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(54) Title: ELECTROSTATIC DISSIPATIVE POLYMER AND POLYMER MIXTURE THEREOF

(57) Abstract: An electrostatic dissipative polymer having excellent light stability (less UV induced yellowing) as well as permanent electrostatic dissipative properties and polymer mixture thereof are disclosed. The electrostatic dissipative polymer comprises polyether based oligomer containing ethylene oxide, aliphatic diisocyanate and C2-C10 chain extender containing primary hydroxyl or amine terminal group. Preferably, the number-average molecular weight (Mn) of polyether based oligomer containing ethylene oxide is 500 to 10000. Preferably, the polyether based oligomer is selected from the group consisting of (i) linear homopolymer having a main chain consisting of ethylene oxide, and hydroxyl or amine terminal groups, (ii) linear copolymer having a main chain consisting of ethylene oxide and different kind of monomer, and hydroxyl or amine terminal groups, and (iii) mixture thereof.



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Description

ELECTROSTATIC DISSIPATIVE POLYMER AND POLYMER MIXTURE THEREOF

Technical Field

- [1] This invention relates to an electrostatic dissipative polymer and polymer mixture thereof, and more particularly, to an electrostatic dissipative polymer and polymer mixture having good stability to ultraviolet that induces yellowing as well as permanent electrostatic dissipative property.

[2]

Background Art

- [3] It is well known that electrostatic charges are generated and accumulated on the surface of most plastic materials. Since the plastic materials have low electrical conductivity, electrostatic charge has a tendency to be easily accumulated on the plastic materials. This accumulated electrostatic charges cause various troubles in the plastic processing and use in the industry. For example, if a film is manufactured by a plastic material that has low electrical conductivity, the electrostatic charges will make the films stick to each other easily which badly effects the next process, or make dust being attracted onto the film surface, thereby deteriorating the high value of the film. Specifically, since the parts used in electrics/electronics industries are very sensitive to electrostatic charges, it is very important to control the generation and dissipation of the electrostatic charges during the process for storing, transporting and assembling the said parts.
- [4] Various electrostatic dissipative materials for suppressing the generation and accumulation of electrostatic charges have been developed. One method is adding low molecular weight antistatic agents in the form of anion or cation to various polymers, which is a conventional method to give electrostatic dissipative properties. However, degradation of antistatic agents at high polymer processing temperature due to its weak thermal stability, makes the electrostatic dissipative properties deterioration. Also, if the compatibility of the antistatic agent to the polymer is not sufficiently good, the antistatic agent is liable to be eluted to the polymer surface, and the electrostatic dissipative properties is deteriorated as time passes.
- [5] Another method for suppressing the generation and accumulation of electrostatic charges is conductive polymer coating on the plastic surface. But this method has some problems that the conductive polymer coating is easily peeled off to lose the conductivity and the torn coated surface during the thermoforming process and cut portion of plastic materials can cause Hot spot that electrostatic charges are accumulated.

- [6] The other method for suppressing the generation and accumulation of static charges is to use polymer composites compounded with organic or inorganic conductive fillers such as metal or carbon black etc. However, for obtaining the sufficient electrostatic dissipative properties, more than 10 weight% of fillers should be used so that the physical properties of the polymer composite such as impact strength could be drastically dropped. Specifically, the packaging materials made out of the polymer composite containing carbon black has migration problem of the carbon black causing contamination on the surface of the product to be packed.
- [7] Use of aromatic polyether based thermoplastic polyurethane as an electrostatic dissipative material which is composed of polyol containing ethylene oxide such as polyethylene glycol etc., and aromatic diisocyanate, have been developed to overcome these problems. However, as will be described hereinafter, aliphatic polyether based thermoplastic polyurethane or polyurea polymer using aliphatic diisocyanate disclosed in the present invention has unexpected electrostatic dissipative properties and light stability (less UV induced yellowing) than the conventional aromatic polyether based thermoplastic polyurethane.

[8]

Disclosure of Invention

Technical Problem

- [9] It is an object of the present invention to provide an aliphatic polyether based thermoplastic polyurethane or polyurea polymer composed of aliphatic diisocyanate, and polymer mixture thereof. The aliphatic polyether based thermoplastic polyurethane or polyurea polymer and polymer mixture thereof have lower surface resistivity, lower volume resistivity, permanent electrical property, recyclability and superior electrostatic dissipative properties in comparison with the conventional aromatic polyether based thermoplastic polyurethane.
- [10] It is another object of the present invention to provide an electrostatic dissipative polymer having light stability (less UV induced yellowing), and a polymer mixture thereof.
- [11] It is still another object of the present invention to provide an electrostatic dissipative polymer widely usable as packaging materials for the parts of electrics /electronics industries which are sensitive to electrostatic charges, and a polymer mixture thereof.

[12]

Technical Solution

- [13] In order to achieve these objects, the present invention provides an electrostatic dissipative polymer comprising polyether based oligomer containing ethylene oxide, aliphatic diisocyanate, and C_2-C_{10} chain extender containing primary hydroxyl group or

- amine terminal group. Preferably, the number-average molecular weight of polyether based oligomer containing ethylene oxide is 500 to 10000. The polyether based oligomer containing ethylene oxide can be selected from the group consisting of (i) linear homopolymer consisting of ethylene oxide, and hydroxyl or amine terminal groups, (ii) linear copolymer consisting of ethylene oxide and different kind of monomer, and hydroxyl or amine terminal groups, and (iii) mixture thereof.
- [14] Also, the present invention provides a polymer mixture comprising an electrostatic dissipative property enhancer in the form of inorganic or organic salt and the electrostatic dissipative polymer, wherein the amount of the electrostatic dissipative property enhancer is 0.1 to 20 weight parts with respect to 100 weight parts of the electrostatic dissipative polymer.
- [15] In addition, the present invention provides the electrostatic dissipative polymer mixture prepared by mixing the electrostatic dissipative polymer and various kinds of polymer.
- [16]
- Mode for the Invention**
- [17] A more complete appreciation of the invention, and many of the attendant advantages thereof, will be better appreciated by reference to the following detailed description.
- [18] The electrostatic dissipative polymer according to the present invention is thermoplastic polyurethane or polyurea polymer, prepared by the reaction of polyether based oligomer containing ethylene oxide, aliphatic diisocyanate and C_{2-10} (2 to 10 carbon atoms) chain extender containing primary hydroxyl or amine terminal group.
- [19] The polyether based oligomer of the present invention has both terminal groups of alcohol (-OH) or amine (-NH₂) which can react with diisocyanates. As the polyether based oligomer of the present invention, (i) linear polymer consisting of ethylene oxide (linear homopolymer), (ii) linear polymer consisting of ethylene oxide and different kind of monomer (linear copolymer) or (iii) mixture thereof can be used. An example of the monomer which composes the linear copolymer with ethylene oxide includes 1,2-propylene oxide, 1,3-propylene oxide, epichlorohydrin, 1,2-butylene oxide, 1,3-butylene oxide, styrene oxide, allyl glycidyl ether, n-butyl glycidyl ether, glycidyl acrylate, glycidyl methacrylate, 2-ethylhexyl glycidyl ether, etc. The number-average molecular weight (Mn) of these polyether based oligomer is about from 500 to 10,000, preferably from 600 to 4,000, more preferably from 1,000 to 2,000. If the number-average molecular weight (Mn) of the polyether based oligomer is less than 500, the electrostatic dissipative property of the polymer is deteriorated and if number-average molecular weight of the polyether based oligomer is more than 10,000, the

polyurethane polymerization could be difficult. The ethylene oxide group in the said polyether based oligomer can give hydrophilic characteristics to the polymer so that the electrostatic dissipative polymer of the present invention has good and permanent electrical conductivity.

[20]

[21] The aliphatic diisocyanates of the present invention gives light stability (less UV induced yellowing). The aliphatic diisocyanates can be C_6-C_{12} (namely, carbon atoms of aliphatic part is 6~12) cyclic aliphatic diisocyanates or C_2-C_{10} (namely, carbon atoms of aliphatic part is 2~10) linear aliphatic diisocyanates, and preferably, is C_2-C_{10} linear aliphatic diisocyanates. An example of the aliphatic diisocyanates includes 1,6-hexamethylene diisocyanate (HDI), 4,4-dicyclohexylmethane diisocyanate (H₁₂MDI), 3-isocyanatomethyl-3,5,5-trimethyl cyclohexyl isocyanate (IPDI), 1,4-cyclohexyl diisocyanate (CHDI), 2,2,4-trimethylhexamethylene diisocyanate (TMDI) and mixture thereof. For obtaining better electrical property, it is preferable to use 1,6-hexamethylene diisocyanate (HDI) and 2,2,4- trimethylhexamethylene diisocyanate (TMDI), and it is most preferable to use the linear aliphatic diisocyanate of 1,6-hexamethylene diisocyanate (HDI).

[22]

[23] The chain extender of the present invention, which is used for extending the backbone of the polymer, is a compound having from 2 to 10 carbon atoms and containing a primary hydroxyl or amine terminal group. Examples of the chain extender include diols such as ethylene glycol, diethylene glycol, propylene glycol, dipropylene glycol, 1,3-propanediol, 1,4-butanediol, 1,5-pentanediol, 1,10-decanediol, 2,2-dimethyl-1,3-propanediol, 1,4-cyclohexane dimethanol, hydroquinone bis(2-hydroxyethyl) ether, 1,6-hexanediol, neopentyl glycol, or diamines such as 1,2-propylenediamine, 1,3-propylenediamine, isophoronediamine, ethylenediamine, N-methylpropylene-1,3-diamine, N,N'-dimethylethylenediamine, or mixture thereof. Preferred chain extender is 1,4-butanediol.

[24]

The amount of the chain extender can be from about 0.1 to about 30 moles, preferably from about 0.1 to about 10 moles and more preferably from 0.1 to 5 moles for 1 mole of polyether based oligomer. The amount of diisocyanate can be from 0.90 to 1.10 moles, preferably from 0.92 to 1.05 moles and more preferably from 0.93 to 1.0 moles for total 1.0 mole of chain extender and polyether based oligomer (namely, chain extender + polyether based oligomer).

[25]

[26] The electrostatic dissipative polymer of the present invention can be prepared by the conventional polymerization process. For example, the electrostatic dissipative polymer of the present invention can be prepared by one-shot polymerization process,

wherein polyether based oligomer containing ethylene oxide, aliphatic diisocyanate and the chain extender are reacted simultaneously. Otherwise the electrostatic dissipative polymer of the present invention can be prepared by blending the polyether based oligomer and the chain extender, and then by reacting the aliphatic diisocyanate. Or the electrostatic dissipative polymer of the present invention can be prepared by firstly reacting the polyether based oligomer and the aliphatic diisocyanate to produce prepolymer and then by reacting the prepolymer with the chain extender. The electrostatic dissipative polymer of the present invention preferably has surface resistivity of less than about $1.0\text{E}+11 \text{ } \Omega/\text{square}$, more preferably of less than about $5.0\text{E}+10 \text{ } \Omega/\text{square}$, as measured according to ASTM D-257.

[27]

[28] Inorganic or organic salts can be added as an electrostatic dissipative property enhancer for further improvement of the electrical conductivity of the electrostatic dissipative polymer of the present invention. Inorganic or organic salts of the electrostatic dissipative property enhancer are added to the electrostatic dissipative polymer so that the electrical conductivity of the electrostatic dissipative polymer of the present invention can be improved. The amount of inorganic or organic salts are 0.1 to 20 weight parts with respect to 100 weight parts of total amount of the polyether based oligomer, the aliphatic diisocyanate and the chain extender. If the amount of electrostatic dissipative property enhancer is less than 0.1 weight parts with respect to 100 weight parts of total amount of the polyether based oligomer, the aliphatic diisocyanate and the chain extender, the improvement on the electrostatic dissipation property and the conductivity is insignificant. More than 20 weight parts of electrostatic dissipative property enhancer with respect to 100 weight parts of total amount of the polyether based oligomer, the aliphatic diisocyanate and the chain extender results in no more improvement of electrostatic dissipation property than expected, increasing product cost and physical properties deterioration of the polymer.

[29]

[30] Examples of the inorganic salts (electrostatic dissipative property enhancer) include lithium perchlorate (LiClO_4), lithium hexafluorophosphate (LiPF_6), lithium hexafluoroarsenate (LiAsF_6), lithium iodide (LiI), lithium bromide (LiBr), lithium thiocyanate (LiSCN), lithium nitrate (LiNO_3), lithium sulfide (Li_2S), lithium tris(trifluoromethylsulfonyl) methide ($\text{LiC}(\text{SO}_2\text{CF}_3)_3$), trifluoromethanesulfonic acid lithium salt (LiSO_3CF_3), lithium(bis)trifluoromethane sulfonamide ($\text{LiN}(\text{SO}_2\text{CF}_3)_2$), lithium(bis)perfluoroethanesulfonimide ($\text{LiN}(\text{SO}_2\text{C}_2\text{F}_5)_2$), 5-lithiosulfoisophthalic acid, 3,5-diiodo-2-hydroxybenzoic acid lithium salt, 3,5-diiodosalicylic acid lithium salt, beta-hydroxypyruvic acid lithium salt hydrate, carbamoylphosphate dilithium salt, p-toluenesulfinic acid lithium salt, poly(ethylene-co-methacrylic acid) lithium salt,

toluene-4-sulfinic acid lithium salt anhydrous or mixture thereof. It is preferable to use lithium(bis)trifluoromethane sulfonimide ($\text{LiN}(\text{SO}_2\text{CF}_3)_2$) or lithium(bis) perfluoroethanesulfonimide ($\text{LiN}(\text{SO}_2\text{C}_2\text{F}_5)_2$).

- [31] Examples of the organic salts (electrostatic dissipative property enhancer) include ionic salt consisting of a nitrogen based cation and/or an anion which forms weak coordinate covalent bond with the cation. Examples of the nitrogen based cation include pyridinium, pyridazinium, pyrimidinium, pyrazinium, imidazolium, pyrazolium, thiazolium, oxazolium, triazolium, or mixture thereof. It is preferable to use imidazolium. Examples of the anion include Cl^- , Br^- , F^- , HSO_4^- , H_2PO_4^- , NO_3^- , ClO_4^- , BF_4^- , PF_6^- , SbF_6^- , AsF_6^- , an organic anion such as alkane sulfonate, aryl sulfonate, alkaryl sulfonate etc., a fluoroorganic anion such as perfluoroalkane-sulfonates, cyanoperfluoroalkanesulfonylamides, bis(cyano)fluoroalkanesulfonylmethides, bis(perfluoroalkanesulfonyl)imides, bis(perfluoroalkanesulfonyl)methides, tris(perfluoroalkanesulfonyl)methides etc, or mixture thereof. It is preferable to use the fluoroorganic anions.

[32]

- [33] The present invention also provides an electrostatic dissipative polymer mixture prepared by adding an inorganic or organic salt electrostatic dissipative property enhancer to the electrostatic dissipative polymer which is prepared by reacting polyether based oligomer containing ethylene oxide, aliphatic diisocyanate and $\text{C}_2\text{-C}_{10}$ chain extender having primary hydroxyl or amine terminal group. The amount of an inorganic salt or organic salt electrostatic dissipative property enhancer is 0.1 to 20 weight parts with respect to 100 weight parts of the electrostatic dissipative polymer.

- [34] The said electrostatic dissipative property enhancer is dispersed into the electrostatic dissipative polymer by physically mixing through various mixers including an extruder or by adding in the polymerization process.

[35]

- [36] The present invention further provides a polymer mixture comprising a matrix polymer and the electrostatic dissipative polymer which is prepared by reacting the polyether based oligomer containing ethylene oxide, aliphatic diisocyanate and $\text{C}_2\text{-C}_{10}$ chain extender having primary hydroxyl or amine terminal group. In the polymer mixture, the amount of the electrostatic dissipative polymer is 3 to 80 weight parts with respect to 100 weight parts of the matrix polymer, wherein the electrostatic dissipative polymer could be the polymer prepared by further adding of the inorganic or organic salt electrostatic dissipative property enhancer. The polymer mixture can be prepared by mixing the electrostatic dissipative polymer and the matrix polymer using a conventional mixer such as the extruder. In the polymer mixture, amount of the electrostatic dissipative polymer is from 3 to 80 weight parts with respect to the 100 weight

of matrix polymer, preferably from 25 to 50 weight parts. Less than 3 weight parts of electrostatic dissipative polymer respect to the 100 weight parts of matrix polymer doesn't give effective electrostatic dissipative property and more than 80 weight parts of that doesn't show further electrostatic dissipative property improvement than expected.

[37]

[38] Examples of the matrix polymer include polyoxymethylene (POM), polyacryl, polymethyl methacrylate (PMMA), polystyrene (PS) homopolymer, polystyrene (PS) copolymer, styrene-acrylonitrile (SAN), acrylonitrile-butadiene-styrene (ABS), high impact polystyrene (HIPS), polycarbonate (PC), polyethylene (PE), polypropylene (PP) homopolymer, polypropylene (PP) copolymer, polyethylene terephthalate (PET), glycol modified polyethylene terephthalate (PETG), polybutylene terephthalate (PBT), polyether-ester copolymers, polyether-amide copolymers, Nylon 6, Nylon 6,6, Nylon 6,10, Nylon 6,12, Nylon 11, Nylon 12, polyamideimides, polyarylates, polyurethanes, ethylene propylene rubber (EPR), ethylene propylene diene monomer (EPDM), polyarylsulfone, polyethersulfone, polyphenylene sulfide, polyphenylene oxide, polyvinyl chloride (PVC), polysulfone, polyetherimide, polytetrafluoroethylene (PTFE), fluorinated propylene ethylene, polyfluoroalkoxy, polychlorotrifluoroethylene, polyvinylidene fluoride, polyvinyl fluoride, polyetherketone (PEK), polyether etherketone (PEEK), polyether ketone or mixture thereof.

[39]

[40] Further the present invention provides a molded or shaped article prepared by the polymer mixture containing 3 to 80 weight parts of electrostatic dissipative polymer and 100 weight part of the matrix, wherein the electrostatic dissipative polymer is produced by reacting polyether based oligomer containing ethylene oxide, aliphatic diisocyanate and C_2-C_{10} chain extender having primary hydroxyl or amine terminal group.

[41]

[42] Hereinafter, the preferable examples of the present invention and comparative examples are provided for better understanding of the present invention. The following examples are to illustrate the present invention, and the present invention is not limited by the following examples.

[43]

[44] [Comparative Example 1]

[45] After 64.3 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500 was heated to 120°C, 29.4 weight% of 4,4-methylenebis(phenyl isocyanate) (MDI) and 6.3 weight% of 1,4-butanediol were heated at 120°C for 5 minutes and reacted with polyethylene glycol by one-shot polymerization process and

then aged in a convection oven at 80°C for 15 hours, thereby an aromatic polyurethane was prepared. The prepared aromatic polyurethane was press-molded at 180°C to make a test specimen. The surface resistivity and UV stability of the specimen were measured, and the results are set forth in Table 1.

- [46] After the specimen conditioning for 24 hours at $23\pm 1^\circ\text{C}$ of temperature and $50\pm 15\%$ of relative humidity, the surface resistivity was measured by a resistivity meter according to ASTM D-257. UV stability was evaluated by measuring color change of the specimen after UV-A exposure at 50°C for 400 hours with Q-UV instrument. The degree of color change was measured by grey scale according to AATCC, which shows color comparison with before and after UV exposure ranged from level 0 to level 5. Level 5 in the grey scale indicates that the color after the irradiation is almost same to the initial color.

[47]

[48] [Comparative Example 2]

- [49] Except for using 61.4 weight% of ethylene oxide-propylene glycol (EO-PPG, the amount of ethylene oxide is 18 mol%.) whose number-average molecular weight is 2400, 30.1 weight% of 4,4-methylenebis(phenyl isocyanate) (MDI) and 8.5 weight% of 1,4-butanediol, the test specimen of aromatic polyurethane was prepared in the same manner as described in Comparative Example 1. The surface resistivity and UV stability of the specimen were measured, and the results are set forth in Table 1.

[50]

[51] [Comparative Example 3]

- [52] Except for using 62.8 weight% of polyoxyalkylene amine whose number-average molecular weight (Mn) is 2000, 29.4 weight% of 4,4-methylenebis(phenyl isocyanate) (MDI) and 7.8 weight% of 1,4-butanediol, the test specimen of aromatic polyurethane was prepared in the same manner as described in Comparative Example 1. The surface resistivity and UV stability of the specimen were measured, and the results are set forth in Table 1.

[53]

[54] [Example 1]

- [55] Except for using 64.0 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, 25.9 weight% of 1,6-hexamethylene diisocyanate (HDI) and 10.1 weight% of 1,4-butanediol, the test specimen of aliphatic polyurethane was prepared in the same manner as described in Comparative Example 1. The surface resistivity and UV stability of the specimen were measured, and the results are set forth in Table 1.

[56]

[57] [Example 2]

- [58] Except for using 69.7 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, 22.4 weight% of 1,6-hexamethylene diisocyanate (HDI) and 7.9 weight% of 1,4-butanediol, the test specimen of aliphatic polyurethane was prepared in the same manner as described in Comparative Example 1. The surface resistivity and UV stability of the specimen were measured, and the results are set forth in Table 1.
- [59]
- [60] [Example 3]
- [61] Except for using 77.0 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, 18.3 weight% of 1,6-hexamethylene diisocyanate (HDI) and 4.7 weight% of 1,4-butanediol, the test specimen of aliphatic polyurethane was prepared in the same manner as described in Comparative Example 1. The surface resistivity and UV stability of the specimen were measured, and the results are set forth in Table 1.
- [62]
- [63] [Example 4]
- [64] Except for using 62.5 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, 30.5 weight% of 4,4-dicyclohexylmethane diisocyanate (H_{12} MDI) and 7.0 weight% of 1,4-butanediol, the test specimen of aliphatic polyurethane was prepared in the same manner as described in Comparative Example 1. The surface resistivity and UV stability of the specimen were measured, and the results are set forth in Table 1.
- [65]
- [66] [Example 5]
- [67] Except for using 65.1 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, 28.7 weight% of 4,4-dicyclohexylmethane diisocyanate (H_{12} MDI) and 6.2 weight% of 1,4-butanediol, the test specimen of aliphatic polyurethane was prepared in the same manner as described in Comparative Example 1. The surface resistivity and UV stability of the specimen were measured, and the results are set forth in Table 1.
- [68]
- [69] [Example 6]
- [70] Except for using 68.1 weight% of ethylene oxide-propylene glycol (EO-PPG, the amount of ethylene oxide is 18 mol%.) whose number-average molecular weight (Mn) is 2400, 22.4 weight% of 1,6-hexamethylene diisocyanate (HDI) and 9.5 weight% of 1,4-butanediol, the test specimen of aliphatic polyurethane was prepared in the same manner as described in Comparative Example 1. The surface resistivity and UV stability of the specimen were measured, and the results are set forth in Table 1.

[71]

[72] [Example 7]

[73] Except for using 69.5 weight% of polyoxyalkylene amine whose number-average molecular weight (Mn) is 2000, 21.9 weight% of 1,6-hexamethylene diisocyanate (HDI) and 8.6 weight% of 1,4-butanediol, the test specimen of aliphatic polyurea was prepared in the same manner as described in Comparative Example 1. The surface resistivity and UV stability of the specimen were measured, and the results are set forth in Table 1.

[74] Table 1

[Table 1]

	Comparative Example 1	Comparative Example 2	Comparative Example 3	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7
polyethylene glycol (PEG, Mn=1500)	64.3%	-	-	64.0%	69.7%	77.0%	62.5%	65.1%	-	-
ethylene oxide- propylene glycol (EO- PPG, Mn=2400, Amount of EO is 18%)	-	61.4%	-	-	-	-	-	-	68.1%	-
polyoxyalkylene amine (Mn=2000)	-	-	62.8%	-	-	-	-	-	-	69.5%
4,4-methylenebis(phenyl isocyanate)	29.4%	30.1%	29.4%	-	-	-	-	-	-	-
1,6-hexamethylene diisocyanate	-	-	-	25.9%	22.4%	18.3%	-	-	22.4%	21.9%
4,4- dicyclohexylmethane diisocyanate	-	-	-	-	-	-	30.5%	28.7%	-	-
1,4-butanediol	6.3%	8.5%	7.8%	10.1%	7.9%	4.7%	7.0%	6.2%	9.5%	8.6%
surface resistivity (Ω /square)	2.0E+11	3.9E+11	3.0E+11	6.3E+09	5.3E+09	2.9E+09	1.0E+11	8.0E+10	9.0E+09	2.3E+09
UV stability (Grey scale)	2.0	2.0	1.5	4.5	4.5	4.5	4.5	4.5	4.5	4.0

[75] Table 1 shows that test specimens of polyurethane or polyurea of Examples 1 to 7 prepared using aliphatic diisocyanates have superior UV stability to Comparative Examples 1 to 3 prepared using aromatic diisocyanates. Specifically, test specimens of

polyurethane or polyurea prepared using linear 1,6-hexamethylene(diisocyanate) (HDI) (Examples 1, 2, 3, 6, 7) have lower surface resistivity by about 2 order comparison with test specimens prepared using aromatic or cyclic aliphatic diisocyanates (Comparatives 1,2,3, Examples 4, 5).

[76]

[77] [Comparative Example 4]

[78] After 58.2 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500 was heated to 120°C, 33.3 weight% of 4,4-methylenebis(phenyl isocyanate) (MDI) and 8.5 weight% of 1,4-butanediol were heated at 120°C for 5 minutes and reacted with polyethylene glycol by one-shot polymerization process and then aged in a convection oven at 80°C for 15 hours, thereby preparing an aromatic polyurethane. The test specimen of sheet was prepared in the same manner as described in Comparative Example 1. The surface resistivity and UV stability of the specimen were measured, and the results are set forth in Table 2.

[79]

[80] [Comparative Example 5]

[81] Except for using 63.8 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, 29.4 weight% of 4,4-methylenebis(phenyl isocyanate) (MDI) and 6.8 weight% of 1,4-butanediol, the test specimen of sheet was prepared in the same manner as described in Comparative Example 4. The surface resistivity and UV stability of the specimen were measured, and the results are set forth in Table 2.

[82]

[83] [Comparative Example 6]

[84] Except for using 63.8 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, 26.3 weight% of 4,4-methylenebis(phenyl isocyanate) (MDI) and 5.4 weight% of 1,4-butanediol, the test specimen of sheet was prepared in the same manner as described in Comparative Example 4. The surface resistivity and UV stability of the specimen were measured, and the results are set forth in Table 2.

[85]

[86] [Example 8]

[87] Except for using 58.2 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, 29.5 weight% of 1,6-hexamethylene(diisocyanate) (HDI) and 12.3 weight% of 1,4-butanediol, the test specimen of sheet was prepared in the same manner as described in Comparative Example 4. The surface resistivity and UV stability of the specimen were measured, and the results are set forth in Table 2.

[88]

[89] [Example 9]

[90] Except for using 63.8 weight% of polyethylene glycol whose number-average

molecular weight (Mn) is 1500, 26.1 weight% of 1,6-hexamethylene(diisocyanate) (HDI) and 10.1 weight% of 1,4-butanediol, the test specimen of aliphatic polyurethane sheet was prepared in the same manner as described in Comparative Example 4. The surface resistivity and UV stability of the specimen were measured, and the results are set forth in Table 2.

[91]

[92] [Example 10]

[93] Except for using 68.3 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, 23.3 weight% of 1,6-hexamethylene(diisocyanate) (HDI) and 8.4 weight% of 1,4-butanediol, the test specimen of aliphatic polyurethane sheet was prepared in the same manner as described in Comparative Example 4. The surface resistivity and UV stability of the specimen were measured, and the results are set forth in Table 2.

[94] Table 2

[Table 2]

	Comparative Example 4	Comparative Example 5	Comparative Example 6	Example 8	Example 9	Example 10
polyethylene glycol (PEG, Mn=1500)	58.2%	63.8%	68.3%	58.2%	63.8%	68.3%
4,4-methylenebis(phenyl isocyanate)	33.3%	29.4%	26.3%	-	-	-
1,6-hexamethylene diisocyanate	-	-	-	29.5%	26.1%	23.3%
1,4-butanediol	8.5%	6.8%	5.4%	12.3%	10.1%	8.4%
Hard segment (isocyanate+1,4butanediol, wt%)	41.8	36.2	31.7	41.8	36.2	31.7
surface resistivity (Ω/square)	4.8E+11	1.2E+11	2.3E+10	1.6E+09	1.5E+09	3.4E+09
UV stability (Grey scale)	2.5	2.5	2.5	4.5	4.5	4.5

[95] Table 2 shows surface resistivity and UV stability between polyurethane using aromatic diisocyanate and polyurethane using aliphatic diisocyanate, which have same

amount of hard segment (amount of diisocyanate + chain extender). Polyurethane polymers prepared using linear aliphatic diisocyanates, 1,6 hexamethylene(diisocyanate) (HDI), (Examples 8-10) have lower surface resistivity by about 1~2 order in comparison with polyurethane polymers prepared using aromatic isocyanates, 4,4-methylenbis(phenyl isocyanate) (MDI), (Comparatives 4-6) so polyurethane polymers of linear aliphatic diisocyanates (Examples 8-10) have better UV stability as well as superior electrostatic dissipative property at the same amount of hard segment.

[96]

[97] [Comparative Example 7]

[98] An aromatic polyurethane containing Lithium (bis)perfluoroethanesulfonimide ($\text{LiN}(\text{SO}_2\text{C}_2\text{F}_5)_2$) was prepared by one-shot polymerization process. The prepared aromatic polyurethane was composed of (A) 71.8 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, (B) 25.0 weight% of 4,4-methylenebis(phenyl isocyanate) (MDI) and (C) 3.2 weight% of ethylene glycol and the amount of lithium (bis)perfluoroethanesulfonimide ($\text{LiN}(\text{SO}_2\text{C}_2\text{F}_5)_2$) was 2.5 weight parts with respect to 100 weight parts of the total compounds of A+B+C.

[99] The prepared polyurethane was press-molded at 180°C to make a test specimen. The surface resistivity, volume resistivity and UV stability of the produced specimen were measured, and the results are set forth in Table 3.

[100] After the specimen conditioning for 24 hours at 23±1°C of temperature and 50±15% of relative humidity according to ASTM D-257, the surface resistivity and volume resistivity were measured by a resistivity meter. The UV stability was measured in the same manner as described in Comparative Example 1.

[101]

[102] [Example 11]

[103] Except for using 78.2 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, 18.3 weight% of 1,6-hexamethylene(diisocyanate) (HDI) and 3.5 weight% of ethylene glycol, the specimen of aliphatic polyurethane sheet was prepared in the same manner as described in Comparative Example 7. The surface resistivity, volume resistivity and UV stability of the produced specimen were measured, and the results are set forth in Table 3.

[104]

[105] [Example 12]

[106] Except for reacting (A) 78.2 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, (B) 18.3 weight% of 1,6-hexamethylene(diisocyanate) (HDI), (C) 3.5 weight% of ethylene glycol and 1.0 weight parts of lithium (bis)perfluoroethanesulfonimide ($\text{LiN}(\text{SO}_2\text{C}_2\text{F}_5)_2$) with respect to 100 weight parts of

total compounds (A+B+C), the specimen of aliphatic polyurethane sheet was prepared in the same manner as described in Comparative Example 7. The surface resistivity, volume resistivity and UV stability of produced specimen were measured, and the results are set forth in Table 3.

[107]

[108] [Example 13]

[109] Except for reacting (A) 78.2 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, (B) 18.3 weight% of 1,6-hexamethylene(diisocyanate) (HDI), (C) 3.5 weight% of ethylene glycol and 1.5 weight parts of lithium (bis)perfluoroethanesulfonimide ($\text{LiN}(\text{SO}_2\text{C}_2\text{F}_5)_2$) with respect to 100 weight parts of total compound (A+B+C), the specimen of aliphatic polyurethane sheet was prepared in the same manner as described in Comparative Example 7. The surface resistivity, volume resistivity and UV stability of the produced specimen were measured, and the results are set forth in Table 3.

[110]

[111] [Example 14]

[112] Except for reacting (A) 78.2 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, (B) 18.3 weight% of 1,6-hexamethylene(diisocyanate) (HDI), (C) 3.5 weight% of ethylene glycol and 2.0 weight parts of lithium (bis)perfluoroethanesulfonimide ($\text{LiN}(\text{SO}_2\text{C}_2\text{F}_5)_2$) with respect to 100 weight parts of total compound (A+B+C), the specimen of aliphatic polyurethane sheet was prepared in the same manner as described in Comparative Example 7. The surface resistivity, volume resistivity and UV stability of the produced specimen were measured, and the results are set forth in Table 3.

[113]

[114] [Example 15]

[115] Except for reacting (A) 78.2 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, (B) 18.3 weight% of 1,6-hexamethylene(diisocyanate) (HDI), (C) 3.5 weight% of ethylene glycol and 2.5 weight parts of lithium (bis)perfluoroethanesulfonimide ($\text{LiN}(\text{SO}_2\text{C}_2\text{F}_5)_2$) with respect to 100 weight parts of total compound (A+B+C), the specimen of aliphatic polyurethane sheet was prepared in the same manner as described in Comparative Example 7. The surface resistivity, volume resistivity and UV stability of the produced specimen were measured, and the results are set forth in Table 3.

[116] Table 3

[Table 3]

	Comparative Example 7	Example 11	Example 12	Example 13	Example 14	Example 15
polyethylene glycol (Mn=1500)	71.8%	78.2%	78.2%	78.2%	78.2%	78.2%
1,6-hexamethylene diisocyanate	-	18.3%	18.3%	18.3%	18.3%	18.3%
4,4-methylenebis(phenyl isocyanate)	25.0%	-	-	-	-	-
ethylene glycol	3.2%	3.5%	3.5%	3.5%	3.5%	3.5%
lithium(bis)perfluoroethanesulfonimide	2.5%	0	1.0%	1.5%	2.0%	2.5%
surface resistivity (Ω /square)	5.3E+07	2.9E+09	2.7E+07	2.1E+07	9.5E+06	9.0E+06
volume resistivity (Ω cm)	3.4E+08	2.3E+09	1.3E+08	4.7E+07	6.8E+07	2.9E+07
UV stability (Grey scale)	2.5	4.5	4.5	4.5	4.5	4.5

[117] Table 3 shows that the enhancement of electrostatic dissipative property by an addition of lithium (bis)perfluoroethanesulfonimide ($\text{Li}(\text{SO}_2\text{C}_2\text{F}_5)_2$), inorganic salt electrostatic dissipative property enhancer.

- [118] The test specimens of polyurethane prepared using 1,6-hexamethylene(diisocyanate) (HDI) of linear aliphatic diisocyanates (Examples 11-15) have lower surface resistivity and volume resistivity than test specimens of polyurethane sheets prepared using 4,4-methylenebis(phenyl isocyanate) (MDI) of aromatic diisocyanates (Comparative Example 7), even though amount of electrostatic dissipative property enhancer used for specimens in Examples 11-15 is less than that used for specimen in Comparative Example 7. Accordingly, the polyurethane polymer prepared using linear aliphatic diisocyanates has superior electrostatic dissipative property as well as superior UV stability to the polyurethane polymer prepared using aromatic diisocyanates.
- [119]
- [120] [Example 16]
- [121] Except for reacting (A) 78.2 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, (B) 18.3 weight% of 1,6-hexamethylene(diisocyanate) (HDI), (C) 3.5 weight% of ethylene glycol and 2.0 weight parts of lithium nitrate (LiNO_3) with respect to 100 weight parts of total compound (A+B+C), the test specimen of aliphatic polyurethane was prepared in the same manner as described in Comparative Example 7. The surface resistivity, volume resistivity and UV stability of the produced specimens were measured, and the results are set forth in Table 4.
- [122]
- [123] [Example 17]
- [124] Except for reacting (A) 78.2 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, (B) 18.3 weight% of 1,6-hexamethylene(diisocyanate) (HDI), (C) 3.5 weight% of ethylene glycol and 2.0 weight part of lithium perchlorate (LiClO_4) with respect to 100 weight parts of total compound (A+B+C), the test specimens of aliphatic polyurethane was prepared in the same manner as described in Comparative Example 7. The surface resistivity, volume resistivity and UV stability of the produced specimens were measured, and the results are set forth in Table 4.
- [125]
- [126] [Example 18]
- [127] Except for reacting (A) 78.2 weight% of polyethylene glycol whose number-average molecular weight (Mn) is 1500, (B) 18.3 weight% of 1,6-hexamethylene(diisocyanate) (HDI), (C) 3.5 weight% of ethylene glycol and 2.0 weight parts of organic salt consisting of imidazolium based cation and (bis)perfluoromethanesulfonimide anion with respect to 100 weight parts of total compound (A+B+C), the test specimens of aliphatic polyurethane was prepared in the same manner as described in Comparative Example 7. The surface resistivity, volume resistivity and UV stability of the produced specimens were measured, and the results are set forth in Table 4.
- [128] Table 4

[Table 4]

	Example 16	Example 17	Example 18
polyethylene glycol (Mn:1500)	78.2%	78.2%	78.2%
1,6-hexamethylene diisocyanate	18.3%	18.3%	18.3%
ethylene glycol	3.5%	3.5%	3.5%
lithium nitrate (LiNO ₃)	2	—	—
lithium perchlorate (LiClO ₄)	—	2	—
Imidazolium + -N(SO ₂ CF ₃) ₂	—	—	2
surface resistivity (Ω/square)	1.3E+ 07	6.7E+ 06	8.6E+ 06
volume resistivity (Ω cm)	1.0E+ 08	6.0E+ 07	7.1E+ 07
UV stability (Grey scale)	4.5	4.5	4.5

[129] Table 4 shows that adding various electrostatic dissipative property enhancers to aliphatic polyurethane using 1,6-hexamethylene(diisocyanate) (HDI) of linear aliphatic diisocyanate (Examples 16-18) gives excellent UV stability and superior electrostatic dissipative properties.

[130]

[131] [Comparative Example 8]

[132] A polymer mixture composed of 25 weight% of polyurethane in Comparative Example 1 and 75 weight% of glycol modified polyethylene terephthalate (PETG) was compounded by extruder and then pelletized. The surface resistivity, volume resistivity and static decay time of the sheet made of above pelletized polymer mixture through sheet extruder were measured and the results are set forth in Table 5.

[133] After the produced sheet conditioning for 24 hours at 23±1°C of temperature and 50±15% of relative humidity, the surface resistivity and volume resistivity were measured by a resistivity meter according to ASTM D-257. The UV stability was measured in the same manner as described in Comparative Example 1. Static decay time is the time required for an electrostatic potential of test specimen from 1000 V to 10V, and was measured in accordance with FTMS-1001C using charge plate monitor.

[134]

[135] [Example 19]

[136] Except for using 25 weight% of polyurethane in Example 1 and 75 weight% of glycol modified polyethylene terephthalate (PETG), the test sheet of polymer mixture was prepared in the same manner as described in Comparative Example 8. The surface resistivity, volume resistivity and static decay time of the test sheet were measured, and the results are set forth in Table 5.

[137]

[138] [Comparative Example 9]

[139] Except for using 25 weight% of polyurethane in Comparative Example 7 and 75 weight% of glycol modified polyethylene terephthalate (PETG), the test sheet of polymer mixture was manufactured in the same manner as described in Comparative Example 8. The surface resistivity, volume resistivity and static decay time of the test sheet were measured, and the results are set forth in Table 5.

[140]

[141] [Example 20]

[142] Except for using 25 weight% of polyurethane in Example 12 and 75 weight% of glycol modified polyethylene terephthalate (PETG), the test sheet of polymer mixture was prepared in the same manner as described in Comparative Example 8. The surface resistivity, volume resistivity and static decay time of the test sheet were measured, and the results are set forth in Table 5.

[143]

[144] [Example 21]

[145] Except for using 30 weight% of polyurethane in Example 12 and 70 weight% of glycol modified polyethylene terephthalate (PETG), the test sheet of polymer mixture was prepared in the same manner as described in Comparative Example 8. The surface resistivity, volume resistivity and static decay time of the test sheet were measured, and the results are set forth in Table 5.

[146]

[147] [Comparative Example 10]

[148] Except for using 40 weight% of polyurethane in Comparative Example 1 and 60 weight% of high impact polystyrene (HIPS), the test sheet of polymer mixture was prepared in the same manner as described in Comparative Example 8. The surface resistivity, volume resistivity and static decay time of the test sheet were measured, and the results are set forth in Table 5.

[149]

[150] [Example 22]

[151] Except for using 30 weight% of polyurethane in Example 12 and 70 weight% of high impact polystyrene (HIPS), the test sheet of polymer mixture was prepared in the same manner as described in Comparative Example 8. The surface resistivity, volume resistivity and static decay time of the test sheet were measured, and the results are set forth in Table 5.

[152]

[153] [Example 23]

[154] Except for using 40 weight% of polyurethane in Example 12 and 60 weight% of high

impact polystyrene (HIPS), the test sheet of polymer mixture was prepared in the same manner as described in Comparative Example 8. The surface resistivity, volume resistivity and static decay time of the test sheet were measured, and the results are set forth in Table 5.

[155] Table 5

[Table 5]

	Comparative Example 8	Example 19	Comparative Example 9	Example 20	Example 21	Comparative Example 10	Example 22	Example 23
PETG	75%	75%	75%	75%	70%	-	-	-
HIPS	-	-	-	-	-	60%	70%	60%
polyurethane in Comparative Example 1	25%	-	-	-	-	40%	-	-
polyurethane in Comparative Example 7	-	-	25%	-	-	-	-	-
polyurethane in Example 1	-	25%	-	-	-	-	-	-
polyurethane in Example 12	-	-	-	25%	30%	-	30%	40%
surface resistivity (Ω /square)	1.1E+11	1.4E+10	8.6E+09	6.4E+08	4.3E+08	2.0E+10	8.3E+08	5.4E+08
volume resistivity (Ω cm)	7.0E+11	8.5E+10	2.0E+09	1.4E+09	2.0E+09	8.0E+10	9.5E+08	5.9E+08
Static decay time(sec)	60	0.3	0.2	0.1	0.1	3.0	0.1	0.1
UV stability (Grey scale)	2.0	4.5	2.5	4.5	4.5	2.0	4.5	4.5

[156]

[157]

The polymer mixture containing polyurethane prepared using linear aliphatic di-isocyanate has relatively lower surface resistivity and volume resistivity by 1 order or

more, and also has relatively lower static decay time, in comparison with polymer mixture containing polyurethane prepared using aromatic diisocyanate. Moreover, the polymer mixture containing polyurethane prepared using linear aliphatic diisocyanate has superior UV stability to the polymer mixture containing polyurethane prepared using aromatic diisocyanate (Example 8 vs. Example 19, Comparative Example 9 vs. Example 20).

[158]

[159] As described above, the polymer and the polymer mixture of the present invention have lower surface resistivity and volume resistivity, permanent electrical property, recyclability and superior electrostatic dissipative properties. In addition, the polymer and the polymer mixture of the present invention have good light stability (less UV induced yellowing). Therefore, the polymer and the polymer mixture of the present invention can be widely used as packaging materials for parts of electrics/electronics industries sensitive to electrostatic charges.

[160]

[161] This application claims the priority benefit of Korean Patent Application No. 10-2006-0076329 filed on August 11, 2006. All disclosure of the Korean Patent application is incorporated herein by reference.

Claims

- [1] An electrostatic dissipative polymer comprising:
polyether based oligomer containing ethylene oxide;
aliphatic diisocyanate; and
 C_2-C_{10} chain extender containing primary hydroxyl or amine terminal group.
- [2] The electrostatic dissipative polymer according to Claim 1, wherein the aliphatic diisocyanate is selected from the group consisting of 1,6-hexamethylene diisocyanate (HDI), 4,4-dicyclohexylmethane diisocyanate (H_{12} MDI), 3-isocyanatomethyl-3,5,5-trimethyl cyclohexyl isocyanate (IPDI), 1,4-cyclohexyl diisocyanate (CHDI), 2,2,4-trimethylhexamethylene diisocyanate (TMDI) and mixture thereof.
- [3] The electrostatic dissipative polymer according to Claim 1, wherein the aliphatic diisocyanate is C_2-C_{10} linear aliphatic diisocyanate.
- [4] The electrostatic dissipative polymer according to Claim 1, wherein the aliphatic diisocyanate is 1,6-hexamethylene diisocyanate (HDI).
- [5] The electrostatic dissipative polymer according to Claim 1, wherein polyether based oligomer containing ethylene oxide is selected from the group consisting of (i) linear homopolymer consisting of the ethylene oxide, and hydroxyl or amine terminal groups, (ii) linear copolymer consisting of ethylene oxide and different kind of monomer, and hydroxyl or amine terminal groups, and (iii) mixture thereof, and number-average molecular weight of the oligomer is 500 to 10,000.
- [6] The electrostatic dissipative polymer according to Claim 5, wherein the monomer which composes the linear copolymer of polyether based oligomer with ethylene oxide is selected from the group consisting of 1,2-propylene oxide, 1,3-propylene oxide, epichlorohydrin, 1,2-butylene oxide, 1,3-butylene oxide, styrene oxide, allyl glycidyl ether, n-butyl glycidyl ether, glycidyl acrylate, glycidyl methacrylate, 2-ethylhexyl glycidyl ether and mixture thereof.
- [7] The electrostatic dissipative polymer according to Claim 1, wherein the chain extender is selected from the group consisting of ethylene glycol, diethylene glycol, propylene glycol, dipropylene glycol, 1,3-propanediol, 1,4-butanediol, 1,5-pentanediol, 1,10-decanediol, 2,2-dimethyl-1,3-propanediol, 1,4-cyclohexane dimethanol, hydroquinone bis(2-hydroxyethyl) ether, 1,6-hexanediol, neopentyl glycol, 1,2-propylenediamine, 1,3-propylenediamine, isophoronediamine, ethylenediamine, N-methylpropylene-1,3-diamine, N,N'-dimethylethylenediamine and mixture thereof.
- [8] The electrostatic dissipative polymer according to Claim 1, wherein the amount

of aliphatic diisocyanate is from 0.90 to 1.10 moles per 1.0 mole of the chain extender plus the polyether based oligomer.

- [9] The electrostatic dissipative polymer according to Claim 1, wherein the amount of the chain extender is from 0.1 to 30 moles per 1.0 mole of the polyether based oligomer.
- [10] The electrostatic dissipative polymer according to Claim 1, further comprising 0.1 to 20 weight parts of an electrostatic dissipative property enhancer in the form of inorganic or organic salts with respect to 100 weight parts of the total amount of the polyether based oligomer, the aliphatic diisocyanate and the chain extender.
- [11] The electrostatic dissipative polymer according to Claim 10, wherein the electrostatic dissipative property enhancer is an inorganic salt selected from the group consisting of lithium perchlorate (LiClO_4), lithium hexafluorophosphate (LiPF_6), lithium hexafluoro arsenate (LiAsF_6), lithium iodide (LiI), lithium bromide (LiBr), lithium thiocyanate (LiSCN), lithium nitrate (LiNO_3), lithium sulfide (Li_2S), lithium tris (trifluoromethylsulfonyl) methide ($\text{LiC}(\text{SO}_2\text{CF}_3)_3$), trifluoromethanesulfonic acid lithium salt (LiSO_3CF_3), lithium(bis)trifluoromethanesulfonimide ($\text{LiN}(\text{SO}_2\text{CF}_3)_2$), lithium(bis)perfluoroethanesulfonimide ($\text{LiN}(\text{SO}_2\text{C}_2\text{F}_5)_2$), 5-lithiosulfo isophthalic acid, 3,5-diiodo-2-hydroxybenzoic acid lithium salt, 3,5-diiodosalicylic acid lithium salt, beta-hydroxypyruvic acid lithium salt hydrate, carbamoylphosphate dilithium salt, p-toluenesulfinic acid lithium salt, poly(ethylene-co-methacrylic acid) lithium salt, toluene-4-sulfinic acid lithium salt anhydrous and mixture thereof.
- [12] The electrostatic dissipative polymer according to Claim 10, wherein the electrostatic dissipative property enhancer is an organic salt consisting of a nitrogen based cation and an anion, wherein the nitrogen based cation is selected from the group consisting of pyridinium, pyridazinium, pyrimidinium, pyrazinium, imidazolium, pyrazolium, thiazolium, oxazolium, triazolium, and mixture thereof, and the anion is selected from the group consisting of Cl^- , Br^- , F^- , HSO_4^- , H_2PO_4^- , NO_3^- , ClO_4^- , BF_4^- , PF_6^- , SbF_6^- , AsF_6^- , alkane sulfonate, aryl sulfonate, alkaryl sulfonate, perfluoroalkanesulfonates, cyanoperfluoroalkanesulfonylamides, bis(cyano)fluoroalkanesulfonylmethides, bis(perfluoroalkanesulfonyl)imides, bis(perfluoroalkanesulfonyl)methides, tris(perfluoroalkanesulfonyl)methides and mixture thereof.
- [13] A polymer mixture comprising:
an electrostatic dissipative polymer prepared by reacting a polyether based oligomer containing ethylene oxide, an aliphatic diisocyanate and a $\text{C}_2\text{-C}_{10}$ chain extender containing primary hydroxyl or amine terminal group; and

electrostatic dissipative property enhancer of inorganic or organic salts, wherein the amount of the electrostatic dissipative property enhancer is 0.1 to 20 weight parts with respect to 100 weight parts of the electrostatic dissipative polymer.

- [14] A polymer mixture comprising:
 a matrix polymer; and
 an electrostatic dissipative polymer prepared by reacting a polyether based oligomer containing ethylene oxide, an aliphatic diisocyanate and a C_2-C_{10} chain extender containing primary hydroxyl or amine terminal group, wherein the amount of the electrostatic dissipative polymer is 3 to 80 weight parts with respect to 100 weight parts of the matrix polymer.
- [15] The polymer mixture according to Claim 14, wherein the matrix polymer is selected from the group consisting of polyoxymethylene (POM), polyacryl, polymethyl methacrylate (PMMA), polystyrene (PS) homopolymer, polystyrene (PS) copolymer, styrene-acrylonitrile (SAN), acrylonitrile-butadiene-styrene (ABS), high impact polystyrene (HIPS), polycarbonate (PC), polyethylene (PE), polypropylene (PP) homopolymer, polypropylene (PP) copolymer, polyethylene terephthalate (PET), glycol modified polyethylene terephthalate (PETG), polybutylene terephthalate (PBT), polyether-ester copolymers, polyether-amide copolymers, Nylon 6, Nylon 6,6, Nylon 6,10, Nylon 6,12, Nylon 11, Nylon 12, polyamideimides, polyarylates, polyurethanes, ethylene propylene rubber (EPR), ethylene propylene diene monomer (EPDM), polyarylsulfone, polyethersulfone, polyphenylene sulfide, polyphenylene oxide, polyvinyl chloride (PVC), polysulfone, polyetherimide, polytetrafluoroethylene (PTFE), fluorinated propylene ethylene, polyfluoroalkoxy, polychlorotrifluoroethylene, polyvinylidene fluoride, polyvinyl fluoride, polyetherketone (PEK), polyether etherketone (PEEK), polyether ketone ketone and mixture thereof.
- [16] A molded article prepared by a polymer mixture, wherein the polymer mixture comprises a matrix polymer, and an electrostatic dissipative polymer prepared by reacting a polyether based oligomer containing ethylene oxide, an aliphatic diisocyanate and a C_2-C_{10} chain extender containing primary hydroxyl or amine terminal group, wherein the amount of the electrostatic dissipative polymer is 3 to 80 weight parts with respect to 100 weight parts of the matrix polymer.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2007/003856

A. CLASSIFICATION OF SUBJECT MATTER <i>C08G 18/48(2006.01)i</i> According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 8 : C08G 18/48 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) eKIPASS, STN(CAPLUS)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 02/064658 A (UNIROYAL CHEMICAL COMPANY, INC.) 22.08.2002 See the whole document(especially, claims 1-19).	1-16
A	US 6,331,577 B1 (Volkert et al.) 18.12.2001 See the whole document.	1-16
A	US 5,597,885 A (Lutter et al.) 28.01.1997 See the whole document.	1-16
A	JP 09-31362 A (NIPPON PAINT CO., LTD.) 04.02.1997 See the whole document.	1-16
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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Date of the actual completion of the international search 19 NOVEMBER 2007 (19.11.2007)	Date of mailing of the international search report 20 NOVEMBER 2007 (20.11.2007)	
Name and mailing address of the ISA/KR  Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer JWA, Seung Kwan Telephone No. 82-42-481-5537 	

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