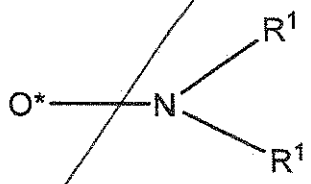
WHAT IS CLAIMED IS:

1. A process for making a polymer polyol, comprising forming a dispersion of solid polymer particles in the presence of a continuous liquid polyol phase and a stabilizer copolymer produced by copolymerizing an unsaturated polyether which has a molecular weight from 2000 to 20,000 and from 0.2 to about 1 polymerizable unsaturated groups per molecule with one or more copolymerizable low molecular weight unsaturated monomers in a controlled radical polymerization to form a stabilizer polymer or copolymer having a number average molecular weight from 30,000 to 500,000 and an average of 1 to 20 pendant polyether chains per molecule.

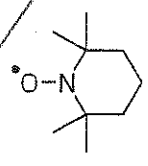
2. The process of claim 1, wherein the controlled radical polymerization is a nitroxide-mediated polymerization.

3. The process of claim 2, wherein the polymerization of the stabilizer polymer or copolymer is performed in the presence of a nitroxide radical having the structure:



wherein each R^1 group is independently an alkyl or substituted alkyl group provided that the R^1 groups together may form an aliphatic ring structure that includes the nitrogen atom within the aliphatic ring structure.

4. The process of claim 3, wherein the polymerization of the stabilizer polymer or copolymer is performed in the presence of a nitroxide radical having one or more of the following structures:



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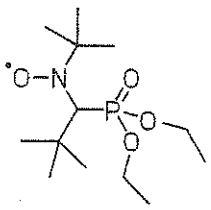
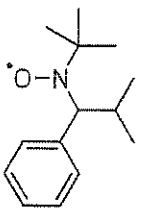


SG1



2,2,5-trimethyl-4-phenyl-3-azahexane-3-nitroxide

and a separate free radical initiator.

5. The process of claim 2, wherein the polymerization of the stabilizer copolymer is performed in the presence of an alkoxyamine.

6. The process of claim 1, wherein the controlled radical polymerization is a reversible addition-fragmentation chemical transfer (RAFT) polymerization.

7. The process of any preceding claim, wherein the stabilizer includes a block copolymer including a first block having a molecular weight of at least 18,000 that is devoid of pendant polyether groups and a second block which is a homopolymer of an unsaturated polyether which has a molecular weight from 2000 to 20,000 and from 0.2 to about 1.0 polymerizable unsaturated groups per molecule or a copolymer of said unsaturated polyether with one or more copolymerizable low molecular weight unsaturated monomers, the second block containing from 2 to 20 pendant polyether groups that each have a molecular weight from 2000 to 20,000.

8. The process of claim 7, wherein the pendant polyether groups are linear.

9. The process of claim 7, wherein at least some of the pendant polyether groups are branched.

10. The process of any of claims 7-9 wherein the first block is polystyrene.

11. A process for making a polymer polyol comprising forming a dispersion of solid polymer particles in the presence of a continuous liquid polyol phase and a stabilizer block copolymer having a first block having a molecular weight of at least 18,000 and which is devoid of pendant polyether groups and a second block which is a homopolymer of a branched or linear unsaturated polyether which has a molecular weight from 2000 to 20,000 and from 0.2 to about 1 polymerizable unsaturated group per molecule or a copolymer of said unsaturated polyether with one or more copolymerizable low molecular weight unsaturated monomers, the second block containing from 2 to 20 pendant branched or linear polyether groups that each have a molecular weight from 2000 to 20,000.

12. The process of claim 11, wherein the pendant polyether groups are linear.

13. The process of claim 11, wherein at least some of the pendant polyether groups are branched.

14. The process of any of claims 11-13 wherein the first block is polystyrene.

15. The process of any preceding claim, wherein the solid polymer particles are a thermoplastic that has a melting or softening temperature of at least 80°C.

16. The process of any preceding claim, wherein the solid polymer particles are a homopolymer or copolymer of styrene.

17. The process of any preceding claim, wherein the liquid polyol phase includes a polyether polyol.

18. The process of claim 17, wherein the polyether polyol is a poly(propylene oxide) homopolymer, random copolymer of propylene oxide and ethylene oxide in which the poly(ethylene oxide) content is from about 1 to about 30% by weight; an ethylene oxide-capped poly(propylene oxide) polymers or an ethylene oxide-capped random copolymers of propylene oxide and ethylene oxide, wherein the polyether polyol contains an average of 1.8 to 8 hydroxyl groups/molecule, has an equivalent weight from 400 to 3000.

19. The process of any preceding claim wherein the dispersion is formed in a melt dispersion process which includes the steps of (a) mixing a melted thermoplastic polymer with the liquid polyol in the presence of the stabilizer under conditions sufficient to disperse the melted thermoplastic polymer in the form of droplets within a continuous phase of the liquid polyol and (b) cooling the dispersed polymer droplets in the polyol to solidify the polymer droplets and form the polymer polyol.

20. The process of any preceding claim wherein the dispersion is formed in an *in situ* polymerization process which includes the steps of polymerizing one or more low

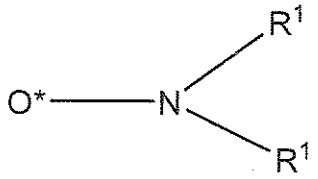
molecular weight monomers in the presence of the continuous polyol phase and in the presence of the stabilizer under conditions such that the low molecular weight monomer(s) polymerize to form polymer particles dispersed in the continuous polyol phase.

21. A polymer polyol formed in the process of any preceding claim.

WHAT IS CLAIMED IS:

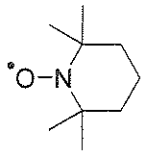
1. A process for making a polymer polyol, comprising forming a dispersion of solid polymer particles in the presence of a continuous liquid polyol phase and a stabilizer copolymer produced by copolymerizing an unsaturated polyether which has a molecular weight from 2000 to 20,000 and from 0.2 to 1 polymerizable unsaturated groups per molecule with one or more copolymerizable low molecular weight unsaturated monomers in a nitroxide-mediated or reversible addition-fragmentation chemical transfer (RAFT) polymerization to form a stabilizer polymer or copolymer having a number average molecular weight from 30,000 to 500,000 and an average of 1 to 20 pendant polyether chains per molecule.

2. The process of claim 1, wherein the polymerization of the stabilizer polymer or copolymer is performed in the presence of a nitroxide radical having the structure:



wherein each R^1 group is independently an alkyl or substituted alkyl group provided that the R^1 groups together may form an aliphatic ring structure that includes the nitrogen atom within the aliphatic ring structure.

3. The process of claim 2, wherein the polymerization of the stabilizer polymer or copolymer is performed in the presence of a nitroxide radical having one or more of the following structures:



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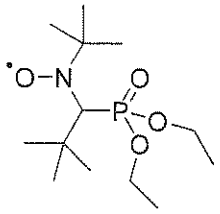

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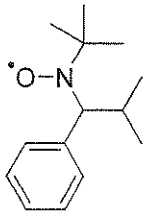

2,2,5-trimethyl-4-phenyl-3-azahexane-3-nitroxide

and a separate free radical initiator.

4. The process of claim 1, wherein the polymerization of the stabilizer copolymer is performed in the presence of an alkoxyamine.

5. The process of any preceding claim, wherein the stabilizer includes a block copolymer including a first block having a molecular weight of at least 18,000 that is devoid of pendant polyether groups and a second block which is a homopolymer of an unsaturated polyether which has a molecular weight from 2000 to 20,000 and from 0.2 to 1.0 polymerizable unsaturated groups per molecule or a copolymer of said unsaturated polyether with one or more copolymerizable low molecular weight unsaturated monomers, the second block containing from 2 to 20 pendant polyether groups that each have a molecular weight from 2000 to 20,000.

6. The process of claim 5 wherein the first block is polystyrene.

7. A process for making a polymer polyol comprising forming a dispersion of solid polymer particles in the presence of a continuous liquid polyol phase and a stabilizer block copolymer having a first block formed in a first polymerization step in which one or more low molecular weight monomers are polymerized in a controlled radical polymerization in the absence of an unsaturated polyether to produce a living macroinitiator, the first block having a molecular weight of at least 18,000 and being devoid of pendant polyether groups and a second block which is a homopolymer of a branched or linear unsaturated polyether which has a molecular weight from 2000 to 20,000 and from 0.2 to 1 polymerizable unsaturated group per molecule or a copolymer of said unsaturated polyether with one or more copolymerizable low molecular weight unsaturated monomers, the second block being formed by copolymerizing an unsaturated polyether with one or more low molecular weight monomers in the presence of the living macroinitiator and containing from 2 to 20 pendant branched or linear polyether groups that each have a molecular weight from 2000 to 20,000.

8. The process of claim 7 wherein the first block is polystyrene.

9. The process of any preceding claim, wherein the solid polymer particles are a thermoplastic that has a melting or softening temperature of at least 80°C and the liquid polyol phase includes a polyether polyol.

10. The process of any preceding claim, wherein the solid polymer particles are a homopolymer or copolymer of styrene.

11. The process of any preceding claim wherein the dispersion is formed in a melt dispersion process which includes the steps of (a) mixing a melted thermoplastic polymer with the liquid polyol in the presence of the stabilizer under conditions sufficient to disperse the melted thermoplastic polymer in the form of droplets within a continuous phase of the liquid polyol and (b) cooling the dispersed polymer droplets in the polyol to solidify the polymer droplets and form the polymer polyol.

12. The process of any preceding claim wherein the dispersion is formed in an *in situ* polymerization process which includes the steps of polymerizing one or more low molecular weight monomers in the presence of the continuous polyol phase and in the presence of the stabilizer under conditions such that the low molecular weight monomer(s) polymerize to form polymer particles dispersed in the continuous polyol phase.

13. A polymer polyol formed in the process of any preceding claim.