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PATENT DOCUMENTS

[0004] Patent Document 1: WO2013/018424

SUMMARY ~~OF THE INVENTION~~

PROBLEM TO BE SOLVED ~~BY THE INVENTION~~

[0005] In consideration of a recently increasing demand for the performance of tires for automobiles, new development of tires hereafter requires a rubber which can provide a cross-linked rubber having lower heat buildup than that of conventional rubbers such as the rubber disclosed in Patent Document 1.

[0006] The present ~~invention~~disclosure has been made in consideration of such a problem, and an object of the present ~~invention~~ disclosure is to provide a conjugated diene-based rubber which can be prepared into a rubber composition which is effectively prevented from adhering to rolls and can provide a cross-linked rubber having excellently low heat buildup and high operation stability.

MEANS FOR SOLVING PROBLEMS

[0007] The present inventors, who have conducted extensive research to achieve the above goal, have found that the goal can be achieved by preparing a conjugated diene-based rubber comprising a polymer block containing isoprene monomer unit as the main component and having a weight average molecular weight (Mw) in a specific range and a polymer block containing 1,3-butadiene monomer unit as the main component, at least one of the polymer blocks containing a unit of a vinyl compound having a functional group interactive with silica, and thus have completed the present ~~invention~~disclosure.

[0008] In other words, the present ~~invention~~ disclosure provides a conjugated diene-based rubber comprising a polymer block (A) containing isoprene

monomer unit as the main component and a polymer block (B) containing 1,3-butadiene monomer unit as the main component, wherein at least one of the polymer block (A) and the polymer block (B) contains a unit of a vinyl compound having a functional group interactive with silica, the polymer block (A) has a weight average molecular weight (Mw) in the range of 1,000 to 30,000, and the entire conjugated diene-based rubber has a weight average molecular weight (Mw) in the range of 50,000 to 5,000,000.

[0008a] In another aspect, there is provided a conjugated diene-based rubber comprising a polymer block (A) containing isoprene monomer unit as the main component, and a polymer block (B) containing 1,3-butadiene monomer unit as the main component,

wherein at least one of the polymer block (A) and the polymer block (B) contains a unit of a vinyl compound having a silicon atom-containing functional group,

the proportion of the unit of the vinyl compound having the silicon atom-containing functional group is 0.01 to 20 wt% of the total monomer units forming the conjugated diene-based rubber, and

the polymer block (A) has a weight average molecular weight (Mw) in the range of 1,000 to 30,000, and the entire conjugated diene-based rubber has a weight average molecular weight (Mw) in the range of 50,000 to 5,000,000.

[0009] In the conjugated diene-based rubber according to the present ~~invention~~disclosure, the proportion of the unit of the vinyl compound having a functional group interactive with silica is preferably 0.01 to 20 wt% of the total monomer units forming the conjugated diene-based rubber.

In the conjugated diene-based rubber according to the present ~~invention~~disclosure, at least one of the polymer block (A) and the polymer block (B) preferably includes aromatic vinyl monomer unit.

In the conjugated diene-based rubber according to the present ~~invention~~disclosure, the polymer block (B) preferably has a hetero atom-

containing terminal functional group.

[0010] In another aspect, ~~T~~the present ~~invention~~ disclosure provides a method of producing the conjugated diene-based rubber according to any of the ~~embodiments~~ examples above, the method comprising: a step of polymerizing a monomer (a) including isoprene in an inert solvent in the presence of a polymerization initiator to form the polymer block (A) having an active terminal; and a step of mixing and continuously polymerizing the polymer block (A) having an active terminal with a monomer (b) including 1,3-butadiene to yield a conjugated diene-based polymer chain including the polymer block (A) and the polymer block (B) and having an active terminal, wherein at least one of the monomer (a) and the monomer (b) contains a vinyl compound having a functional group interactive with silica.

Preferably, the method of producing the conjugated diene-based rubber according to the present ~~invention~~ disclosure further comprises a step of reacting a

hetero atom-containing compound with the active terminal of the conjugated diene-based polymer chain having an active terminal.

[0011] In another aspect, ~~T~~the present ~~invention~~disclosure also provides a rubber composition comprising a rubber ingredient containing the conjugated diene-based rubber according to any of the ~~embodiments~~ examples above, and silica.

Preferably, the rubber composition according to the present ~~invention~~ disclosure further comprises a cross-linking agent.

[0012] Furthermore, the present ~~invention~~ disclosure provides a cross-linked rubber prepared by cross-linking the rubber composition as defined above, and a tire comprising the cross-linked rubber as defined above.

EFFECTS ~~OF INVENTION~~

[0013] The present ~~invention~~ disclosure can provide a conjugated diene-based rubber which can be prepared into a rubber composition which is effectively prevented from adhering to rolls and can provide a cross-linked rubber having excellently low heat buildup and high operation stability. The present ~~invention~~ disclosure can also provide a method of producing such a conjugated diene-based rubber, and a rubber composition, a cross-linked rubber, and a tire comprising such a conjugated diene-based rubber.

DESCRIPTION OF EMBODIMENTS

[0014] <Conjugated diene-based rubber>

The conjugated diene-based rubber according to the present invention comprises a polymer block (A) containing isoprene monomer unit as the main component and a polymer block (B) containing 1,3-butadiene monomer unit as the main component,

wherein at least one of the polymer block (A) and the polymer block (B) contains a unit of a vinyl compound having a functional group interactive with silica, and

the polymer block (A) has a weight average molecular weight (Mw) in

CLAIMS

1. A conjugated diene-based rubber comprising a polymer block (A) containing isoprene monomer unit as the main component, and a polymer block (B) containing 1,3-butadiene monomer unit as the main component,

wherein at least one of the polymer block (A) and the polymer block (B) contains a unit of a vinyl compound having a silicon atom-containing functional group ~~interactive with silica~~, ~~and~~

the proportion of the unit of the vinyl compound having the silicon atom-containing functional group is 0.01 to 20 wt% of the total monomer units forming the conjugated diene-based rubber, and

the polymer block (A) has a weight average molecular weight (Mw) in the range of 1,000 to 30,000, and the entire conjugated diene-based rubber has a weight average molecular weight (Mw) in the range of 50,000 to 5,000,000.

~~2. The conjugated diene-based rubber according to claim 1,~~

~~wherein the proportion of the unit of the vinyl compound having a functional group interactive with silica is 0.01 to 20 wt% of the total monomer units forming the conjugated diene-based rubber.~~

2~~3~~. The conjugated diene-based rubber according to claim 1 ~~or 2~~,

wherein at least one of the polymer block (A) and the polymer block (B) contains aromatic vinyl monomer unit.

3~~4~~. The conjugated diene-based rubber according to ~~any one of~~ claim~~s~~ 1 ~~to 3~~,

wherein the polymer block (B) has a hetero atom-containing terminal functional group.

~~5~~4. A method of producing the conjugated diene-based rubber according to ~~any one of~~ claim~~s~~ 1~~ to 4~~, the method comprising the steps of:

polymerizing a monomer (a) including isoprene in an inert solvent in the presence of a polymerization initiator to form the polymer block (A) having an active terminal; and

mixing and continuously polymerizing the polymer block (A) having an active terminal with a monomer (b) including 1,3-butadiene to yield a conjugated diene-based polymer chain including the polymer block (A) and the polymer block (B) and having an active terminal,

wherein at least one of the monomer (a) and the monomer (b) contains a vinyl compound having a functional group interactive with silica.

~~6~~5. The method of producing the conjugated diene-based rubber according to claim ~~5~~4, the method further comprising a step of reacting a hetero atom-containing compound with the active terminal of the conjugated diene-based polymer chain having an active terminal.

~~7~~6. A rubber composition comprising a rubber ingredient containing the conjugated diene-based rubber according to ~~any one of~~ claim~~s~~ 1~~ to 4~~, and silica.

~~8~~7. The rubber composition according to claim ~~7~~6, further comprising a cross-linking agent.

~~9~~8. A cross-linked rubber prepared by cross-linking the rubber composition according to claim ~~6~~7~~ or 8~~.

~~10~~9. A tire comprising the cross-linked rubber according to claim ~~9~~8.