Claims

1. A liquid butadiene-styrene polymer, wherein based on the total amount of the liquid butadiene-styrene polymer, in the liquid butadiene-styrene polymer, the content of a styrene structural unit is 15-30 wt%, the content of a butadiene structural unit is 70-85 wt%, and the content of a 1,2-structural unit is 60-80 wt%; and the content of a cyclized 1,2-structural unit is 20-60 wt% based on the total amount of the 1,2-structural unit in the liquid butadiene-styrene polymer.

2. The liquid butadiene-styrene polymer according to claim 1, wherein the content of the cyclized 1,2-structural unit is 30-55 wt%, preferably 40-50 wt% based on the total amount of the 1,2-structural unit in the liquid butadiene-styrene polymer; and
preferably, a molar ratio of the cyclized 1,2-structural unit to the 1,2-structural unit in the liquid butadiene-styrene polymer is 0.4-0.9 : 1, preferably 0.5-0.7 : 1.

3. The liquid butadiene-styrene polymer according to claim 1 or 2, wherein the liquid butadiene-styrene polymer has a number-average molecular weight of 2000-7000, preferably 2500-6500, more preferably 3500-4500; and the liquid butadiene-styrene polymer has a molecular weight distribution index of 1-1.15, preferably 1-1.09.

4. The liquid butadiene-styrene polymer according to any one of claims 1 to 3, wherein the dynamic viscosity of the liquid butadiene-styrene polymer at 45°C is 230-700 P, preferably 300-600 P, more preferably 400-500 P.

5. The liquid butadiene-styrene polymer according to any one of claims 1 to 4, wherein the content of the 1,2-structural unit in the liquid butadiene-styrene polymer is 65-80 wt%, preferably 68-75 wt% based on the total amount of the liquid butadiene-styrene polymer.

6. The liquid butadiene-styrene polymer according to any one of claims 1 to 5, wherein the liquid butadiene-styrene polymer is a random copolymer;
preferably, the content of a styrene block in the liquid butadiene-styrene polymer is 0.1 wt% or

less, preferably 0.05 wt% or less based on the total amount of the liquid butadiene-styrene polymer; and

preferably, the liquid butadiene-styrene polymer has a glass transition temperature of -40°C to -10°C, preferably -30°C to -15°C.

7. A liquid butadiene-styrene polymer, wherein based on the total amount of the liquid butadiene-styrene polymer, in the liquid butadiene-styrene polymer, the content of a 1,2-structural unit is 60-80 wt%; the content of a cyclized 1,2-structural unit is 20-60 wt% based on the total amount of a 1,2-structural unit in the liquid butadiene-styrene polymer, and a coefficient of linear thermal expansion of the liquid butadiene-styrene polymer is $(45\text{-}80)\times10^{-6}$m/m/°C, the coefficient of linear thermal expansion is determined by thermomechanical analysis according to the method specified in GB/T 36800.2-2018.

8. The liquid butadiene-styrene polymer according to claim 7, wherein based on the total amount of the liquid butadiene-styrene polymer, in the liquid butadiene-styrene polymer, the content of a styrene structural unit is 15-30 wt%, the content of a butadiene structural unit is 70-85 wt%;

preferably, the content of the cyclized 1,2-structural unit is 30-55 wt%, preferably 40-50 wt% based on the total amount of the 1,2-structural unit in the liquid butadiene-styrene polymer;

preferably, a molar ratio of the cyclized 1,2-structural unit to the 1,2-structural unit in the liquid butadiene-styrene polymer is 0.4-0.9 : 1, preferably 0.5-0.7 : 1;

preferably, the liquid butadiene-styrene polymer has a number-average molecular weight of 2000-7000, preferably 2500-6500, more preferably 3500-4500; and the liquid butadiene-styrene polymer has a molecular weight distribution index of 1-1.15, preferably 1-1.09;

preferably, the dynamic viscosity of the liquid butadiene-styrene polymer at 45°C is 230-700P, preferably 300-600P, more preferably 400-500P;

preferably, the content of the 1,2-structural unit in the liquid butadiene-styrene polymer is 65-80 wt%, preferably 68-75 wt% based on the total amount of the liquid butadiene-styrene polymer;

preferably, the liquid butadiene-styrene polymer is a random copolymer;

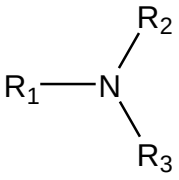
preferably, the content of a styrene block in the liquid butadiene-styrene polymer is 0.1 wt% or less, preferably 0.05 wt% or less based on the total amount of the liquid butadiene-styrene polymer; and

preferably, the liquid butadiene-styrene polymer has a glass transition temperature of -40°C to -10°C, preferably -30°C to -15°C; and

preferably, a coefficient of linear thermal expansion of the liquid butadiene-styrene polymer is (45-75)×10^{-6} m/m/°C, preferably (50-70)×10^{-6} m/m/°C, more preferably (55-65)×10^{-6} m/m/°C.

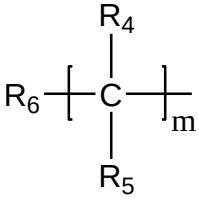
9. A preparation method for a liquid butadiene-styrene polymer, comprising contacting 1,3-butadiene and styrene with a structure modifier and an anionic polymerization initiator in a polymerization solvent under anionic polymerization reaction conditions to obtain a polymerization solution comprising a butadiene-styrene polymer, wherein the contacting is carried out at a temperature of 85-130°C; the structure modifier comprises a component A and a component B, wherein the component A is a tertiary amine, the component B is an alkali metal alkoxide, and a molar ratio of the component B to the component A is 0.1-0.5 : 1; and the polymerization solvent comprises an aliphatic heterocyclic solvent.

10. The method according to claim 9, wherein the component A is one or two or more selected from compounds shown in a formula I,



(Formula I)

in the formula I, R_2 and R_3 are the same or different, and are each independently C_1-C_6 alkyl, and R_1 is a monovalent group shown in a formula II,



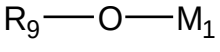
(Formula II)

in the formula II, m is an integer of 1-5, R_4 and R_5 are the same or different, and are each

independently a hydrogen atom or C_1-C_6 alkyl, and R_6 is -NR_7R_8 or C_3-C_6 oxacycloalkyl, wherein R_7 and R_8 are the same or different, and are each independently C_1-C_6 alkyl, and

preferably, the component A is N,N,N',N'-tetramethylethylenediamine and/or N,N-dimethyltetrahydrofurfurylamine.

11. The method according to claim 9 or 10, wherein the component B is one or two or more selected from compounds shown in a formula III,



(Formula III)

in the formula III, R_9 is C_1-C_{20} alkyl, C_1-C_{20} alkyl with a heteroatom-containing substituent, or C_6-C_{30} aryl, and

M_1 is an alkali metal atom;

preferably, the heteroatom-containing substituent is heteroatom-containing cycloalkyl, and the heteroatom is preferably an oxygen atom, a sulfur atom or a nitrogen atom, more preferably the oxygen atom; and

preferably, the component B is one or more of sodium tetrahydrofurfurylate, sodium tert-amylate, sodium tert-butoxide, sodium n-hexylate and sodium mentholate.

12. The method according to any one of claims 9 to 11, wherein the molar ratio of the component B to the component A is 0.15-0.45 : 1, preferably 0.2-0.4 : 1.

13. The method according to any one of claims 9 to 12, wherein the component B is used in an amount of 0.15-0.5 mol relative to 1 mol of the anionic polymerization initiator.

14. The method according to any one of claims 9 to 13, wherein the contacting is carried out at a temperature of 88-100°C.

15. The method according to any one of claims 9 to 14, wherein the anionic polymerization initiator is used in an amount such that the prepared liquid butadiene-styrene polymer has a number-average molecular weight of 2000-7000, preferably 2500-6500, more preferably 3500-4500;

preferably, the anionic polymerization initiator is an organolithium initiator, preferably one or two or more selected from compounds shown in a formula IV,

$R_{10}Li$ (Formula IV)

in the formula IV, R_{10} is C_1-C_6 alkyl, C_3-C_{12} cycloalkyl, C_7-C_{14} aralkyl, or C_6-C_{12} aryl; and more preferably, the anionic polymerization initiator is n-butyllithium and/or sec-butyllithium.

16. The method according to any one of claims 9 to 15, wherein the polymerization solvent is tetrahydrofuran.

17. A liquid butadiene-styrene polymer prepared by the method according to any one of claims 9 to 16.

18. A composition, comprising a liquid butadiene-styrene polymer and at least one additive, wherein the liquid butadiene-styrene polymer is the liquid butadiene-styrene polymer according to any one of claims 1 to 8 and 17.

19. The composition according to claim 18, wherein the additive comprises an antioxidant.

20. A polymer coating, comprising the liquid butadiene-styrene polymer according to any one of claims 1 to 8 and 17, or the composition according to any one of claims 18 and 19.

21. An adhesive, comprising the liquid butadiene-styrene polymer according to any one of claims 1 to 8 and 17, or the composition according to any one of claims 18 and 19.

22. A cross-linking agent, comprising the liquid butadiene-styrene polymer according to any one of claims 1 to 8 and 17, or the composition according to any one of claims 18 and 19.

23. Application of the liquid butadiene-styrene polymer according to any one of claims 1 to 8 and 17, or the composition according to any one of claims 18 and 19 as a cross-linking agent, an adhesive or an electrical insulating material.