CLAIMS

1. A modified conjugated diene-based polymer having:

an unimodal shape molecular weight distribution curve by gel permeation chromatography (GPC), and

a molecular weight distribution (PDI; MWD) of 1.0 to less than 1.7,

wherein the modified conjugated diene-based polymer includes a functional group derived from a modifier represented by Formula 1 below at one terminal, and a functional group derived from a modification initiator at the other terminal,

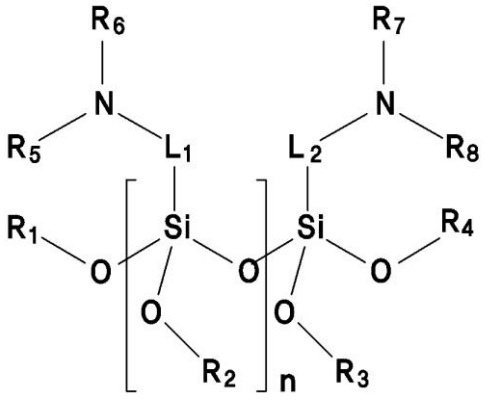
wherein the modification initiator is one or more compounds selected from the group consisting of:

a compound represented by the following Formula 2a;

a reaction product of a compound selected from the compounds represented by the following Formula 2b to Formula 2e with an organometallic compound; and

a compound represented by the following Formula 2f:

[Formula 1]



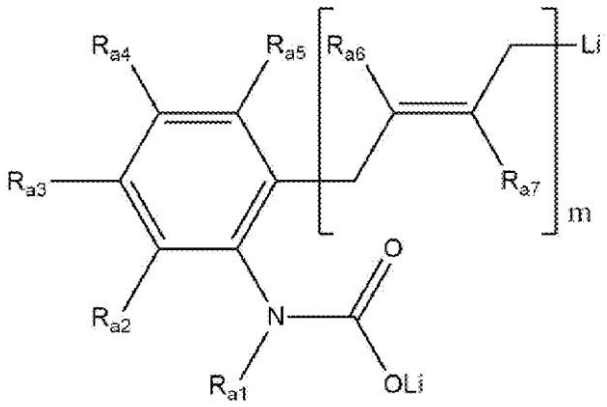
in Formula 1,

R_1 to R_8 are each independently an alkyl group of 1 to 20 carbon atoms,

L_1 and L_2 are each independently an alkylene group of 1 to 20 carbon atoms, and

n is an integer of 2 to 4,

[Formula 2a]



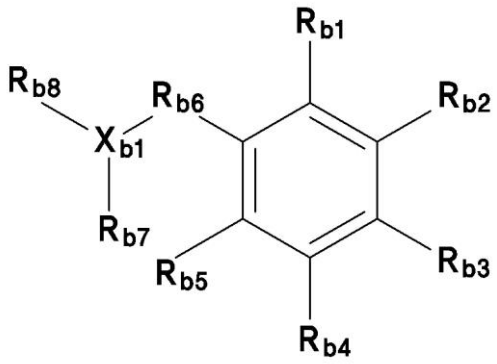
in Formula 2a,

R_{a1} to R_{a7} are each independently a hydrogen atom; an alkyl group of 1 to 20 carbon atoms; a cycloalkyl group of 3 to 20 carbon atoms; an aryl group of 6 to 20 carbon atoms; an

arylalkyl group of 7 to 20 carbon atoms; an alkylaryl group of 7 to 20 carbon atoms; or a heteroatom-containing alkyl group of 1 to 20 carbon atoms, and

m is an integer of 0 to 3,

[Formula 2b]



in Formula 2b,

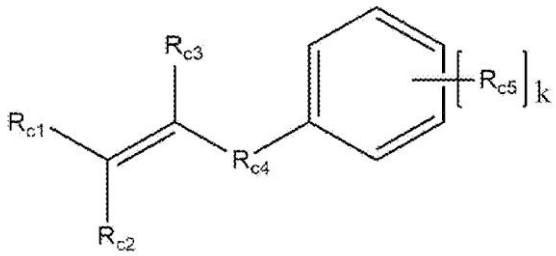
X_{b1} is N or O, in case where X_{b1} is O, R_{b7} or R_{b8} is not present,

R_{b1} to R_{b5} are each independently a hydrogen atom; an alkyl group of 1 to 20 carbon atoms; a cycloalkyl group of 3 to 20 carbon atoms; an aryl group of 6 to 20 carbon atoms; an arylalkyl group of 7 to 20 carbon atoms; or an alkylaryl group of 7 to 20 carbon atoms; or adjacent two substituents may be connected to form one aliphatic or aromatic ring,

R_{b6} is a single bond; or an alkylene group of 1 to 12 carbon atoms, and

R_{b7} and R_{b8} are each independently an alkyl group of 1 to 14 carbon atoms or an aryl group of 6 to 14 carbon atoms,

[Formula 2c]



in Formula 2c,

R_{c1} to R_{c3} are each independently a hydrogen atom; an alkyl group of 1 to 30 carbon atoms; an alkenyl group of 2 to 30 carbon atoms; an alkynyl group of 2 to 30 carbon atoms; a heteroalkyl group of 1 to 30 carbon atoms, a heteroalkenyl group of 2 to 30 carbon atoms; a heteroalkynyl group of 2 to 30 carbon atoms; a cycloalkyl group of 5 to 30 carbon atoms; an aryl group of 6 to 30 carbon atoms; or a heterocyclic group of 3 to 30 carbon atoms,

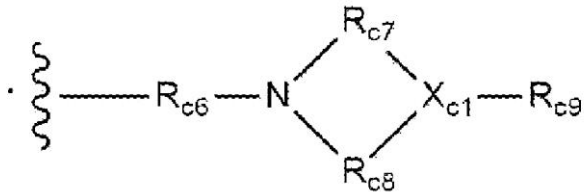
R_{c4} is a single bond; a substituted with a substituent or unsubstituted alkylene group of 1 to 20 carbon atoms; a substituted with a substituent or unsubstituted cycloalkylene group of 5 to 20 carbon atoms; or a substituted with a substituent or unsubstituted arylene group of 6 to 20 carbon atoms, where the substituent is an alkyl group of 1 to 10 carbon atoms, a cycloalkyl group of 5 to 10 carbon atoms, or an aryl group of 6 to 20 carbon atoms,

R_{c5} is an alkyl group of 1 to 30 carbon atoms; an alkenyl group of 2 to 30 carbon atoms; an alkynyl group of 2 to 30 carbon atoms; a heteroalkyl group of 1 to 30 carbon atoms; a heteroalkenyl group of 2 to 30 carbon atoms; a

heteroalkynyl group of 2 to 30 carbon atoms; a cycloalkyl group of 5 to 30 carbon atoms; an aryl group of 6 to 30 carbon atoms; a heterocyclic group of 3 to 30 carbon atoms; or a functional group represented by the following Formula 2c-1 or Formula 2c-2, and

k is an integer of 1 to 5, at least one R_{c5} is a functional group represented by Formula 1a or Formula 1b, in case where k is an integer of 2 to 5, multiple R_{c5} may be the same or different,

[Formula 2c-1]



in Formula 2c-1,

R_{c6} is a substituted with a substituent or unsubstituted alkylene group of 1 to 20 carbon atoms; a substituted with a substituent or unsubstituted cycloalkylene group of 5 to 20 carbon atoms; or a substituted with a substituent or unsubstituted arylene group of 6 to 20 carbon atoms, where the substituent is an alkyl group of 1 to 10 carbon atoms, a cycloalkyl group of 5 to 10 carbon atoms, or an aryl group of 6 to 20 carbon atoms,

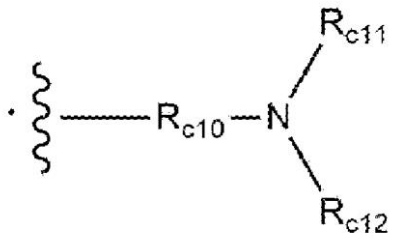
R_{c7} and R_{c8} are each independently an alkylene group of 1 to 20 carbon atoms, which is substituted with an alkyl

group of 1 to 10 carbon atoms, a cycloalkyl group of 5 to 10 carbon atoms, or an aryl group of 6 to 20 carbon atoms, or unsubstituted,

R_{c9} is a hydrogen atom; an alkyl group of 1 to 30 carbon atoms; an alkenyl group of 2 to 30 carbon atoms; an alkynyl group of 2 to 30 carbon atoms; a heteroalkyl group of 1 to 30 carbon atoms; a heteroalkenyl group of 2 to 30 carbon atoms; a heteroalkynyl group of 2 to 30 carbon atoms; a cycloalkyl group of 5 to 30 carbon atoms; an aryl group of 6 to 30 carbon atoms; or a heterocyclic group of 3 to 30 carbon atoms, and

X_{c1} is N, O or S atom, in case where X_{c1} is O or S, R_{c9} is not present,

[Formula 2c-2]



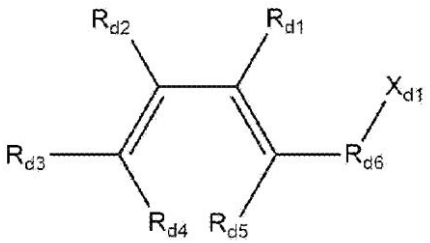
in Formula 2c-2,

R_{c10} is a substituted with a substituent or unsubstituted alkylene group of 1 to 20 carbon atoms; a substituted with a substituent or unsubstituted cycloalkylene group of 5 to 20 carbon atoms; or a substituted with a substituent or unsubstituted arylene group of 6 to 20 carbon atoms, where the substituent is an alkyl group of 1 to 10

carbon atoms, a cycloalkyl group of 5 to 10 carbon atoms, or an aryl group of 6 to 20 carbon atoms, and

R_{c11} and R_{c12} are each independently an alkyl group of 1 to 30 carbon atoms; an alkenyl group of 2 to 30 carbon atoms; an alkynyl group of 2 to 30 carbon atoms; a heteroalkyl group of 1 to 30 carbon atoms; a heteroalkenyl group of 2 to 30 carbon atoms; a heteroalkynyl group of 2 to 30 carbon atoms; a cycloalkyl group of 5 to 30 carbon atoms; an aryl group of 6 to 30 carbon atoms; or a heterocyclic group of 3 to 30 carbon atoms,

[Formula 2d]



in Formula 2d,

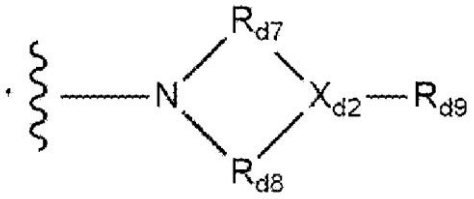
R_{d1} to R_{d5} are each independently a hydrogen atom; an alkyl group of 1 to 30 carbon atoms; an alkenyl group of 2 to 30 carbon atoms; an alkynyl group of 2 to 30 carbon atoms; a heteroalkyl group of 1 to 30 carbon atoms; a heteroalkenyl group of 2 to 30 carbon atoms; a heteroalkynyl group of 2 to 30 carbon atoms; a cycloalkyl group of 5 to 30 carbon atoms; an aryl group of 6 to 30 carbon atoms; or a heterocyclic group of 3 to 30 carbon atoms,

R_{d6} is an alkylene group of 1 to 20 carbon atoms, which

is substituted with an alkyl group of 1 to 30 carbon atoms; an alkenyl group of 2 to 30 carbon atoms; an alkynyl group of 2 to 30 carbon atoms; a heteroalkyl group of 1 to 30 carbon atoms, a heteroalkenyl group of 2 to 30 carbon atoms; a heteroalkynyl group of 2 to 30 carbon atoms; a cycloalkyl group of 5 to 30 carbon atoms; an aryl group of 6 to 30 carbon atoms; or a heterocyclic group of 3 to 30 carbon atoms or unsubstituted, and

X_{d1} is a functional group represented by the following Formula 2d-1 or Formula 2d-2,

[Formula 2d-1]



in Formula 2d-1,

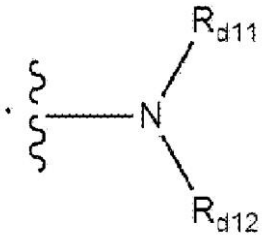
R_{d7} and R_{d8} are each independently an alkylene group of 1 to 20 carbon atoms, which is substituted with an alkyl group of 1 to 10 carbon atoms, a cycloalkyl group of 5 to 10 carbon atoms, or an aryl group of 6 to 20 carbon atoms or unsubstituted,

R_{d9} is a hydrogen atom; an alkyl group of 1 to 30 carbon atoms; an alkenyl group of 2 to 30 carbon atoms; an alkynyl group of 2 to 30 carbon atoms; a heteroalkyl group of 1 to 30 carbon atoms; a heteroalkenyl group of 2 to 30 carbon atoms;

a heteroalkynyl group of 2 to 30 carbon atoms; a cycloalkyl group of 5 to 30 carbon atoms; an aryl group of 6 to 30 carbon atoms; or a heterocyclic group of 3 to 30 carbon atoms, and

X_{d2} is N, O or S, in case where X_{d2} is O or S, R_{d9} is not present,

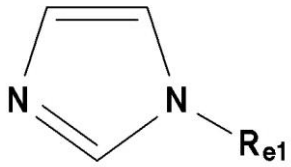
[Formula 2d-2]



in Formula 2d-2,

R_{d11} and R_{d12} are each independently an alkyl group of 1 to 30 carbon atoms; an alkenyl group of 2 to 30 carbon atoms; an alkynyl group of 2 to 30 carbon atoms; a heteroalkyl group of 1 to 30 carbon atoms; a heteroalkenyl group of 2 to 30 carbon atoms; a heteroalkynyl group of 2 to 30 carbon atoms; a cycloalkyl group of 5 to 30 carbon atoms; an aryl group of 6 to 30 carbon atoms; or a heterocyclic group of 3 to 30 carbon atoms,

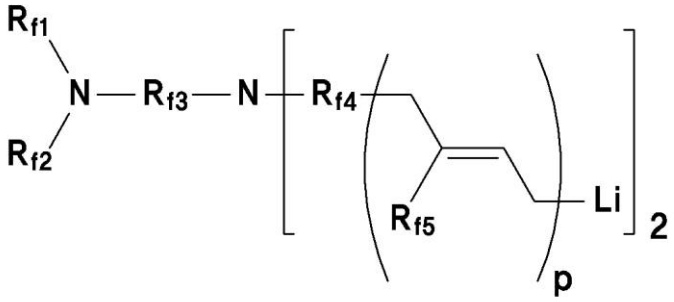
[Formula 2e]



in Formula 2e,

Re1 is an alkenyl group of 2 to 10 carbon atoms,

[Formula 2f]



in Formula 2f,

R_{f1}, R_{f2} and R_{f5} are each independently an alkyl group of 1 to 20 carbon atoms; a cycloalkyl group of 3 to 20 carbon atoms; an aryl group of 6 to 20 carbon atoms; an arylalkyl group of 7 to 20 carbon atoms; or an alkylaryl group of 7 to 20 carbon atoms,

R_{f3} and R_{f4} are each independently an alkylene group of 1 to 20 carbon atoms or an arylene group of 6 to 20 carbon atoms, and

p is an integer of 1 to 5.

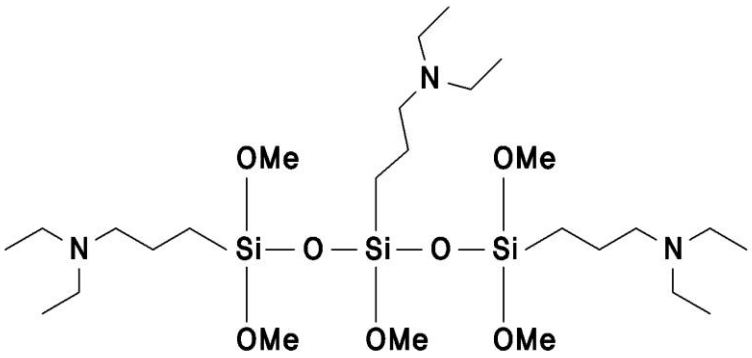
2. The modified conjugated diene-based polymer of claim 1, wherein, in Formula 1, R_1 to R_8 are each independently an alkyl group of 1 to 10 carbon atoms.

3. The modified conjugated diene-based polymer of claim 1, wherein, in Formula 1, R_1 to R_8 are each independently an alkyl group of 1 to 6 carbon atoms.

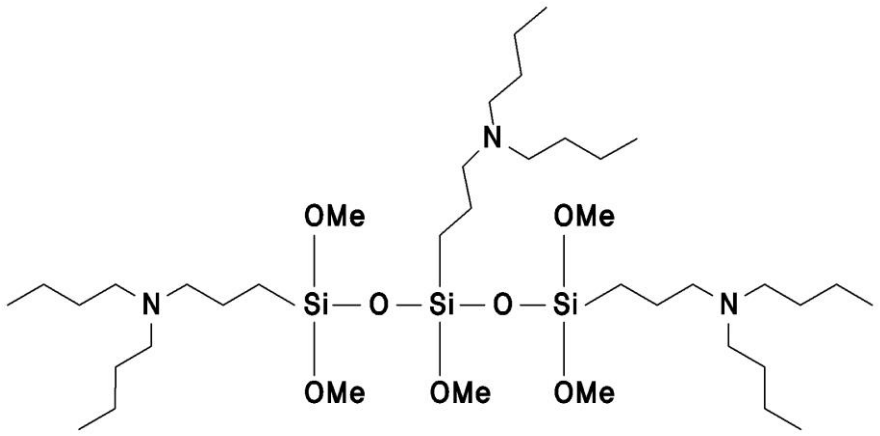
4. The modified conjugated diene-based polymer of claim 1, wherein, in Formula 1, R_1 to R_4 are methyl groups or ethyl groups, and R_5 to R_8 are alkyl groups of 1 to 10 carbon atoms.

5. The modified conjugated diene-based polymer of claim 1, wherein the modifier represented by Formula 1 is one or more selected from the group consisting of the following Formula 1a to Formula 1e:

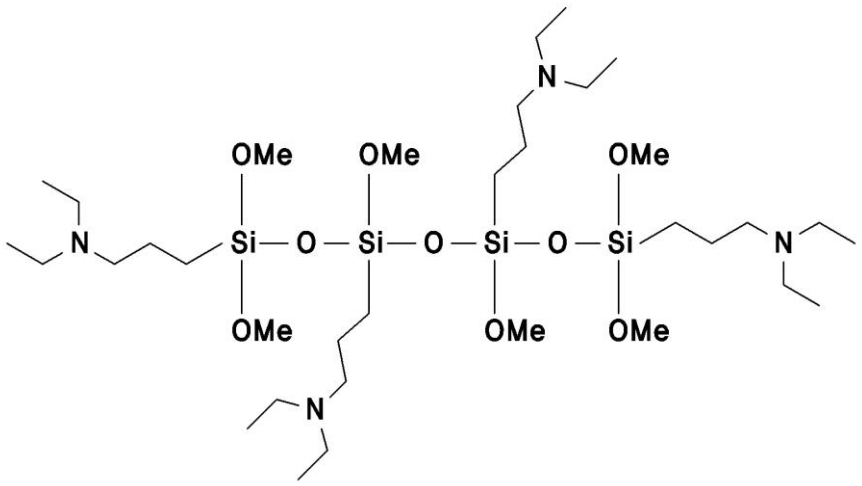
[Formula 1a]



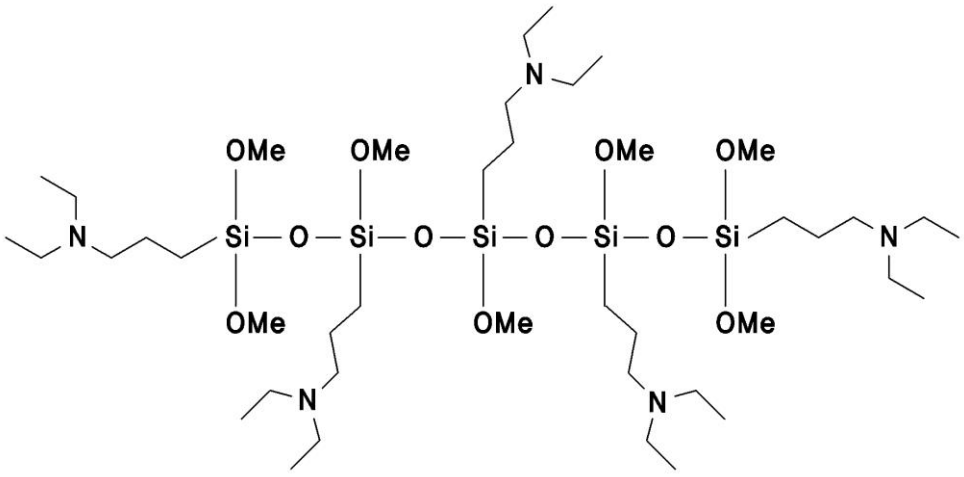
[Formula 1b]



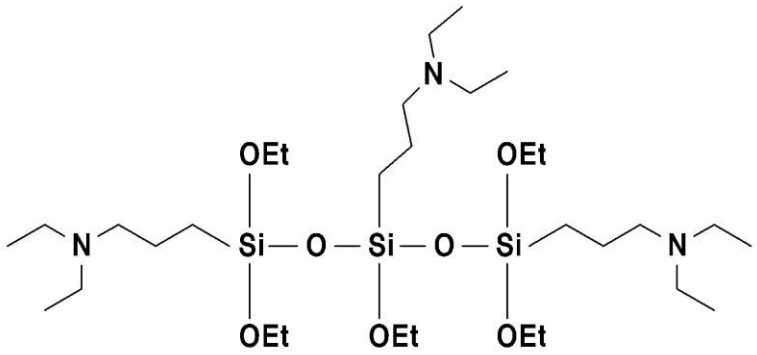
[Formula 1c]



[Formula 1d]



[Formula 1e]



in Formula 1a to Formula 1e, Me is a methyl group, and Et is an ethyl group.

6. The modified conjugated diene-based polymer of claim 1, wherein the modified conjugated diene-based polymer has a number average molecular weight (Mn) of 1,000 g/mol to 2,000,000 g/mol, and a weight average molecular weight (Mw) of 1,000 g/mol to 3,000,000 g/mol.

7. The modified conjugated diene-based polymer of claim 1, wherein the modified conjugated diene-based polymer has a Si content and a N content of 50 ppm or more, respectively, based on a weight.

8. The modified conjugated diene-based polymer of claim 1, wherein the modified conjugated diene-based polymer has a mooney stress relaxation ratio measured at 100°C of 0.7 to

3.0.

9. The modified conjugated diene-based polymer of claim 1, wherein a coupling number (C.N.) of the modified conjugated diene-based polymer satisfies $1<C.N<F$, where F is the number of functional groups of the modifier.