by a formula 2,



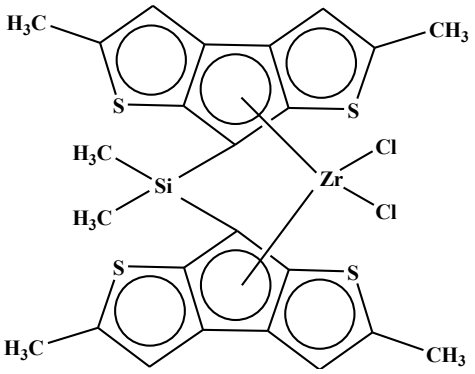
(Formula 2)

in the formula 2, R^1 and R^2 are the same or different, and are each independently C_1-C_{10} alkyl.

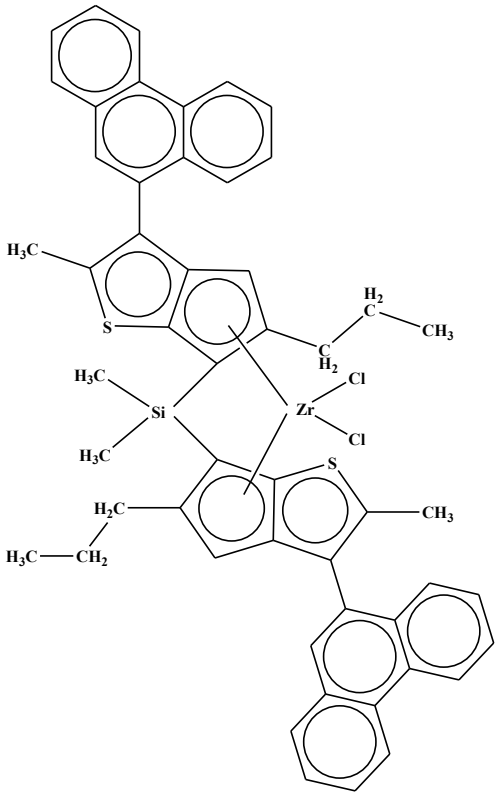
13. The method according to claim 10, wherein the component A is one or two or more selected from metal compounds represented by formulae 7 to 10:



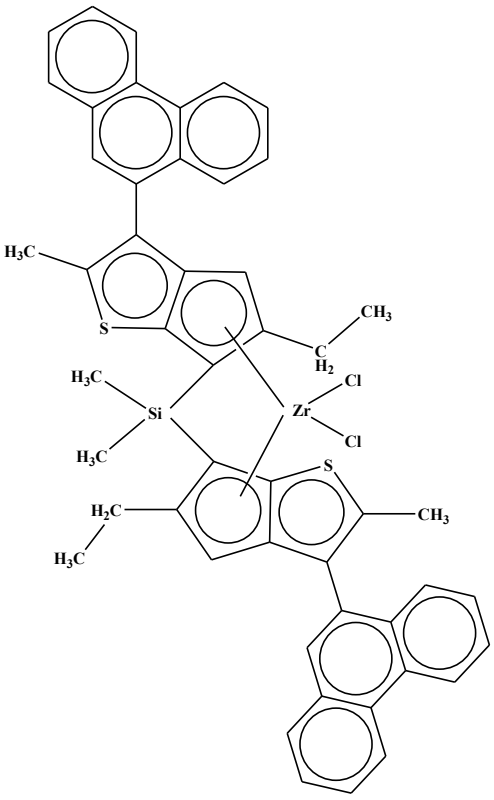
Formula 7



Formula 8



Formula 9



Formula 10 .

14. The method according to any one of claims 10 to 13, wherein a molar ratio of the component A to the component B is 1:0.1-5000.

15. The method according to any one of claims 10 to 14, wherein the component A is used in an amount of 0.1-100 μmol relative to 1 mol of the conjugated diene.

16. The method according to any one of claims 10 to 15, wherein the conjugated diene is butadiene.

17. The method according to any one of claims 10 to 16, wherein the contacting is carried out at a temperature of -50°C to 150°C, and the pressure of ethylene is 0-100 MPa, the pressure being in terms of a gauge pressure.

18. The method according to any one of claims 10 to 17, wherein the contacting is carried out in the presence of a molecular weight regulator, and the molecular weight regulator is used in an amount so that the prepared ethylene copolymer has a weight average molecular weight of 30,000

to 300,000, or

the contacting is carried out in the presence of a molecular weight regulator, and the molecular weight regulator is used in an amount so that the prepared ethylene copolymer has a weight average molecular weight of 30,000 to 250,000, or

the contacting is carried out in the presence of a molecular weight regulator, and the molecular weight regulator is used in an amount so that the prepared ethylene copolymer has a weight average molecular weight of 30,000 to 200,000, or

the contacting is carried out in the presence of a molecular weight regulator, and the molecular weight regulator is used in an amount so that the prepared ethylene copolymer has a weight average molecular weight of 40,000 to 150,000.

19. An ethylene copolymer, prepared by the method according to any one of claims 10 to 18.

20. A composition, comprising an ethylene copolymer and a crosslinking agent, wherein the ethylene copolymer is the ethylene copolymer according to any one of claims 1 to 9 and 19.

21. A crosslinked polymer, formed by crosslinking the ethylene copolymer according to any one of claims 1 to 9 and 19.

22. A tire, having at least one constituent element comprising the ethylene copolymer according to any one of claims 1 to 9 and 19, the composition according to claim 20, or the crosslinked polymer according to claim 21.