CLAIMS

1. A method of post-polymerization modification of ~~a~~ an isobutylene-based polymer, comprising the steps of:

(a) reacting a polymer with at least one nucleophile in a nucleophilic substitution reaction; and

(b) recovering a functionalized polymer;

wherein the reaction is substantially free of a solvent and wherein the reaction time of the nucleophilic substitution is 10 minutes to 15 minutes.

2. The method of claim 1, wherein the nucleophile is selected from the group consisting of thioacetate, phenoxide, alkoxide, carboxylate, thiolate, thiocarboxylate, dithiocarboxylate, thiourea, thiocarbamate, dithiocarbamate, xanthate, thiocyanate, and combinations thereof.

~~3. The method of any preceding claim, further comprising the step of mixing a metal salt or an organic cationic salt with the polymer.~~

~~4.~~3. The method of ~~any preceding~~ claim 1, wherein the nucleophilic substitution reaction is performed in the presence of a phase transfer catalyst.

~~5. The method of claims 1-3, wherein the nucleophilic substitution reaction is performed without the presence of a phase transfer catalyst~~

~~6.~~4. The method of claim ~~4 or 5~~ 3, wherein the phase transfer catalyst is tetrabutyl ammonium bromide. ~~a compound of a formula~~

~~$R_4N^+Br^-$.~~

~~7. The method of any preceding claim, further comprising the step of cooling the functionalized polymer to a temperature of about 22°C to about 25°C.~~

~~8.~~5. The method of claim ~~4 or 5~~ 3, wherein the phase transfer catalyst is selected from the group consisting of ammonium salts, heterocyclic ammonium salts, phosphonium salts, DL-α-Tocopherol methoxypolyethylene glycol succinate, DL-α-Tocopherol methoxypolyethylene glycol succinate solution, and combinations thereof.

~~9. The method of claim 4 or 5, wherein the phase transfer catalyst is tetrabutylammonium halide;~~

~~wherein the halide of the tetrabutylammonium halide is selected from the group consisting of fluoride, chloride, bromide, and iodide.~~

~~10. The method of any preceding claim, wherein the polymer is a halogenated isoolefin.~~

~~11. The method of claim 10, wherein the polymer is brominated poly(isobutylene *co* para-methylstyrene).~~

~~12. The method of claim 10, wherein the polymer is brominated poly(isobutylene *co* isoprene).~~

~~13.~~6. The method of ~~any preceding~~ claim 1, wherein the functionalized polymer is a thioacetate functionalized poly(isobutylene-co-para-methylstyrene).

~~14.~~7. The method of ~~claims 1-12~~ claim 1, wherein the functionalized polymer is a mercaptobenzothiazole functionalized poly(isobutylene-co-para-methylstyrene).

~~15.~~8. The method of ~~claima 1-12~~ claim 1, wherein the functionalized polymer is a thioacetate functionalized poly(isobutylene-co-isoprene).

~~16.~~9. The method of ~~claims 1-12~~ claim 1, wherein the functionalized polymer is a mercaptobenzothiazole functionalized poly(isobutylene-co-isoprene).

~~17. The method of claims 3-16, wherein the metal salt is potassium thioacetate.~~

~~18. The method of claims 3-16, wherein the metal salt is sodium mercaptobenzothiazole.~~

~~19. The method of any preceding claim, wherein the functionalized polymer is mixed with thioalkylate reagent and mercaptobenzothiazole reagent to make a functionalized poly(isobutylene-co-para-methylstyrene) and functionalized poly(isobutylene-co-isoprene).~~

~~20. The method of any preceding claim, wherein the polymer is halobutyl rubber.~~

~~21. The method of any preceding claim, wherein the temperature of the nucleophilic substitution reaction is between about 70°C to about 160°C.~~

~~22. The method of claims 1-20, wherein the temperature of the nucleophilic substitution reaction is between about 120°C to about 150°C.~~

~~23. The method of any preceding claim, wherein the reaction time of the nucleophilic substitution reaction is about 10 minutes to about 30 minutes.~~

~~24. A non-ionic functionalized poly(isobutylene-co-para-methylstyrene) produced by the method of any preceding claim.~~

~~25. A non-ionic functionalized poly(isobutylene-co-isoprene) produced by the method of of claims 1-23.~~

~~26. An article comprising the functionalized polymer produced by the method of any preceding claim.~~

~~27.~~10. A method of post-polymerization modification of ~~a~~ an isobutylene-based polymer, comprising the steps of:

(a) reacting a polymer with a first nucleophile to form a first functionalized polymer;

(b) reacting the first functionalized polymer with a second nucleophile; and

(c) recovering the bi-functionalized polymer~~.~~;

wherein the reaction is substantially free of a solvent and wherein the first nucleophile is an amine.

~~28. The method of claim 27, wherein the first nucleophile is an amine.~~