Claims

1. A process for preparing a polyisobutene, the process comprising

conducting a polymerization in a reaction medium comprising an organic diluent and at least one polymerizable monomer in the presence of an initiator system or catalyst to form an organic medium comprising an elastomer, the organic diluent and optionally residual monomers, wherein the elastomer forms a suspension of primary particles; and

contacting said suspension of primary particles with an aqueous medium comprising at least one LCST compound having a cloud point of 0 to 100°C determined by at least one of the following methods:

DIN EN 1890 of September 2006, method A,

DIN EN 1890 of September 2006, method C,

DIN EN 1890 of September 2006, method E,

DIN EN 1890 of September 2006, method A wherein the amount of compound tested is reduced from 1g per 100 ml of distilled water to 0.05 g per 100 ml of distilled water, and

DIN EN 1890 of September 2006, method A wherein the amount of compound tested is reduced from 1g per 100 ml of distilled water to 0.2 g per 100 ml of distilled water

thereby forming an aqueous slurry of elastomer particles,

wherein

the primary particles obtained during the polymerization agglomerate to form secondary particles, and

the polymerizable monomer includes an isoolefin monomer having from 4 to 16 carbon atoms.

2. The process according to claim 1, wherein the polymerizable monomer comprises isobutene.

3. The process according to claim 1, wherein the organic diluent includes at least one hydrochlorocarbon selected from the group consisting of methyl chloride, methylene chloride, and ethyl chloride.

4. The process according to claim 1, wherein the organic diluent includes at least one hydrofluorocarbon represented by formula $C_xH_yF_z$, where x is an integer from 1 to 40 and y and z are integers of at least one.

5. The process according to claim 1, wherein the organic diluent includes at least one hydrofluorocarbon selected from the group consisting of fluoromethane; difluoromethane; trifluoromethane; fluoroethane; 1,1-difluoroethane; 1,2-difluoroethane; 1,1,1-trifluoroethane; 1,1-,2-trifluoroethane; 1,1,2,2-tetrafluoroethane; 1,1,1,2,2-pentafluoroethane; 1-fluoropropane; 2-fluoropropane; 1,1-difluoropropane; 1,2-difluoropropane; 1,3-difluoropropane; 2,2-difluoropropane; 1,1,1-trifluoropropane; 1,1,2-trifluoropropane; 1,1,3-trifluoropropane; 1,2,2-trifluoropropane; 1,2,3-trifluoropropane; 1,1,1,2-tetrafluoropropane; 1,1,1,3-tetrafluoropropane; 1,1,2,2-tetrafluoropropane; 1,1,2,3-tetrafluoropropane; 1,1,3,3-tetrafluoropropane; 1,2,2,3-tetrafluoropropane; 1,1,1,2,2-pentafluoropropane; 1,1,1,2,3-pentafluoropropane; 1,1,1,3,3-pentafluoropropane; 1,1,2,2,3-

pentafluoropropane; 1,1,2,3,3-pentafluoropropane; 1,1,1,2,2,3-hexafluoropropane; 1,1,1,2,3,3-hexafluoropropane; 1,1,1,3,3,3-hexafluoropropane; 1,1,1,2,2,3,3-heptafluoropropane; 1,1,1,2,3,3,3-heptafluoropropane; 1-fluorobutane; 2-fluorobutane; 1,1-difluorobutane; 1,2-difluorobutane; 1,3-difluorobutane; 1,4-difluorobutane; 2,2-difluorobutane; 2,3-difluorobutane; 1,1,1-trifluorobutane; 1,1,2-trifluorobutane; 1,1,3-trifluorobutane; 1,1,4-trifluorobutane; 1,2,2-trifluorobutane; 1,2,3-trifluorobutane; 1,3,3-trifluorobutane; 2,2,3-trifluorobutane; 1,1,1,2-tetrafluorobutane; 1,1,1,3-tetrafluorobutane; 1,1,1,4-tetrafluorobutane; 1,1,2,2-tetrafluorobutane; 1,1,2,3-tetrafluorobutane; 1,1,2,4-tetrafluorobutane; 1,1,3,3-tetrafluorobutane; 1,1,3,4-tetrafluorobutane; 1,1,4,4-tetrafluorobutane; 1,2,2,3-tetrafluorobutane; 1,2,2,4-tetrafluorobutane; 1,2,3,3-tetrafluorobutane; 1,2,3,4-tetrafluorobutane; 2,2,3,3-tetrafluorobutane; 1,1,1,2,2-pentafluorobutane; 1,1,1,2,3-pentafluorobutane; 1,1,1,2,4-pentafluorobutane; 1,1,1,3,3-pentafluorobutane; 1,1,1,3,4-pentafluorobutane; 1,1,1,4,4-pentafluorobutane; 1,1,2,2,3-pentafluorobutane; 1,1,2,2,4-pentafluorobutane; 1,1,2,3,3-pentafluorobutane; 1,1,2,4,4-pentafluorobutane; 1,1,3,3,4-pentafluorobutane; 1,2,2,3,3-pentafluorobutane; 1,2,2,3,4-pentafluorobutane; 1,1,1,2,2,3-hexafluorobutane; 1,1,1,2,2,4-hexafluorobutane; 1,1,1,2,3,3-hexafluorobutane, 1,1,1,2,3,4-hexafluorobutane; 1,1,1,2,4,4-hexafluorobutane; 1,1,1,3,3,4-hexafluorobutane; 1,1,1,3,4,4-hexafluorobutane; 1,1,1,4,4,4-hexafluorobutane; 1,1,2,2,3,3-hexafluorobutane; 1,1,2,2,3,4-hexafluorobutane; 1,1,2,2,4,4-hexafluorobutane; 1,1,2,3,3,4-hexafluorobutane; 1,1,2,3,4,4-hexafluorobutane; 1,2,2,3,3,4-hexafluorobutane; 1,1,1,2,2,3,3-heptafluorobutane; 1,1,1,2,2,4,4-heptafluorobutane; 1,1,1,2,2,3,4-heptafluorobutane; 1,1,1,2,3,3,4-heptafluorobutane; 1,1,1,2,3,4,4-heptafluorobutane; 1,1,1,2,4,4,4-heptafluorobutane; 1,1,1,3,3,4,4-heptafluorobutane;

1,1,1,2,2,3,3,4-octafluorobutane; 1,1,1,2,2,3,4,4-octafluorobutane; 1,1,1,2,3,3,4,4-octafluorobutane; 1,1,1,2,2,4,4,4-octafluorobutane; 1,1,1,2,3,4,4,4-octafluorobutane; 1,1,1,2,2,3,3,4,4-nonafluorobutane; 1,1,1,2,2,3,4,4,4-nonafluorobutane; 1-fluoro-2-methylpropane; 1,1-difluoro-2-methylpropane; 1,3-difluoro-2-methylpropane; 1,1,1-trifluoro-2-methylpropane; 1,1,3-trifluoro-2-methylpropane; 1,3-difluoro-2-(fluoromethyl)propane; 1,1,1,3-tetrafluoro-2-methylpropane; 1,1,3,3-tetrafluoro-2-methylpropane; 1,1,3-trifluoro-2-(fluoromethyl)propane; 1,1,1,3,3-pentafluoro-2-methylpropane; 1,1,3,3-tetrafluoro-2-(fluoromethyl)propane; 1,1,1,3-tetrafluoro-2-(fluoromethyl)propane; fluorocyclobutane; 1,1-difluorocyclobutane; 1,2-difluorocyclobutane; 1,3-difluorocyclobutane; 1,1,2-trifluorocyclobutane; 1,1,3-trifluorocyclobutane; 1,2,3-trifluorocyclobutane; 1,1,2,2-tetrafluorocyclobutane; 1,1,3,3-tetrafluorocyclobutane; 1,1,2,2,3-pentafluorocyclobutane; 1,1,2,3,3-pentafluorocyclobutane; 1,1,2,2,3,3-hexafluorocyclobutane; 1,1,2,2,3,4-hexafluorocyclobutane; 1,1,2,3,3,4-hexafluorocyclobutane; and 1,1,2,2,3,3,4-heptafluorocyclobutane.

6. The process according to claim 1, wherein the organic diluent includes at least one hydrocarbon.

7. The process according to claim 1, wherein the organic diluent includes at least one hydrocarbon selected from the group consisting of propane, isobutane, pentane, methycyclopentane, isohexane, 2-methylpentane, 3-methylpentane, 2-methylbutane, 2,2-dimethylbutane, 2,3-dimethylbutane, 2-methylhexane, 3-methylhexane, 3-ethylpentane, 2,2-dimethylpentane, 2,3-dimethylpentane, 2,4-dimethylpentane, 3,3-dimethyl pentane, 2-methylheptane, 3-ethylhexane, 2,5-dimethylhexane, 2,2,4,-

trimethylpentane, octane, heptane, butane, ethane, methane, nonane, decane, dodecane, undecane, hexane, methyl cyclohexane, cyclopropane, cyclobutane, cyclopentane, methylcyclopentane, 1,1-dimethylcycopentane, cis-1,2-dimethylcyclopentane, trans-1,2-dimethylcyclopentane, trans-1,3-dimethyl-cyclopentane, ethylcyclopentane, cyclohexane, methylcyclohexane, benzene, toluene, xylene, ortho-xylene, para-xylene, and meta-xylene.

8. The process according to claim 1, wherein the reaction medium is polymerized in the presence of at least one Lewis acid and an initiator.

9. The process according to claim 8, wherein the Lewis acid is represented by formula MX_3, where M is a group 13 element and X is a halogen or formula $MR_{(m)}X_{(3-m)}$, where M is a group 13 element; X is a halogen; R is a monovalent hydrocarbon radical selected from the group consisting of C_1-C_{12} alkyl, C_6-C_{10} aryl, C_7-C_{14} arylalkyl, and C_7-C_{14} alkylaryl radicals; and m is an integer of 1 or 2.

10. The process according to claim 8, wherein the Lewis acid is selected from the group consisting of aluminum trichloride, aluminum tribromide, boron trifluoride, boron trichloride, boron tribromide, gallium trichloride, and indium trifluoride.

11. The process according to claim 8, wherein the initiator comprises at least one compound selected from the groups consisting of water, a hydrogen halide, a carboxylic acid, a carboxylic acid halide, a sulfonic acid, a sulfonic acid halide, an alcohol, a phenol, a tertiary alkyl halide, a tertiary aralkyl halide, a tertiary alkyl ester,

a tertiary aralkyl ester, a tertiary alkyl ether, a tertiary aralkyl ether, an alkyl halide, an aryl halide, an alkylaryl halide, and an arylalkylacid halide.

12. The process according to claim 8, wherein the initiator comprises at least one compound selected from the groups consisting of an ether, an amine, an N-heteroaromatic compound, an aldehyde, a ketone, a sulfone, a sulfoxide, a carboxylic acid ester, and an amide.

13. The process according to claim 1, wherein the at least one LCST compound is selected from the group consisting of poly(N-isopropylacrylamide), poly(N-isopropylacrylamide-co-N,N-dimethylacrylamide, poly(N-isopropylacrylamide)-alt-2-hydroxyethylmethacrylate, poly(N-vinylcaprolactam), poly(N,N-diethylacrylamide), poly[2-(dimethylamino)ethyl methacrylate], a poly(2-oxazoline) glyelastomer, poly(3-ethyl-N-vinyl-2-pyrrolidone), hydroxylbutyl chitosan, polyoxyethylene (20) sorbitan monostearate, polyoxyethylene (20) sorbitan monolaurate, polyoxyethylene (20) sorbitan monooleate, methyl cellulose, hydroxypropyl cellulose, hydroxyethyl methylcellulose, hydroxypropyl methylcellulose, a poly(ethylene glycol) methacrylate with 2 to 6 ethylene glycol units, a polyethyleneglycol-co-polypropylene glycol, an ethoxylated iso-C13H27-alcohol, a polyethylene glycol with 4 to 50 ethyleneglycol units, a polypropylene glycol with 4 to 30 propyleneglycol units, a polyethylene glycol monomethyl, dimethyl, monoethyl and diethyl ether with 4 to 50 ethyleneglycol units, and polypropylene glycol monomethyl, dimethyl, monoethyl and diethyl ether with 4 to 50 propyleneglycol units.

14. The process according to claim 1, wherein the at least one LCST compound is selected from the group consisting of methyl cellulose, hydroxypropyl cellulose, hydroxyethyl methylcellulose, and hydroxypropyl methylcellulose.

15. The process according to claim 1, wherein the primary particles have a particle size of about 0.1 to about 800 μm.

16. The process according to claim 1, wherein the secondary particles have a particle size of between 0.05 mm and 25 mm.

17. The process according to claim 1, wherein the polymerization is carried out at a temperature ranging from -110 °C to 20 °C.

18. The process according to claim 1, wherein the at least one LCST compound is a compound of formula (I):

$HO\text{-}[\text{-}CH_2\text{-}CH_2\text{-}O]_x\text{-}[\text{-}CH(CH_3)\text{-}CH_2\text{-}O]_y\text{-}[\text{-}CH_2\text{-}CH_2\text{-}O]_z\text{-}H$ (I)

where x is from 1 to 8, y is 3 to 10, z is from 1 to 8, and x+y+z is from 5 to 18.

19. The process according to claim 1, wherein 80% or more of the primary particles have a size ranging from 0.1 to 800 μm.

20. The process according to claim 1, wherein 80% or more of the primary particles have a size ranging from 0.25 to 500 μm.