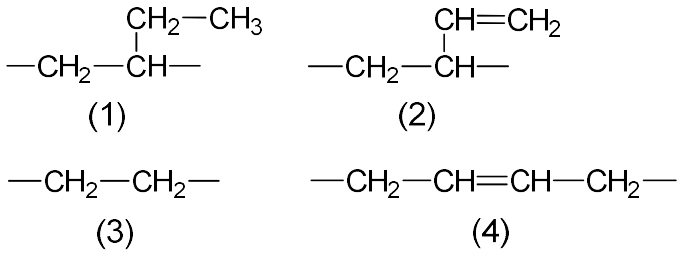
Claims

1. A conjugated diene-based polymer

which has a value α defined by the following mathematical expression (i):

$\alpha=(p+(0.5\times r))/(p+q+(0.5\times r)+s)$ … (i); of 0.65 to 0.97, wherein p, q, r, and s represent molar amounts of the structural units represented by the following formulas (1) to (4), respectively:

[F1]



; in the polymer, wherein

the conjugated diene-based polymer comprises, in an amount of 30 to 75 mass%, polymer (A1) which comprises a multi-branched structure having 4 or more molecular chains; and

the vinyl bond content of the structural units derived from 1,3-butadiene in the conjugated diene-based polymer is 65 mol% or less;

the polymer (A1) has a functional group comprising at least one element selected from the group consisting of nitrogen, oxygen, and sulfur at one or both of a terminal and a branching point of the polymer (A1).

2. The conjugated diene-based polymer according to claim 1, which comprises a structural unit derived from an

aromatic vinyl compound.

3. The conjugated diene-based polymer according to claim 2, which comprises the structural unit derived from the aromatic vinyl compound in a relative amount of more than 0 mass% and 45 mass% or less.

4. The conjugated diene-based polymer according to any one of claims 1 to 3, wherein

the polymer (A1) comprises a structure in which 4 or more molecular chains are bonded to a moiety derived from a coupling agent; and

the coupling agent comprises at least one element selected from the group consisting of nitrogen, oxygen, sulfur, and silicon.

5. The conjugated diene-based polymer according to any one of claims 1 to 4, wherein the polymer (A1) has a secondary or tertiary amino group at a terminal thereof.

6. The conjugated diene-based polymer according to any one of claims 1 to 5, which further comprises polymer (A2) of a linear-chain form or a branched form having 3 or less branches.

7. The conjugated diene-based polymer according to claim 6, wherein the polymer (A2) comprises a linear-chain polymer which has a secondary or tertiary amino group at one terminal, and a functional group comprising at least one element selected from the group consisting of nitrogen, phosphorus, oxygen, sulfur, and silicon at the other terminal.

8. A method for producing a conjugated diene-based polymer, the method comprising:

a polymerization step of polymerizing a monomer comprising a conjugated diene compound in the presence of a metallic compound comprising an alkali metal or an alkaline earth metal, to thereby yield conjugated diene-based polymer (I) having an active terminal;

a reaction step of reacting the conjugated diene-based polymer (I) with compound [B] having 4 or more functional groups which can react with the active terminal, to thereby yield conjugated diene-based polymer (II); and

a hydrogenation step of performing hydrogenation, so that the hydrogenation ratio of structural units derived from the conjugated diene compound comprised in the conjugated diene-based polymer (II) is adjusted to 65 to 97%, wherein

the reaction step is a step of reacting the conjugated diene-based polymer (I) with the compound [B], so that the conjugated diene-based polymer (II) contains a polymer comprising a multi-branched structure having 4 or more molecular chains in an amount of 30 to 75 mass%, and the vinyl bond content of the structural units derived from 1,3-butadiene in the conjugated diene-based polymer (II) is 65 mol% or less; and

at least one species of the metallic compound and the compound [B] comprises at least one element selected from the group consisting of nitrogen, oxygen, and sulfur.

9. The method for producing a conjugated diene-based

polymer according to claim 8, wherein the metallic compound is a metal amide compound comprising an alkali metal or an alkaline earth metal.

10. The method for producing a conjugated diene-based polymer according to claim 8 or 9, wherein

the conjugated diene-based polymer (II) further comprises a polymer of a linear-chain form or a branched form having 3 or less branches;

after the reaction step and before the hydrogenation step, the production method further comprises a step of forming a polymer of a linear-chain form or a branched form having 3 or less branches which polymer has a functional group comprising at least one element selected from the group consisting of nitrogen, phosphorus, oxygen, sulfur, and silicon, by reacting a compound which comprises at least one element selected from the group consisting of nitrogen, phosphorus, oxygen, sulfur, and silicon and which can react with the active terminal, with a linear-chain polymer comprised in the conjugated diene-based polymer (II).

11. A polymer composition comprising the conjugated diene-based polymer as recited in any one of claims 1 to 7 or the conjugated diene-based polymer produced through the production method as recited in any one of claims 8 to 10; and an inorganic filler.

12. A cross-linked product formed by cross-linking the polymer composition as recited in claim 11.

13. A tire comprising a tread and a sidewall, wherein

one or both of the tread and the sidewall is formed by use of the polymer composition as recited in claim 11.