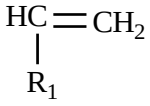
Claims

1. A butyl rubber, comprising structural unit derived from isobutylene, structural unit derived from conjugated diene, and optionally structural unit derived from aryl olefin, at least a part of the conjugated diene is isoprene, and the aryl olefin is selected from a group consisting of compound shown in Formula I,



(Formula I)

in Formula I, R_1 is an aryl group of C_6-C_{20};
in the butyl rubber, a part of the structural unit derived from conjugated diene is used as a grafting site such that a part of the molecular chain of the butyl rubber is a grafted chain, and a remaining part of the molecular chain of the butyl rubber is linear chain; and
a peak molecular weight of the butyl rubber is 0.9 million to 2.6 million, and content of the butyl rubber of which Log (MW) is greater than or equal to 6 is 30 to 80% by weight.

2. The butyl rubber according to claim 1, wherein the main chain of the grafted chain comprises the structural unit derived from conjugated diene and the structural unit derived from aryl olefin, or the main chain of the grafted chain comprises the structural unit derived from conjugated diene and the structural unit derived from styrene, or the main chain of the grafted chain is derived from styrene-butadiene polymer and styrene-isoprene polymer; and
branch of the grafted chain comprises structural unit derived from the isobutylene and structural unit derived from the isoprene.

3. The butyl rubber according to claim 1, wherein the linear chain comprises structural unit derived from isobutylene and structural unit derived from isoprene.

4. The butyl rubber according to claim 1, wherein in the butyl rubber, content of the structural unit derived from conjugated diene is from 0.5 to 2.5 mol%, and based on the total amount of the butyl rubber, content of the structural unit derived from aryl olefin is from 0.01 to 3mol%, or 0.05-0.6 mol%, or 0.1-0.5 mol%.

5. The butyl rubber according to claim 1, wherein a Mooney viscosity ML(1+8)125^{o}C of the butyl rubber is 30 to 70, or 40 to 60.

6. The butyl rubber according to claim 1, wherein the content of the butyl rubber of which Log (MW) is greater than or equal to 6 is 35 to 75% by weight, or 40 to 70% by weight.

7. The butyl rubber according to claim 1, wherein the peak molecular weight of the butyl rubber is 0.95 million to 2.3 million, or 1 million to 2.1 million, or 1.1 million to 1.9 million.

8. The butyl rubber according to claim 1, wherein the molecular weight of the butyl rubber exhibits bimodal distribution, and a Log (MW) value of a high molecular weight shoulder peak is between 6 and 7.5.

9. A method for preparing a butyl rubber according to claim 1, comprising a step of contacting isobutylene and isoprene with at least one grafting agent in at least one diluent in the presence of at least one Lewis acid and at least one compound capable of providing protons under cationic polymerization conditions,
the Lewis acid is selected from a group consisting of compound shown in Formula III,

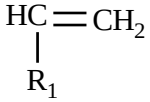
$AlR^5_nX^1_{(3-n)}$ (Formula III)

in Formula III, R^5 present in a total of n are the same or different and each of R^5 is an alkyl group of C_1-C_8; X^1 present in a total of 3-n are the same or different and each of X^1 is one selected from a group consisting of halogen groups, or -Cl; n is 1, 2 or 3; and
the compound capable of providing protons is selected from a group consisting of protonic acids.

10. The method according to claim 9, wherein based on the total amount of the isobutylene and the isoprene, the content of the isobutylene is 85 to 99% by weight, or 90 to 98% by weight, or 93 to 97.5% by weight; the content of the isoprene is 1 to 15% by weight, or 2 to 10% by weight, or 2.5 to 7% by weight.

11. The method according to claim 9, wherein addition amount of the grafting agent is 0.01 to 3% by weight of the isobutylene, or 0.1 to 2% by weight of the isobutylene, or 0.15 to 1% by weight of the isobutylene, or 0.2 to 0.8% by weight of the isobutylene.

12. The method according to claim 9, wherein the grafting agent comprises polymerizable structural unit with cationically polymerizable group and optionally aryl olefin structural unit derived from compound shown in Formula I,



(Formula I)

in Formula I, R_1 is an aryl group of C_6-C_{20};
or, the grafting agent comprises polymerizable structural unit derived from conjugated diene and styrene structural unit derived from styrene, or the conjugated diene is butadiene and/or isoprene;
or, the grafting agent is selected from a group consisting of styrene-butadiene copolymer and a styrene-isoprene copolymer, or the styrene-butadiene copolymer.

13. The method according to claim 12, wherein in the grafting agent, content of the polymerizable structural unit is 1 to 15 mol%, or 2 to 14 mol%, or 2.5 to 12 mol%.

14. The method according to claim 9, wherein a weight-average molecular weight of the grafting agent is 10,000 to 300,000, or 20,000 to 200,000, or 50,000 to 180,000; and molecular weight distribution index is 1 to 2.5, or 1.1 to 2.

15. The method according to claim 9, wherein molar ratio of the Lewis acid to isobutylene is 1:500 to 1:5,000, or 1:1,000 to 1:4,000, or 1:1,500 to 1:3,500.

16. The method according to claim 9, wherein molar ratio of the compound capable of providing protons to the Lewis acid is from 0.01:1 to 1:1, or 0.04:1 to 0.8:1, or 0.08:1-0.2:1.

17. The method according to claim 9, wherein the Lewis acid is ethylaluminum dichloride and/or diethylaluminum chloride.

18. The method according to claim 9, wherein the diluent is selected from a group consisting of alkanes and halogenated alkanes, or selected from a group consisting of halogenated alkanes, or selected from a group consisting of C_1-C_{10} halogenated alkanes.

19. The method according to claim 9, wherein the contacting is carried out at a temperature ranging from -120 ^oC to -50 ^oC, or at a temperature ranging from -110 ^oC to - 80 ^oC, or at a temperature ranging from -100 ^oC to -90 ^oC.

20. A halogenated butyl rubber, comprising a rubber matrix and a halogen element bonded to the rubber matrix, characterized in that the rubber matrix is the butyl rubber of any one of claims 1 to 8.

21. The halogenated butyl rubber according to claim 20, wherein the halogen element is a chlorine element and/or a bromine element.

22. The halogenated butyl rubber according to claim 20, wherein based on the total amount of the halogenated butyl rubber, the content of the halogen element is in a range of 0.2 to 2 mol%, or in a range of 0.4 to 1.5 mol%.

23. A composition, comprising a butyl rubber and/or a halogenated butyl rubber, a vulcanizing agent and optionally at least one additive agent, wherein the additive agent is selected from a group consisting of vulcanization accelerator and carbon black, the butyl rubber is the butyl rubber according to any one of claims 1 to 8, and the halogenated butyl rubber is a halogenated butyl rubber comprising a rubber matrix and a halogen element bonded to the rubber matrix, characterized in that the rubber matrix is the butyl rubber.

24. A rubber product, formed by vulcanizing the composition according to claim 23.

25. An automobile tire inner liner, formed by the halogenated butyl rubber according to claim 20.

26. An automobile tire inner tube, formed by the butyl rubber according to any one of claims 1 to 8, or a halogenated butyl rubber comprising a rubber matrix and a halogen element bonded to the rubber matrix, characterized in that the rubber matrix is the butyl rubber.

27. A curing bladder, formed by the butyl rubber according to any one of claims 1 to 8.