dissipative polymer and (b) a halogen-free metal salt of an amidoalkanesulfonic acid, a hydrocarbyl-substituted benzenesulfonic acid, or a mixture thereof, or a polymer derived from a halogen-free metal salt of an amidoalkanesulfonic acid, a hydrocarbyl-substituted benzenesulfonic acid, or a mixture thereof. In the process of the present invention, component (b) may be compounded into the inherently dissipative polymer, resulting in the inherently dissipative polymer composition. In some embodiments, component (b) is added to one or more of the reactants used in the preparation of component (a) and wherein component (b) is present during the polymerization of component (a), resulting in the inherently dissipative polymer composition.

[0018] The compositions of the invention may have a surface resistivity of from about $1.0x10^6$ ohm/square to about $1.0x10^{12}$ as measured by ASTM D-257.

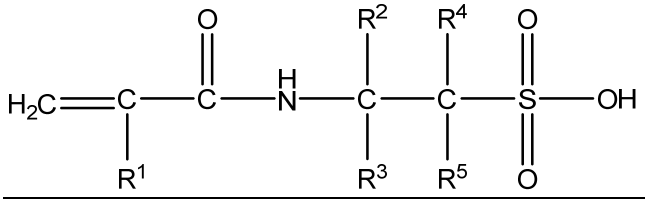
For example, the present invention provides the following items:

(Item 1) A composition comprising:

(a) an inherently dissipative polymer;

(b) a halogen-free metal salt of an amidoalkanesulfonic acid, ahydrocarbyl-substituted benzenesulfonic acid, or a mixture thereof, or a polymer derived from a halogen-free metal salt of an amidoalkanesulfonic acid, a hydrocarbyl-substituted benzenesulfonic acid, or a mixture thereof.

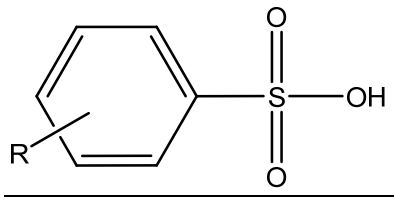
(Item 2) The composition of item 1 wherein component (b) comprises a halogen-free metal salt of an amidoalkanesulfonic acid or polymer derived from said acid where said acid is represented by the formula:



(I)

wherein R^1 is hydrogen or a hydrocarbyl group; and each R^2, R^3, R^4 and R^5 is independently hydrogen, a hydrocarbyl group, or $–CH_2SO_3H$.

(Item 3) The composition of item 1 wherein component (b) comprises a halogen-free metal salt of a hydrocarbyl-substituted benzenesulfonic acid or polymer derived from said acid where said acid is represented by the formula:



(II)

where R is a hydrocarbyl group containing from 2 to 20 carbon atoms.

(Item 4) The composition of any of the items 1 to 3 wherein component (b) comprises acids salted with one or more alkali metals, one or more alkaline-earth metals, or a combination thereof.

(Item 5) The composition of any of the items 1 to 4 wherein the composition further comprises one or more lithium-containing salts other than component (b)

(Item 6) The composition of any of the items 1 to 5 wherein the inherently dissipative polymer comprises a thermoplastic elastomer and wherein the surface resistance of the resulting composition, as measured by ASTM D-257, is from $1.0x10^6$ ohm/square to $1.0x10^{12}$ ohm/square.

(Item 7) The composition of any of the items 1 to 6 wherein the inherently dissipative polymer comprises a thermoplastic polyurethane (TPU), a polyolefin polyether copolymer, a thermoplastic polyester elastomer (COPE), a polyether block amide elastomer (COPA), or a combination thereof.

(Item 8) The composition of item 7 wherein the polyether of the inherently dissipative polymer comprises polyethylene glycol, polypropylene glycol, ethylene oxide/propylene oxide copolymer, or a combination thereof

(Item 9) The composition of any of the items 1 to 8 wherein the inherently dissipative polymer comprises a thermoplastic polyurethane composition made by reacting (a) at least one polyether polyol intermediate with (b) at least one diisocyanate and (c) at least one chain extender;

wherein (a), the polyether polyol intermediate comprises an intermediate derived from at least one dialkylene glycol and at least one dicarboxylic acid, or an ester or anhydride thereof; and wherein (a) may optionally further comprise a polyester polyol.

(Item 10) The composition of any of the items 1 to 9 wherein the inherently dissipative polymer comprises a blend of at least two polymers.

(Item 11) The composition of item 10 wherein the blend of polymers comprises two or more of: a thermoplastic polyurethane (TPU), a polycarbonate, a polyolefin, a styrenic polymer, an acrylic polymer, a polyoxymethylene polymer, a polyamide, a polyphenylene oxide, a polyphenylene sulfide, a polyvinylchloride, a chlorinated polyvinylchloride, an ethylene vinyl acetate copolymer (EVA), a thermoplastic elastomer (TPE), or any combination thereof.

(Item 12) A shaped polymeric article comprising the inherently dissipative polymer composition of any of the items 1 to 11.

(Item 13) The polymeric article of item 12, wherein the article comprises: packaging materials for electronic parts; internal battery separators for use in the construction of lithium-ion batteries; parts for clean room construction, equipment and supplies; parts for equipment that handles flammable liquids and/or dry powders; fibers, wires, or cables; or combinations thereof.

(Item 14) A process of making an inherently dissipative polymer composition comprising the steps of:

I. mixing (a) an inherently dissipative polymer and (b) a halogen-free metal salt of an amidoalkanesulfonic acid, a hydrocarbyl-substituted benzenesulfonic acid, or a mixture thereof, or a polymer derived from a halogen-free metal salt of an amidoalkanesulfonic acid, a hydrocarbyl-substituted benzenesulfonic acid, or a mixture thereof.

(Item 15) The process of item 14 wherein component (b) is added to one or more of the reactants used in the preparation of component (a) and wherein component (b) is present during the polymerization reaction used to prepare component (a), resulting in the inherently dissipative polymer composition.

DETAILED DESCRIPTION OF THE INVENTION

[0019] Various features and embodiments of the invention will be described below by way of non-limiting illustration. The inherently dissipative polymer compositions of the invention include an inherently dissipative polymer where the polymer is modified by a salt. The use of the term composition, as used herein, generally refers to the overall composition, which includes one or more inherently dissipative polymers.

The Inherently Dissipative Polymer

[0020] The compositions of the present invention include an inherently dissipative polymer. That is, a polymer that has electrostatic dissipative (ESD) properties. In some embodiments, the polymer comprises a thermoplastic elastomer. Such materials may be generally described as polymers having in their backbone structures hard and/or crystalline segments and/or blocks in combination with soft and/or rubbery segments and/or blocks.

[0021] In some embodiments, the inherently dissipative polymer includes a thermoplastic polyurethane (TPU), a polyolefin polyether copolymer, a thermoplastic polyester elastomer (COPE), a polyether block amide elastomer (COPA or PEBA), or a combination thereof. Examples of suitable copolymers include polyolefin-polyether copolymers.

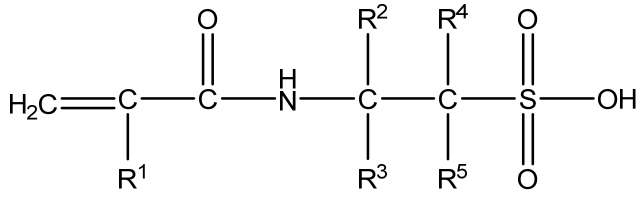
We claim:

1. A composition comprising:

(a) an inherently dissipative polymer comprising a thermoplastic polyurethane, wherein the thermoplastic polyurethane is a polyester-based thermoplastic polyurethane, a polyether-based thermoplastic polyurethane, a thermoplastic polyurethane containing both polyester and polyether groups, or a combination thereof, and wherein the inherently dissipative polymer has a surface resistivity range of 1.5x1011 ohm/square to 5x109 ohm/square;

(b) a halogen-free metal salt of an amidoalkanesulfonic acid, ~~a hydrocarbyl-substituted benzenesulfonic acid, or a mixture thereof,~~ or a polymer derived from a halogen-free metal salt of an amidoalkanesulfonic acid, ~~a hydrocarbyl-substituted benzenesulfonic acid, or a mixture thereof.~~

~~2. The composition of claim 1 wherein component (b) comprises a halogen-free metal salt of an amidoalkanesulfonic acid or polymer derived from said acid~~ wherein said amidoalkanesulfonic acid is represented by the formula:

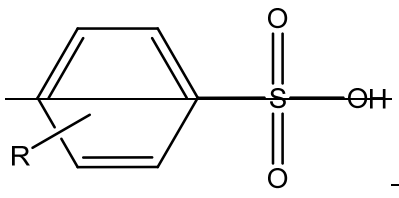


(I)

wherein R^1 is hydrogen or a hydrocarbyl group; and each R^2, R^3, R^4 and R^5 is independently hydrogen, a hydrocarbyl group, or $–CH_2SO_3H$; and

wherein the total amount of all salts present in the composition is 0.23 %wt to 3.5 %wt of the composition..

~~3~~2. The composition of claim 1 ~~wherein component (b) comprises a halogen-free metal salt of a hydrocarbyl-substituted benzenesulfonic acid or polymer derived from said acid where said acid is represented by the formula:~~



~~(II)~~

~~where R is a hydrocarbyl group containing from 2 to 20 carbon atoms.~~

~~4. The composition of any of the claims 1 to 3~~ wherein component (b) comprises acids salted with one or more alkali metals, one or more alkaline-earth metals, or a combination thereof.

~~5~~3. The composition of ~~any of the~~ claim~~s~~ 1 to ~~4~~2 wherein the composition further comprises one or more lithium-containing salts other than component (b)

~~6~~4. The composition of any of the claims 1 to ~~5~~3 wherein the inherently dissipative polymer comprises a thermoplastic elastomer and wherein the surface resistance of the resulting composition, as measured by ASTM D-257, is from $1.0x10^{6}$ ohm/square to $1.0x10^{12}$ ohm/square.

~~7. The composition of any of the claims 1 to 6 wherein the inherently dissipative polymer comprises a thermoplastic polyurethane (TPU), a polyolefin polyether copolymer, a thermoplastic polyester elastomer (COPE), a polyether block amide elastomer (COPA), or a combination thereof.~~

~~8. The composition of claim 7 wherein the polyether of the inherently dissipative polymer comprises polyethylene glycol, polypropylene glycol, ethylene oxide/propylene oxide copolymer, or a combination thereof~~

~~9~~5. The composition of any of the claims 1 to ~~8~~4 wherein the inherently dissipative polymer comprises a thermoplastic polyurethane composition made by reacting (a) at least one polyether polyol intermediate with (b) at least one diisocyanate and (c) at least one chain extender;

wherein (a), the polyether polyol intermediate comprises an intermediate derived from at least one dialkylene glycol and at least one dicarboxylic acid, or an ester or anhydride thereof; and wherein (a) may optionally further comprise a polyester polyol.

~~10~~6. The composition of any of the claims 1 to ~~9~~5 wherein the inherently dissipative polymer comprises a blend of at least two polymers.

~~11. The composition of claim 10 wherein the blend of polymers comprises two or more of: a thermoplastic polyurethane (TPU), a polycarbonate, a polyolefin,~~

~~a styrenic polymer, an acrylic polymer, a polyoxymethylene polymer, a polyamide,~~ ~~a~~

~~polyphenylene oxide, a polyphenylene sulfide, a polyvinylchloride, a chlorinated polyvinylchloride, an ethylene vinyl acetate copolymer (EVA), a thermoplastic elastomer (TPE), or any combination thereof.~~

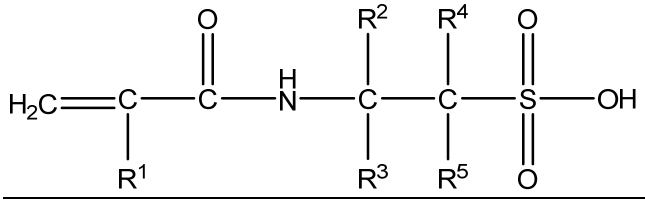
~~12~~7. A shaped polymeric article comprising the inherently dissipative polymer composition of any of the claims 1 to ~~11~~6.

~~13~~8. The polymeric article of claim ~~12~~7, wherein the article comprises: packaging materials for electronic parts; internal battery separators for use in the construction of lithium-ion batteries; parts for clean room construction, equipment and supplies; parts for equipment that handles flammable liquids and/or dry powders; fibers, wires, or cables~~; or combinations thereof~~.

~~14~~9. A process of making an inherently dissipative polymer composition comprising the steps of:

I. mixing (a) an inherently dissipative polymer comprising a thermoplastic polyurethane, wherein the thermoplastic polyurethane is a polyester-based thermoplastic polyurethane, a polyether-based thermoplastic polyurethane, a thermoplastic polyurethane containing both polyester and polyether groups, or a combination thereof, and wherein the inherently dissipative polymer has a surface resistivity range of 1.5x1011 ohm/square to 5x109 ohm/square, and (b) a halogen-free metal salt of an amidoalkanesulfonic acid, ~~a hydrocarbyl-substituted benzenesulfonic acid, or a mixture thereof,~~ or a polymer derived from a halogen-free metal salt of an amidoalkanesulfonic acid, ~~a hydrocarbyl-substituted benzenesulfonic acid, or a mixture thereof.~~

wherein said amidoalkanesulfonic acid is represented by the formula:



(I)

wherein R1 is hydrogen or a hydrocarbyl group; and each R2, R3, R4 and R5 is independently hydrogen, a hydrocarbyl group, or –CH2SO3H; and

wherein the total amount of all salts present in the composition is 0.23 %wt to 3.5 %wt of the composition.

~~15~~10. The process of claim ~~14~~9 wherein component (b) is added to one or more of the reactants used in the preparation of component (a) and wherein component (b) is present during the polymerization reaction used to prepare component (a), resulting in the inherently dissipative polymer composition.