

SPECIFICATION

HIGHLY ANTISTATIC LAMINATE

TECHNICAL FIELD OF THE INVENTION

The present invention relates to a highly antistatic laminate superior in
5 antistatic property under low humidity, water resistance and warm water
resistance, which has transparency and resistance to blocking. More particularly,
the present invention relates to a highly antistatic laminate having conductivity
that protects electronic materials such as IC, LSI, silicon wafer, hard disc, liquid
crystal substrate, electronic parts and the like during storage, transfer and
10 mounting thereof, from destruction and adhesion of dust etc. due to static
electricity and the like, which laminate is particularly suitable for carrier tape,
cover tape, container (e.g., tray), partition board used for clean room and the like
as well as suitable for substrates for OHP, X ray photograph film, silver salt coat
photograph film, printing paper, synthetic paper and the like.

BACKGROUND OF THE INVENTION

15 In recent years, miniaturized electronic parts, such as chip type electronic
parts, particularly IC, transistor, diode, crystal oscillator and the like, have been
increasingly demanded. They are housed in a pocket (concave) of a carrier tape
made from a plastic mold, and sealed with a cover film to give a package to be
20 supplied or transferred. When in use, the cover film is peeled off to take out the
content, which is then mounted, on a substrate and the like.

During the supply and transfer of a package, static electricity tends to
occur on the carrier tape, resulting in electrification, and electrification tends to
occur in the carrier tape during peeling off of the cover film. The electrification of
25 the carrier tape makes ensured mounting of electronic parts difficult and causes
problems such as static breakage and the like.

To solve these problems, conductivity or antistatic property is imparted to
a thermoplastic resin sheet such as polystyrene, polypropylene, poly(vinyl chloride),
polyethylene terephthalate and polyacrylonitrile to be used as a starting material of
30 a carrier tape, by kneading in or coating carbon black and surfactant.

To obtain a carrier tape having sufficient conductivity from a thermoplastic
resin sheet containing carbon black kneaded therein, however, carbon black

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should be added in a proportion of about 10-30 wt%. As a result, a molded carrier tape may have less tensile strength, breakage strength, elongation and the like. In addition, the tape have poor transparency, which makes confirmation of electronic parts housed in the concave of a carrier tape difficult, thereby making
5 positioning using an optical sensor unfeasible.

To solve the above-mentioned problems, a paint containing carbon black dispersed in a binder and the like is applied thin to the surface of a plastic sheet to form a conductive layer for ensured transparency. This treatment results in a slightly improved, though not sufficient, light permeation, and confirmation of
10 electronic parts housed in the concave of a carrier tape remains difficult. It is associated with a different problem in that carbon black does not follow expansion of the sheet during forming of the concave by deep drawing process and the like, thus failing to achieve desired conductivity.

In addition, a carrier tape obtained from a sheet using a surfactant has
15 superior transparency, but has low conductivity that is greatly dependent on humidity, thus impairing stable antistatic property.

The tendency toward recycled use of an antistatic container for electronic materials is growing in recent years. When the above-mentioned antistatic container containing a surfactant is washed with water for repeated use, the
20 surfactant elutes out, which prevents recycled use thereof.

While silicon is applied to the surface of a thermoplastic resin sheet, such as a polyester sheet, to prevent blocking, silicon can degrade printability and heat sealing property.

The present invention resolves the defects of the prior art techniques, and
25 provides a highly antistatic laminate having superior transparency, resistance to blocking and antistatic property under low humidity, after immersion in water and after forming, which certainly prevents occurrence of static electricity in any environment.

SUMMARY OF THE INVENTION

30 Such object can be achieved by the present invention set forth in the following.

Accordingly, the present invention provides the following.

(1) A highly antistatic laminate comprising a substrate and a conductive layer

laminated on at least one side of the substrate, said conductive layer comprising a conductive polymer and having been cured.

(2) The highly antistatic laminate of (1) above, wherein the conductive layer further comprises a thermoplastic polymer.

5 (3) The highly antistatic laminate of (1) or (2) above, wherein the conductive layer is cured by crosslinking reaction with a crosslinking agent.

(4) The highly antistatic laminate of (1) above, wherein the conductive polymer is a conductive polymer soluble in water or an organic solvent.

10 (5) The highly antistatic laminate of (1) above, wherein the conductive polymer is polyaniline or a derivative thereof.

(6) The highly antistatic laminate of (1) above, wherein the conductive polymer is sulfonic acid group-containing polyaniline or a derivative thereof.

15 (7) The highly antistatic laminate of (1) above, wherein the conductive polymer comprises an alkoxy-substituted aminobenzenesulfonic acid as a polymerizable component.

(8) The highly antistatic laminate of (1) above, wherein the conductive polymer comprises aminoanisolesulfonic acid as a polymerizable component.

(9) The highly antistatic laminate of (2) above, wherein the thermoplastic polymer is a polyester having a hydrophilic group.

20 (10) The highly antistatic laminate of (2) above, wherein the thermoplastic polymer is a copolymerized polyester obtained by copolymerizing a dicarboxylic acid having a hydrophilic group in a proportion of 0.5-15 mol% of the entire dicarboxylic acid component and/or a diol having a hydrophilic group in a proportion of 0.5-15 mol% of the entire diol component.

25 (11) The highly antistatic laminate of (2) above, wherein the thermoplastic polymer is a graft polyester obtained by graft polymerization of a vinyl monomer having a hydrophilic group to polyester.

30 (12) The highly antistatic laminate of (3) above, wherein the crosslinking agent is at least one member selected from the group consisting of a multifunctional epoxy compound, a multifunctional isocyanate compound, a multifunctional oxazoline compound, a multifunctional vinyl compound, a multifunctional acrylic compound, a multifunctional carboxylic acid compound, a multifunctional amine compound, a multifunctional hydroxy compound and a multifunctional mercapto

compound.

(13) The highly antistatic laminate of (1) or (2) above, wherein the conductive layer is cured by self-crosslinking of a conductive polymer and/or a thermoplastic polymer.

- 5 (14) The highly antistatic laminate of (1) above, wherein the conductive layer further comprises a surfactant.

(15) The highly antistatic laminate of (1) above, wherein the substrate is a film or sheet made from an organic resin, and the highly antistatic laminate has a haze of not more than 5.0.

- 10 (16) The highly antistatic laminate of (1) above, wherein the substrate is a film or sheet made from a material selected from the group consisting of polyester, polycarbonate, polyolefin and polyurethane.

(17) A highly antistatic laminate comprising a substrate and a conductive layer laminated on at least one side of the substrate,

- 15 said conductive layer having a surface resistance (RS_0) at 25°C, relative humidity 15% of not more than $10^{11} \Omega/\square$, and a ratio (RS_1/RS_0) of surface resistance (RS_1) at 25°C, relative humidity 15% after immersing the highly antistatic laminate in pure water at 40°C for one hour, to RS_0 of not more than 10.

- (18) The highly antistatic laminate of (17) above, wherein the conductive layer
20 further has a ratio (RS_2/RS_0) of surface resistance (RS_2) at 25°C, relative humidity 15% after stretching the highly antistatic laminate by 150%, to RS_0 of not more than 10.

(19) The highly antistatic laminate of (17) or (18) above, wherein the conductive layer comprises a conductive polymer and have been cured.

- 25 (20) A container for electronic parts, which is obtained by forming the highly antistatic laminate of (1), (17) or (18) above.

(21) The container of (20) above, which is a tray.

(22) A carrier tape for electronic parts, which is obtained by forming the highly antistatic laminate of (1), (17) or (18) above.

- 30 (23) A tray for electronic parts, which is obtained by forming a highly antistatic laminate comprising a substrate and a conductive layer laminated on at least one side of the substrate, which tray comprises a concave and a flange on the outer periphery thereof,

wherein a surface resistance (RS_3) at 25°C, relative humidity 15% of the conductive layer of the flange is not more than $10^{11} \Omega / \square$, a ratio (RS_4/RS_3) of surface resistance (RS_4) at 25°C, relative humidity 15% of the conductive layer of the flange after immersing the tray in pure water at 40°C for one hour, to RS_3 is not
 5 more than 10, and a ratio (RS_5/RS_3) of surface resistance (RS_5) at 25°C, relative humidity 15% of the conductive layer of the concave having a thickness corresponding to 0.5 to 0.7-fold of the thickness of the flange, to RS_3 is not more than 100.

(24) The tray for electronic parts of the above (23), which is obtained by forming the
 10 highly antistatic laminate of (1), (17) or (18) above.

(25) A carrier tape for electronic parts, which is obtained by forming a highly antistatic laminate comprising a substrate and a conductive layer laminated on at least one side of the substrate, which carrier tape comprises plural concaves to house plural electronic parts disposed along the longitudinal direction and a flange
 15 on the outer periphery thereof,

wherein a surface resistance (RS_6) at 25°C, relative humidity 15% of the conductive layer of the flange is not more than $10^{11} \Omega / \square$, a ratio (RS_7/RS_6) of a surface resistance (RS_7) at 25°C, relative humidity 15% of the conductive layer of the flange after immersing the carrier tape in pure water at 40°C for one hour, to
 20 RS_6 is not more than 10, and a ratio (RS_8/RS_6) of a surface resistance (RS_8) at 25°C, relative humidity 15% of the conductive layer of the concave having a thickness corresponding to 0.5 to 0.7-fold of the thickness of the flange, to RS_6 is not more than 100.

(26) The carrier tape for electronic parts of the above (25), which is obtained by
 25 forming the highly antistatic laminate of (1), (17) or (18) above.

(27) A buffering package material comprising a container and a pair of stretch films for carrying an article to be packaged therebetween, said stretch films having a pair of opposing ends fixed in the container, wherein said stretch films are the members selected from the group consisting of the highly antistatic laminates of
 30 (1), (17) and (18) above.

(28) An IC card which is obtained by using the highly antistatic laminate of (1), (17) or (18) above as a substrate for the card.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows one embodiment of the buffering package material of the present invention, wherein 1 is a container, 2 are highly antistatic laminates, 3 is an article to be packaged, 4 is a lid and 5 is a frame.

DETAILED DESCRIPTION OF THE INVENTION

5 The present invention is explained in detail in the following.

The highly antistatic laminate of the present invention comprises a substrate and a conductive layer laminated on at least one side of the substrate.

While the kind of substrate is not particularly limited in the present invention, inorganic substrate and/or organic substrate can be used. Examples
10 of the inorganic substrate include substrates made from metallic materials such as steel, aluminum, stainless and the like, inorganic polymer materials obtained by hydrolysis of alkolate of silica, aluminum, titanium and the like, and the like. Examples of the organic substrate include a mono or poly-layer substrate made from single or plural kinds from thermoplastic resin materials such as polyester,
15 nylon (e.g., 6-nylon, 6,6-nylon and the like), polyolefin (e.g., polypropylene, polyethylene, polymethylpentene and the like), polystyrene, poly(vinyl chloride), polyurethane, polycarbonate and the like, and a substrate made from a thermosetting resin material and the like. Of the above-mentioned thermoplastic resin materials, polyester, polycarbonate, polyolefin and polyurethane can be
20 preferably used. A substrate made from a hybrid material of the above-mentioned inorganic material and the above-mentioned organic material can be also used.

The above-mentioned substrate preferably has a planar form such as a film, a sheet and the like. For example, a polyester film or sheet, a steel board,
25 aluminum board, stainless board and the like are used.

While the following explanation focuses on a polyester sheet or film as a substrate, the substrate of the highly antistatic laminate of the present invention is not limited to a polyester sheet or film. By polyester is meant here a polymer mainly obtained from an aliphatic and/or aromatic dicarboxylic acid component
30 and an aliphatic and/or aromatic diol component. Examples thereof include homopolymers such as polyethylene terephthalate (PET), polyethylene naphthalate (PEN), those obtained by partially or entirely substituting the terephthalic acid component of PET by one or more dicarboxylic acid components

such as orthophthalic acid, isophthalic acid, adipic acid, diphenylcarboxylic acid, diphenyl ethercarboxylic acid, sebacic acid, naphthalenedicarboxylic acid and the like, those obtained by partially or entirely substituting the naphthalenedicarboxylic acid component of PEN by one or more dicarboxylic acid components such as terephthalic acid, orthophthalic acid, isophthalic acid, adipic acid, diphenylcarboxylic acid, diphenyl ethercarboxylic acid, sebacic acid and the like, and those obtained by partially or entirely substituting the ethylene glycol component of PET and/or PEN by one or more glycol components such as diethylene glycol, triethylene glycol, hexamethylene glycol, propylene glycol, cyclohexane glycol, neopentyl glycol, butylene glycol, trimethylene glycol and the like.

This polyester sheet or film may contain an inorganic or organic lubricant such as silica, talc, calcium carbonate, alumina, silica alumina, titanium oxide, zeolite, polystyrene particle and the like. From the aspect of transparency, the amount of the lubricant is preferably small, wherein the amount is dependent on the particle size of the lubricant. In general, the lubricant preferably has an average particle size of not more than 5 microns, more preferably not more than 2 microns, and the amount to be added is preferably in a proportion of not more than 5000 ppm, more preferably not more than 3000 ppm. Moreover, an additive, UV absorbent, stabilizer or pigment can be added as long as the inherent property of the polymer is not affected.

In the present invention, a conductive layer is laminated on at least one side of the above-mentioned substrate, wherein the conductive layer contains a conductive polymer and is cured. By the function of the conductive polymer to be added, conductivity can be imparted and the antistatic property, particularly that under low humidity, can be improved.

The conductive polymer in the present invention is not particularly limited, but a conductive polymer having a π -electron conjugated structure is used, such as polyaniline, polypyrrole, polythiophene and derivatives thereof, with preference given to a conductive polymer capable of dissolution or dispersion in water or an organic solvent, particularly water, and a conductive polymer solubilized or dispersed in water or an organic solvent by the aid of a dopant.

Examples of such conductive polymer include polyaniline and copolymers

thereof that are solubilized or dispersed by a dopant, such as an inorganic acid (e.g., hydrochloric acid, perchloric acid, sulfuric acid and the like), sulfonic acid group-containing compound (e.g., benzenesulfonic acid, naphthalenesulfonic acid, polystyrenesulfonic acid and the like); sulfonated polyaniline wherein one or more
 5 hydrogen atoms of a part or entirety of benzene rings of polyaniline is substituted by sulfonic acid group; long-chain alkyl-bonded polypyrrole or polythiophene; and derivatives thereof. In the present invention, sulfonated polyaniline, and polyaniline and derivatives thereof solubilized by a dopant, such as the above-mentioned acidic compounds, are particularly preferable.

10 The sulfonated polyaniline to be used in the present invention is explained in detail later. This sulfonated polyaniline is a polymer wherein one or more hydrogen atoms of a part or the entirety of benzene rings of polyaniline is substituted by sulfonic acid group and the structure thereof is not subject to any particular limitation. Examples thereof include sulfonated polyaniline obtained
 15 by sulfonating polyaniline with con. sulfuric acid and sulfonated polyaniline obtained by polymerizing aminobenzenesulfonic acids alone or with other anilines. In the present invention, the latter sulfonated polyaniline is preferable, and as the aminobenzenesulfonic acids, alkoxy-substituted aminobenzenesulfonic acids and particularly aminoanisolesulfonic acids are preferable.

20 Examples of aminoanisolesulfonic acids include 2-aminoaniso-3-sulfonic acid, 2-aminoaniso-4-sulfonic acid, 2-aminoaniso-5-sulfonic acid, 2-aminoaniso-6-sulfonic acid, 3-aminoaniso-2-sulfonic acid, 3-aminoaniso-4-sulfonic acid, 3-aminoaniso-5-sulfonic acid, 3-aminoaniso-6-sulfonic acid, 4-aminoaniso-2-sulfonic acid, 4-aminoaniso-3-sulfonic acid and the like. It is
 25 possible to use a compound wherein methoxy of the above-mentioned aminoanisolesulfonic acids is substituted by other alkoxy (e.g., ethoxy, isopropoxy and the like). Of the above-mentioned aminoanisolesulfonic acids, 2-aminoaniso-3-sulfonic acid, 2-aminoaniso-4-sulfonic acid, 2-aminoaniso-5-sulfonic acid, 2-aminoaniso-6-sulfonic acid, 3-aminoaniso-2-sulfonic acid, 3-
 30 aminoaniso-4-sulfonic acid and 3-aminoaniso-6-sulfonic acid are preferably used.

With regard to the sulfonated polyaniline to be used in the present invention, the content of the sulfonic acid group is preferably not less than 70

mol%, more preferably not less than 80 mol%, and particularly preferably 100 mol% of the amount of benzene ring. It is possible that a benzene ring containing sulfonic acid group and a benzene ring without sulfonic acid group be concurrently present or alternately disposed. When the content of the sulfonic acid group is less than 70 mol%, the solubility or dispersibility of sulfonated polyaniline in water, alcohol or a mixed solvent thereof and the like may become insufficient, thus resulting in poor coating property and extensibility on a substrate and dramatically reduced conductivity of the obtained coating layer.

The sulfonated polyaniline to be used in the present invention has a number average molecular weight of preferably 300-500000, wherein not less than 10000 is particularly preferable for the aforesaid solubility in a solvent and strength of the coating layer. Sulfonated polyaniline and a derivative thereof having a low molecular weight may be polymerized with a compound having two or more groups reactive with amino, such as diepoxy compound, diisocyanate compound and the like, and used.

For coating sulfonated polyaniline to a substrate, a coating solution is prepared from a predetermined solvent. The solution contains sulfonated polyaniline at a proportion of preferably 0.01-10 parts by weight and more preferably 0.1-2 parts by weight relative to 100 parts by weight of a solvent. When sulfonated polyaniline is used in a proportion of less than 0.01 part by weight, the solution may show poor long-term storability. As a result, it allows occurrence of pin holes in the coating layer and extremely low conductivity of the coating layer. When the amount thereof exceeds 10 parts by weight, solubility and dispersibility of sulfonated polyaniline in water or water/organic solvent, as well as coating property to substrate tend to be degraded, which is unpreferable.

The above-mentioned solvent may be any as long as it does not dissolve or swell a substrate such as polyester film and the like. Preferred are water and a mixed solvent of water/organic solvent such as alcohol, in view of the use environment and possible improvement in coating property and conductivity induced thereby.

The organic solvent is preferably alcohols such as methanol, ethanol, propanol, isopropyl alcohol and the like, ketones such as acetone, methyl ethyl ketone and methyl isobutyl ketone, cellosolves such as methyl cellosolve, ethyl

cellosolve and the like, propylene glycols such as methylpropylene glycol, ethylpropylene glycol and the like, amides such as dimethylformamide, dimethylacetamide and the like, and pyrrolidones such as N-methylpyrrolidone, N-ethylpyrrolidone and the like, which are used upon mixture with water at an optional ratio.

Specific examples include water/methanol, water/ethanol, water/propanol, water/isopropanol, water/methylpropylene glycol, water/ethylpropylene glycol and the like. The ratio thereof is preferably water/organic solvent=1/10 - 10/1.

From the aspect of adhesion to substrate, extensibility and strength, the conductive layer preferably contains a thermoplastic polymer in addition to a conductive polymer. The thermoplastic polymer to be used in the present invention includes thermoplastic polymers such as polyester, polyamide (e.g., nylon, aromatic polyamide and the like), polyolefin (e.g., polyethylene, polypropylene and the like), poly(vinyl chloride), polyurethane, polyamidimide, polyimide and the like, and the form thereof is not particularly limited. In view of the dispersibility in water, a thermoplastic polymer having a hydrophilic group is preferable for the present invention. The hydrophilic group shows affinity for water, and is exemplified by acidic group such as sulfonic acid group, carboxylic group, phosphoric acid group and the like, alkali metal salt groups thereof, ammonium salt groups thereof, amino group and hydroxy group. It is also possible to use a thermoplastic polymer having a group capable of converting to a hydrophilic group and to convert this polymer to a thermoplastic polymer having a hydrophilic group. The group capable of converting to a hydrophilic group is, for example, ester group, amide group, acid anhydride group, glycidyl group, nitrile group, chloro group and the like.

An aqueous dispersion of the above-mentioned thermoplastic polymer can be desirably obtained by dissolving a thermoplastic polymer in a suitable water-soluble organic compound, and dispersing the solution in water. For example, a thermoplastic polymer having a hydrophilic group is preferably mixed with a water-soluble organic compound at 50-200°C and dissolved, and water is added and stirred to give a dispersion; or this mixture is added to water and the mixture is stirred to give a dispersion; or a thermoplastic polymer having a hydrophilic

group is stirred in the presence of a water-soluble organic compound in water at 40-120°C.

The above-mentioned water-soluble organic compound has a solubility in water at 20°C of not less than 20 g/l, which is specifically aliphatic or alicyclic
 5 alcohols, ethers, esters, ketones and the like. Examples thereof include monovalent alcohols such as methanol, ethanol, isopropanol, n-butanol and the like; glycols such as ethylene glycol, propylene glycol and the like; glycol derivatives such as methyl cellosolve, ethyl cellosolve, n-butyl cellosolve and the like; ethers such as dioxane, tetrahydrofuran and the like; esters such as acetates and the
 10 like; and ketones such as methyl ethyl ketone and the like. These organic compounds are used alone or in combination. Of the above-mentioned water-soluble organic compounds, isopropanol, butyl cellosolve and ethyl cellosolve are preferable in view of dispersibility in water and coating property to a substrate.

In the present invention, hydrophilic group-containing polyesters can be
 15 preferably used as thermoplastic polymers in view of conductivity. A hydrophilic group can be introduced into the polyester by, for example, reacting polyester with con. sulfuric acid to introduce sulfonic acid group, or using a monomer having a hydrophilic group as a copolymerizable component, with preference given to the latter method for easy production.

20 The hydrophilic group-containing polyester preferable for the present invention is a substantially water-insoluble copolymerized polyester obtained by polymerizing dicarboxylic acid having a hydrophilic group in a proportion of 0.5 – 15 mol% and dicarboxylic acid without a hydrophilic group in a proportion of 85 - 99.5 mol%, both relative to the total dicarboxylic acid component, and/or diol
 25 having a hydrophilic group in a proportion of 0.5 – 15 mol% and diol without a hydrophilic group in a proportion of 85 - 99.5 mol%, both relative to the total diol component. When the content(s) of dicarboxylic acid and/or diol having a hydrophilic group exceeds 15 mol%, the copolymerized polyester may have lower water resistance, whereas when it is less than 0.5 mol%, copolymerized polyester
 30 may not easily disperse in water, as a result of which a water dispersion may not be applied to a substrate with ease.

In the present invention, the hydrophilic group is particularly preferably sulfonic acid metal salt group, in which case a sulfonic acid metal salt group-

containing dicarboxylic acid is preferably used as a monomer starting material. Examples of sulfonic acid metal salt group-containing dicarboxylic acid include metal salts of sulfoterephthalic acid, 5-sulfoisophthalic acid, 4-sulfophthalic acid, 4-sulfonaphthalene-2,7-dicarboxylic acid, 5-(4-sulfophenoxy)isophthalic acid and
 5 the like, with particular preference given to sodium 5-sulfoisophthalate and sodium sulfoterephthalate. These sulfonic acid metal salt group-containing dicarboxylic acid components are contained in a proportion of preferably 0.5 – 15 mol%, particularly preferably 2.0 – 10 mol%, of the total dicarboxylic acid component.

10 The dispersibility of the above-mentioned polyester in water varies depending on the kind and mixing ratio of the copolymerizable component, water-soluble organic compound as a solvent and the like. The content of the hydrophilic group is preferably small as long as the dispersibility in water is not impaired, for the sake of better water resistance.

15 The dicarboxylic acid of the above-mentioned polyester, which is without a hydrophilic group, may be aromatic, aliphatic or alicyclic dicarboxylic acid. Terephthalic acid, isophthalic acid, orthophthalic acid, 2,6-naphthalenedicarboxylic acid and the like can be used as the aromatic dicarboxylic acid. These aromatic dicarboxylic acids are preferably contained in a
 20 proportion of not less than 40 mol% of the total dicarboxylic acid component. When it is less than 40 mol%, the polyester may have less mechanical strength and water resistance. Examples of aliphatic or alicyclic dicarboxylic acid include succinic acid, adipic acid, sebacic acid, 1,3-cyclopentanedicarboxylic acid, 1,2-cyclohexanedicarboxylic acid, 1,4-cyclohexanedicarboxylic acid and the like.

25 The glycol component of the above-mentioned polyester is mainly aliphatic glycol having 2 to 8 carbon atoms, which is exemplified by ethylene glycol, trimethylene glycol, propylene glycol, 1,4-butanediol, neopentyl glycol, 1,6-hexanediol, 1,2-cyclohexanedimethanol, 1,3-cyclohexanedimethanol, 1,4-cyclohexanedimethanol, p-xylene glycol, diethylene glycol, triethylene glycol and
 30 the like. Polyethers such as polyethylene glycol, polypropylene glycol, polytetramethylene glycol and the like can be also used. Moreover, oxycarboxylic acid component such as p-oxyethoxybenzoic acid may be copolymerized, and dicarboxylic acid and/or glycol component containing a small amount of amide

bond, urethane bond, ether bond, carbonate bond and the like may be copolymerized.

The above-mentioned hydrophilic group-containing polyester is obtained by ester exchange reaction, condensation polymerization reaction and the like of
 5 the above-mentioned dicarboxylic acid component and the above-mentioned glycol component, according to a conventional method. The obtained hydrophilic group-containing polyester is heated and stirred with, for example, a solvent such as n-butyl cellosolve, followed by addition of water while stirring to give an aqueous solution or aqueous dispersion.

10 In the present invention, a graft polyester obtained by graft polymerization of vinyl monomer having a hydrophilic group, which is a polymerization component of a branch polymer, to the side chain of the polyester which is a backbone polymer, can be also used as a thermoplastic polymer. The use of this polymer results in an improved transparency, adhesion to a substrate and
 15 durability.

The vinyl monomer having a hydrophilic group which can be grafted to polyester may be vinyl monomer having carboxylic group, sulfonic acid group, alkali metal salt groups thereof, ammonium salt groups thereof, hydroxy group, amide group and the like, and vinyl monomer having a group capable of converting
 20 to a hydrophilic group, such as ester group, amide group, acid anhydride group, glycidyl group, chloro group, nitrile group and the like. Of these, vinyl monomer having carboxylic group or an alkali metal salt group thereof or an ammonium salt group thereof is most preferable.

Examples thereof include monomer having carboxylic group or a salt
 25 group thereof, such as acrylic acid, methacrylic acid, alkali metal salts thereof, ammonium salts thereof; alkyl acrylates such as methyl acrylate, ethyl acrylate, n-propyl acrylate, isopropyl acrylate, n-butyl acrylate, t-butyl acrylate and the like; alkyl methacrylates such as methyl methacrylate, ethyl methacrylate, n-propyl methacrylate, isopropyl methacrylate, n-butyl methacrylate, t-butyl methacrylate
 30 and the like; hydroxy-containing monomers such as 2-hydroxyethyl acrylate, 2-hydroxyethyl methacrylate and the like; amide-containing monomers such as acrylamide, methacrylamide, N-methylacrylamide, N-methylmethacrylamide, N-methylolacrylamide, N-methylolmethacrylamide, N-methoxymethylacrylamide, N-

methoxymethylmethacrylamide, N,N-dimethylolacrylamide, N-phenylacrylamide and the like; epoxy-containing monomers such as glycidyl acrylate, glycidyl methacrylate and the like; and the like.

Examples of other monomers having a hydrophilic group are epoxy-
 5 containing monomers such as arylglycidyl ether and the like, monomer containing sulfonic acid group or a salt group thereof, such as stylenesulfonic acid, vinylsulfonic acid and salts thereof; monomer containing carboxylic group or a salt group thereof, such as crotonic acid, itaconic acid, maleic acid, fumaric acid and salts thereof; and monomer containing acid anhydride group, such as anhydrous
 10 maleic acid, anhydrous itaconic acid and the like.

These can be used concurrently with other monomers. Examples of other monomers include vinylisocyanate, arylisocyanate, styrene, vinylmethyl ether, vinylethyl ether, acrylonitrile, methacrylonitrile, vinylidene chloride, vinyl acetate, vinyl chloride and the like. One or more members therefrom can be
 15 copolymerized. The molar ratio of monomer having a hydrophilic group to other monomer is preferably 30/70 - 100/0. When the ratio of vinyl monomer having a hydrophilic group is less than 30 mol%, the coating layer may not have sufficiently high transparency.

The dicarboxylic component of the polyester, which is a backbone polymer
 20 of the above-mentioned graft polyester, may be aromatic, aliphatic or alicyclic dicarboxylic acid. Examples of the aromatic dicarboxylic acid include terephthalic acid, isophthalic acid, orthophthalic acid, 2,6-naphthalenedicarboxylic acid and the like. These aromatic dicarboxylic acids are preferably contained in a proportion of not less than 40 mol% of the total
 25 dicarboxylic acid component. When it is less than 40 mol%, the graft polyester may have less mechanical strength and water resistance. The aliphatic and alicyclic dicarboxylic acids may be succinic acid, adipic acid, sebacic acid, 1,3-cyclopentanedicarboxylic acid, 1,2-cyclohexanedicarboxylic acid, 1,4-cyclohexanedicarboxylic acid and the like. As the glycol component, aliphatic
 30 glycol having 2 to 8 carbon atoms is mainly used, which is specifically ethylene glycol, trimethylene glycol, propylene glycol, 1,4-butanediol, neopentyl glycol, 1,6-hexanediol, 1,2-cyclohexanedimethanol, 1,3-cyclohexanedimethanol, 1,4-cyclohexanedimethanol, p-xylene glycol, diethylene glycol, triethylene glycol and

the like. In addition, polyethers such as polyethylene glycol, polypropylene glycol, polytetramethylene glycol and the like can be also used. Moreover, oxycarboxylic acid component such as p-oxyethoxybenzoic acid may be copolymerized, and dicarboxylic acid and/or glycol component containing a small amount of amide bond, urethane bond, ether bond, carbonate bond and the like may be copolymerized.

The vinyl monomer having a hydrophilic group can be grafted to the polyester by a known graft polymerization method. Typical examples thereof include the following.

For example, usable are radical polymerization wherein light, heat, radiation and the like are used to produce radicals in the polyester, which is a backbone polymer, and the vinyl monomer is graft polymerized; cation polymerization wherein AlCl_3 , TiCl_4 and the like is used as a catalyst to produce cations and the vinyl monomer is graft polymerized; anion polymerization wherein metal Na, metal Li and the like are used to produce anions and the vinyl monomer is graft polymerized, and the like.

In addition, a method comprising introducing a polymerizable unsaturated double bond into the polyester, which is a backbone polymer, and reacting vinyl monomer therewith. The monomer having a polymerizable unsaturated double bond may be fumaric acid, maleic acid, maleic anhydride, itaconic acid, citraconic acid, 2,5-norbornenedicarboxylic acid and anhydride thereof, anhydrous tetrahydrophthalic acid and the like. Of these, the most preferable is fumaric acid, maleic acid and 2,5-norbornenedicarboxylic acid.

In addition, a method comprising reacting a polyester having a functional group on the side chain, which is a backbone polymer, and a branch polymer having a group reactive with the aforementioned functional group on an end can be used. For example, a polyester having an active hydrogen, such as $-\text{OH}$, $-\text{SH}$, $-\text{NH}_2$, $-\text{COOH}$, CONH_2 and the like, on the side chain and a vinyl polymer having a hydrogen receptor group, such as $-\text{N}=\text{C}=\text{O}$, $-\text{C}=\text{C}=\text{O}$, epoxy group, glycidyl group, ethylenesulfide group and the like, on the other end are reacted, or the reaction is performed in the reverse combination.

In the present invention, the polyester which is a backbone polymer and the vinyl monomer to be grafted are used in a weight ratio of preferably 40/60 -

95/5, more preferably 55/45 - 93/7, particularly preferably 60/40 - 90/10.

When the weight ratio of the polyester is less than 40%, the vinyl monomer may not react completely and the remainder may impair the properties that the conventional polyesters have, such as heat resistance, processability and the like.

- 5 Conversely, when it exceeds 95%, an improvement in conductivity and transparency, which is the object of the present invention, sometimes may not be fully accomplished.

For an improved surface hardness of the conductive layer, a polycarboxylic group-containing monomer, such as trimellitic acid, trimesic acid, pyromellitic
10 acid, anhydrous trimellitic acid, anhydrous pyromellitic acid and the like, may be used in a proportion of not more than 5 mol% as the polymerizable component of the above-mentioned hydrophilic group-containing polyester and graft polyester. When its content exceeds 5 mol%, however, the obtained polymer may become thermally instable, is easily gelled, and is not preferable as the component of the
15 conductive layer of the present invention.

As mentioned later, when a thermoplastic polymer is capable of self-crosslinking, a crosslinking reactive group is introduced into this thermoplastic polymer. Examples of the crosslinking reactive group include acrylic group, vinyl
20 group, epoxy group, isocyanate group, oxazoline group, silanol group, acid chloride group, carboxylic group, amino group, hydroxy group, mercapto group and the like. These crosslinking reactive groups are introduced by polymerization of polymerizable component having a crosslinking reactive group. For example, when the thermoplastic polymer is the above-mentioned hydrophilic group-containing polyester, a monomer having a crosslinking reactive group is used as
25 the dicarboxylic acid component and/or diol component of the polyester, and when the thermoplastic polymer is the above-mentioned graft polyester, a monomer having a crosslinking reactive group is used as the dicarboxylic acid component and/or diol component of the polyester or a monomer having a crosslinking reactive group is used as the vinyl monomer.

30 While the content of the above-mentioned thermoplastic polymer is not particularly limited, in view of the conductivity and mechanical property of the obtained the conductive layer, it is preferably 50 - 2000 parts by weight, more preferably 100 - 1500 parts by weight, most preferably 200 - 1000 parts by weight,

relative to 100 parts by weight of the conductive polymer such as sulfonated polyaniline and the like.

The highly antistatic laminate of the present invention needs to include a conductive layer cured due to a three-dimensional crosslinking to improve water
 5 resistance of the conductive layer and to suppress reduction of antistatic property after immersion in water. The method of crosslinking includes a method using a crosslinking agent, a method comprising self-crosslinking by the introduction of a crosslinking reactive group into a conductive polymer and/or thermoplastic polymer, a method comprising crosslinking of conductive polymer and/or
 10 thermoplastic polymer by excess heating or radiation, and the like.

The crosslinking agent to be used in the present invention may be a compound having, in a molecule, two or more reactive groups (e.g., acrylic group, vinyl group, epoxy group, isocyanate group, oxazoline group, silanol group, acid chloride group, carboxylic group, amino group, hydroxy group, mercapto group
 15 and the like), or a compound that does not react in a solvent such as water and the like under normal conditions but, by the treatment of heating, pH adjustment and the like, has, in a molecule, two or more groups regenerated to be the above-mentioned reactive group such as isocyanate group and the like, both of which compounds being capable of intermolecular self-crosslinking on its own to form a
 20 three-dimensional net structure, or capable of reacting with an organic compound having an active hydrogen, inorganic compound having an active hydrogen or polymer compound having an active hydrogen (which may be the above-mentioned conductive polymer or thermoplastic polymer) to form a crosslinking bond. Examples of such compound include multifunctional vinyl compound,
 25 multifunctional acrylic compound, multifunctional epoxy compound, multifunctional isocyanate compound, multifunctional oxazoline compound, multifunctional carboxylic acid compound, multifunctional amine compound, multifunctional hydroxy compound, multifunctional mercapto compound and the like.

Examples of multifunctional epoxy compound include bisphenol A epoxy
 30 resin using bisphenol A as a starting material, sorbitol polyglycidyl ether, polyglycerol polyglycidyl ether, pentaerythritol polyglycidyl ether, diglycerol polyglycidyl ether, glycerol polyglycidyl ether, triglycidyl tris(2-hydroxyethyl)isocyanurate, trimethylolpropane polyglycidyl ether, resorcin

diglycidyl ether, neopentyl glycol diglycidyl ether, 1,6-hexanediol diglycidyl ether, bisphenol S diglycidyl ether, ethylene glycol diglycidyl ether, polyethylene glycol diglycidyl ether, polypropylene glycol diglycidyl ether, propylene glycol diglycidyl ether, polytetramethylene glycol diglycidyl ether, adipic acid glycidyl ester, o-
 5 phthalic acid glycidyl ester, dibromoneopentyl glycol diglycidyl ether, and the like.

The above-mentioned multifunctional epoxy compound can react with a compound having an active hydrogen, besides the reaction with the co-present conductive polymer and/or thermoplastic polymer. Such compound may be, for example, aliphatic polyamines such as diethylene triamine, triethylene tetramine,
 10 tetraethylene pentamine, polyoxypropylene polyamine, triethylene glycol diamine, tetraethylene glycol diamine and the like, cyclic polyamines such as xylene diamine, spiroacetal diamine, isophorone diamine, bis(3-methyl-4-aminocyclohexyl)methane and the like, aromatic polyamines such as diaminodiphenylmethane, diaminodiphenylsulfone and the like, modified amines
 15 such as polyamino amide having a number of active amino groups in a molecule synthesized by the condensation of polyamine and dicarboxylic acid, amine adduct curing agent, mannich curing agent and the like, and the like.

The multifunctional isocyanate compound is, for example, a thermally reactive water-soluble urethane resin, ELASTRON (trademark, manufactured by
 20 Daiichi Kogyo Seiyaku) and the like. This is a reactive urethane resin wherein the terminal isocyanate is protected by a blocking agent, so that it can be handled stably in water. As the blocking agent for ELASTRON, a compound having a strong hydrophilic group called carbamoylsulfonate ($-\text{NHCOSO}_3^-$) is used. ELASTRON upon certain heat treatment shows dissociation of the blocking agent
 25 and regeneration of active isocyanate. Specifically, it is preliminarily dried at not more than 100°C and heat treated at $120\text{--}170^\circ\text{C}$ for several minutes, whereby ELASTRON undergoes intermolecular self-crosslinking on its own due to the isocyanate regenerated, to give a polyurethane coating film having a three-dimensional net structure. When a different compound containing an active
 30 hydrogen is mixed with ELASTRON and heated, the compound can be improved by crosslinking. For example, polyvinyl alcohol is mixed with ELASTRON and subjected to heat treatment, thereby to make same water resistant.

For example, the multifunctional vinyl compound includes polybutadiene

and isoprene.

For example, the multifunctional acrylic compound includes ARONIX (trademark, manufactured by TOA GOSEI CO., LTD., which is specifically exemplified by bisphenol F EO-modified (4 moles) diacrylate (M-208), bisphenol A
 5 EO-modified (4 moles) diacrylate (M-210), isocyanuric acid EO-modified diacrylate (M-215), tripropylene glycol diacrylate (M-220), polypropylene glycol diacrylate (n=ca. 7, PPG#400, M-225), pentaerythrithol diacrylate monostearate (M-233), polyethylene glycol diacrylate (n=ca. 4, PPG#200, M-240), polyethylene glycol diacrylate (n=ca. 9, PPG#400, M-245), polyethylene glycol diacrylate (n=ca. 13-14,
 10 PPG#600, M-260), polypropylene glycol diacrylate (n=ca. 12, M-270), pentaerythrithol triacrylate (M-305), trimethylolpropane triacrylate (M-309), trimethylolpropane PO-modified (3 moles) triacrylate (M-310), isocyanuric acid EO-modified triacrylate (M-315), trimethylolpropane PO-modified (6 moles) triacrylate (M-320), trimethylolpropane EO-modified (3 moles) triacrylate (M-350),
 15 trimethylolpropane EO-modified (6 moles) triacrylate (M-360), dipentaerythrithol penta- and hexa-acrylate (M-400), ditrimethylolpropane tetraacrylate (M-408), pentaerythrithol tetraacrylate (M-450), urethane acrylate (M-1100), and polyester acrylate (M-7000 series, M-8000 series, M-7100, M-8060).

For example, the multifunctional oxazoline compound includes epocross
 20 (trademark, manufactured by NIPPON SYOKUBAI KOGYO CO., LTD).

For example, the multifunctional carboxylic acid compound includes anhydrous trimellitic acid, anhydrous pyromellitic acid, trimesic acid and the like.

For example, the multifunctional amine compound includes VARSAMINE and VERSAMID (trademarks, manufactured by Henkel Japan Ltd.)

25 For example, the multifunctional hydroxy compound includes poly(vinyl alcohol), poly(ether polyol), polyester polyol, acrylic polyol, polycarbonate diol, trimethylolethane, trimethylolpropane, glycerol, pentaerythrithol and the like.

For example, the multifunctional mercapto compound includes trivinylcyclohexane-modified trimethylenediol and the like.

30 The above-mentioned crosslinking agent may be any as long as it is stable and can be dissolved in a solvent used for forming a conductive layer. Of these, multifunctional epoxy compound and multifunctional isocyanate compound, particularly, an aqueous multifunctional isocyanate compound soluble in water

and stable therein, are preferable.

The above-mentioned multifunctional reactive group-containing compound can contain monovinyl compound, monoacrylic compound, monoepoxy compound, monoisocyanate compound, monooxazoline compound, monocarboxylic acid compound, monoamine compound, monohydroxy compound, monomercapto compound and the like.

When a conductive polymer and/or thermoplastic polymer are(is) capable of self-crosslinking, these polymers need to have a crosslinking reactive group. Examples of the crosslinking reactive group include acrylic group, vinyl group, epoxy group, isocyanate group, oxazoline group, silanol group, acid chloride group, carboxylic group, amino group, hydroxy group, mercapto group and the like.

When the laminate of the present invention is used to form a container (particularly tray) which is used for electronic parts, the tray is repeatedly used after repetitive water washing. By crosslinking, reduction of antistatic property due to water washing can be prevented, and water attached to the tray after washing can be swung off easily. The curing by crosslinking is also effective in that drying time can be shortened, because conductive layer has less water attached after water washing and is not become swollen. In addition, dust attaches less and the tray is less damaged by water washing.

On the other hand, in the case where curing by crosslinking is too hard, and when highly antistatic laminate is stretched during processing and the like, the conductive layer cannot follow stretch and antistatic property at the stretched part is reduced. Thus, curing by crosslinking should be done such that the surface resistance does not exceed 10 times by 150% stretching.

When a conductive layer contains a polyethylene glycol component, stretchability becomes beneficially fine. Polyethylene glycol may be contained separately, or used as a copolymerizable polyester component of the aforementioned hydrophilic group-containing polyester or graft polyester, or incorporated into the branch polymer of the aforementioned graft polyester.

In the present invention, the conductive layer can be formed on the substrate by any method, such as a melt extrusion method comprising melting a composition for conductive layer, containing a conductive polymer, a thermoplastic polymer, where necessary, a crosslinking agent and the like and extruding the melt from a suitable die, and a coating method comprising dispersing or dissolving the above-mentioned composition in water or a suitable organic solvent to prepare a coating liquid and applying this to a substrate. The latter is preferable, because the thickness of the coating layer can be made thin and can be controlled, and the obtained laminate has fine transparency.

When a conductive layer is formed by a coating method, a coating liquid made from the above-mentioned composition can be used to obtain the highly antistatic laminate of the present invention. However, the above-mentioned composition preferably contains a surfactant as well, because cissing, non-
5 uniformity and the like upon coating can be prevented and coatability can be improved.

The surfactant to be used in the present invention may be any irrespective of ionic or onionic, and, for example, fluorine surfactants such as fluoroalkylcarboxylic acid, perfluoroalkylcarboxylic acid, perfluoroalkylbenzene
10 sulfonic acid, perfluoroalkyl quaternary ammonium, perfluoroalkylpolyoxyethylene ethanol and the like; and nonionic surfactants such as polyoxyethylene octylphenyl ether, polyoxyethylenealkyl ether, polyoxyethylenesorbitan fatty acid ester and the like, can be preferably used.

When the conductive polymer is a water-soluble or water-dispersible
15 conductive polymer such as polyaniline solubilized or dispersed in water by a dopant (e.g., sulfonated polyaniline), a nonionic surfactant is preferably used.

The amount of the surfactant to be used in the present invention is preferably 0.001-10 parts by weight per 100 parts by weight of the conductive polymer such as sulfonated polyaniline and the like. When the amount of the
20 surfactant exceeds 10 parts by weight, when highly antistatic laminates are superposed or rolled and the conductive layer comes into contact with the back surface of the substrate, the surfactant is transferred to the back surface of the substrate, which easily causes problems in the secondary processing such as lamination, deposition, printing, and the like.

25 To improve slipping property of the obtained laminate, the above-mentioned composition for conductive layer can further contain fatty acid metal salt and inactive particles.

The fatty acid metal salt to be used in the present invention includes sodium montanate, calcium montanate, sodium melissate, sodium oleate, sodium
30 stearate, sodium palmitate, sodium laurate, sodium myristate and the like, with preference given to alkali metal salts and alkaline earth metal salts and particular preference given to sodium salt.

The inactive particles to be used in the present invention include inorganic

particles such as titanium oxide (TiO_2), silicon oxide (SiO_2), kaolin, calcium carbonate (CaCO_3), alumina (Al_2O_3), barium sulfate (BaSO_4), zinc oxide (ZnO), talc, mica, complex particles and the like; organic particles consisting of polystyrene, polyacrylate, a crosslinked compound thereof, and the like. These particles
5 preferably have an average primary particle size of not more than 0.2 micron in view of transparency of the coating layer. In addition, the amount to be added thereof is preferably not more than 1000 ppm of the conductive layer composition for desired transparency.

For a further improvement in the conductivity of the conductive layer, a
10 powder of SnO_2 (tin oxide) or ZnO (zinc oxide), or inorganic particles or organic particles, such as TiO_2 , BaSO_4 and the like, coated with the same; carbon conductive fillers, such as carbon black, graphite, carbon fiber and the like; or inorganic particles or organic particles, coated or laminated with a conductive polymer, such as polyaniline, sulfonated polyaniline, polypyrrole, soluble
15 polypyrrole, polythiophene and the like, may be added. From the aspect of transparency, the particles have an average primary particle size of preferably not more than 0.2 micron. The above-mentioned additive is preferably added in an amount of not more than 4000 parts by weight per 100 parts by weight of the conductive polymer such as sulfonated polyaniline and the like. When it exceeds
20 4000, non-uniformity upon coating may occur due to increased viscosity of the coating liquid and transparency may be degraded.

The amount applied to a substrate is preferably $0.01 - 6.0 \text{ g/m}^2$ in dry weight. When the coating amount is less than 0.01 g/m^2 , the desired conductivity may not be afforded. Whereas, when it exceeds 6.0 g/m^2 , blocking
25 property may be degraded.

A gravure roll coating method, reverse roll coating method, knife coating method, dip coating method, spin coating method, spray method and the like can be used to form a conductive layer on a substrate, particularly thermoplastic resin sheet and film. The coating method suitable for conductive composition is not
30 particularly limited. There are an in-line coating method wherein the coating is applied during film forming process and an off-line coating method wherein the coating is applied separately after film forming process. A method preferable for use can be selected without any particular limitation.

The conductive polymer to be used in the present invention, particularly, sulfonated polyaniline is instable at a high temperature of not less than 250°C but stable during heat treatment at 200°C for about 3 minutes. Therefore, heating for a short time at 200°C generally does not adversely affect the conductivity, though
 5 subject to variation depending on the kind of the coexisting thermoplastic polymer and additive, and transparency and fine antistatic property can be maintained while preferably affording high surface strength.

When the substrate is an organic substrate, a corona treatment, a corona treatment under nitrogen atmosphere or an ultraviolet irradiation may be applied,
 10 or an undercoat layer may be formed before applying a coating liquid containing a conductive composition to a substrate, whereby the coating liquid has superior coating property and the adhesion to the substrate can be improved.

After forming a conductive layer, a corona treatment or an ultraviolet irradiation may be applied to the conductive layer, whereby coating property and
 15 printability of the surface of the conductive layer can be improved and a layer can be formed on the conductive layer or printing can be done smoothly.

In addition, a thin protective layer may be formed on a conductive layer to the extent that the conductivity is not impaired.

The highly antistatic laminate of the present invention has a very low
 20 surface resistance and the conductive layer has a surface resistance (RS_0) at 25°C, relative humidity 15% of not more than $10^{11} \Omega / \square$, preferably not more than $10^{10} \Omega / \square$, more preferably not more than $10^9 \Omega / \square$, thus showing superior antistatic property under low humidity. The charge attenuation time is preferably not more than 2.0 seconds, more preferably not more than 0.5 second. As used herein, the
 25 surface resistance indicates difficulty in flowing electricity on the surface of the conductive layer, and charge attenuation time indicates easiness for once electrified charge to escape. Both are indices showing antistatic property.

The highly antistatic laminate of the present invention is superior in water resistance, wherein the ratio (RS_1/RS_0) of surface resistance (RS_1) at 25°C, relative
 30 humidity 15% of the conductive layer after immersion of the inventive highly antistatic laminate in pure water at 40°C for one hour, to RS_0 is not more than 10, preferably not more than 8, more preferably 5. With scarce reduction in antistatic property by immersion in water, the use of the laminate is possible in an

environment associated with repeated use upon water washing and a possibility of becoming wet with water.

The inventive laminate is superior in forming property, wherein the ratio (RS_2/RS_0) of surface resistance (RS_2) at 25°C, relative humidity 15% of the
 5 conductive layer after stretching the inventive highly antistatic laminate by 150%, to RS_0 is preferably not more than 10, more preferably not more than 8, most preferably 5. The stretching during forming scarcely reduces the antistatic property.

The inventive laminate is also superior in heat resistance, wherein the
 10 ratio (RS_9/RS_0) of surface resistance (RS_9) at 25°C, relative humidity 15% of the conductive layer after heating the inventive highly antistatic laminate at 250°C for 1 minute, to RS_0 is preferably not more than 5.0, more preferably not more than 3.0. The heat for forming scarcely reduces the antistatic property.

The highly antistatic laminate of the present invention preferably has a
 15 visible light transmittance as measured according to JIS 7105 of not less than 75%, more preferably not less than 80%, and most preferably not less than 85%. By setting the visible light transmittance to not less than 75%, visual confirmation of contents, automatic monitoring by TV camera, treatment of bar code attached to the content and the like can be easily performed, when the highly antistatic
 20 laminate is used as a packaging material.

The conductive layer of the highly antistatic laminate of the present invention preferably has a visible light transmittance as measured according to JIS 7105 of not less than 75%, more preferably not less than 80%, and most preferably not less than 85%. By the use of conductive layer having high visible
 25 light transmittance, a substrate having somewhat lower visible light transmittance and a semitransparent substrate can be also used, thereby increasing the kind of substrate to be used. When the above-mentioned optical monitoring of the content is performed, a surface matting treatment and the like is required to prevent malfunction. The high visible light transmittance can compensate for the
 30 decrease in visible light transmittance caused by the matting.

The visible light transmittance (X) of the conductive layer can be obtained by measuring visible light transmittance (Z) of highly antistatic laminate and visible light transmittance (Y) of substrate, and roughly calculating from the

relational formula $Z=XY$. The visible light transmittance of the substrate can be measured by swelling the conductive layer of the highly antistatic laminate with a solvent and the like, removing same by scraping and the like and subjecting the remainder to the measurement. When matted, measurement can be done after
 5 applying a suitable solvent having nearly the same index of refraction as that of the subject of measurement, and which does not invade the subject, to the surface.

Moreover, the inventive highly antistatic laminate preferably has a haze of not more than 5.0, more preferably not more than 3.0, and the laminate is superior in transparency.

10 A highly antistatic laminate containing a conductive layer having RS_0 of not more than $10^{11} \Omega/\square$, RS_1/RS_0 of not more than 10, and RS_2/RS_0 of not more than 10, can be produced by using the aforementioned composition containing conductive polymer and thermoplastic polymer as the conductive layer composition to form a coating layer and curing the coating layer, and by other
 15 method.

The highly antistatic laminate of the present invention is superior in antistatic property under low humidity, after immersion in water and after forming, transparency and resistance to blocking. Therefore, it is suitably used as a highly antistatic laminate for carrier tape, container (particularly tray), magazine,
 20 package material, IC card and the like, that protects electronic materials such as IC, LSI, silicon wafer, hard disc, liquid crystal substrate, electronic parts and the like during storage, transfer and mounting thereof, from destruction and adhesion of dust etc. due to static electricity and the like,

In the case of tray and carrier tape for electronic parts, a resin may be
 25 formed first and a conductive layer may be formed thereon. It is preferable to press (e.g., with heating at 250°C for one minute) a highly antistatic laminate comprising a thermoplastic film as a substrate. The highly antistatic laminate of the present invention is almost free of reduction of antistatic property due to stretching and heat during forming, or peeling off of the conductive layer, so that a
 30 desired tray or a carrier tape can be obtained by press forming.

When used as a tray for electronic parts, the highly antistatic laminate of the present invention is pressed to form a concave (processed part) and a flange on the outer periphery thereof. In the case of the tray for electronic parts, the surface

resistance (RS_3) at 25°C, relative humidity 15% of the conductive layer of the flange is not more than $10^{11} \Omega / \square$, preferably not more than $10^{10} \Omega / \square$, more preferably $10^9 \Omega / \square$. Thus, it shows superior antistatic property under low humidity.

The ratio (RS_4/RS_3) of surface resistance (RS_4) at 25°C, relative humidity 15% of the conductive layer of the flange after immersing the tray in pure water at 40°C for one hour, to RS_3 is not more than 10, preferably not more than 8, more preferably not more than 5. With scarce reduction in antistatic property caused by the immersion in water, the use is possible in an environment associated with repeated use upon water washing and a possibility of becoming wet with water.

The ratio (RS_5/RS_3) of surface resistance (RS_5) at 25°C, relative humidity 15% of the conductive layer of the concave, the concave having a thickness corresponding to 0.5 to 0.7-fold of the thickness of the flange, to RS_3 is not more than 100, preferably not more than 80, more preferably not more than 50. Therefore, the reduction in antistatic property due to the stretch or heat during press forming is small.

When the highly antistatic laminate of the present invention is used as a carrier tape for electronic parts, the highly antistatic laminate of the present invention is pressed to form plural concaves (processed parts) to house electronic parts disposed along the longitudinal direction and a flange on the outer periphery thereof. In the case of the carrier tape for electronic parts, the surface resistance (RS_6) at 25°C, relative humidity 15% of the conductive layer of the flange is not more than $10^{11} \Omega / \square$, preferably not more than $10^{10} \Omega / \square$, more preferably $10^9 \Omega / \square$. Thus, it shows superior antistatic property under low humidity.

The ratio (RS_7/RS_6) of surface resistance (RS_7) at 25°C, relative humidity 15% of the conductive layer of the flange after immersing the carrier tape in pure water at 40°C for one hour, to RS_6 is not more than 10, preferably not more than 8, more preferably not more than 5. With scarce reduction in antistatic property caused by immersion in water, the use is possible in an environment associated with repeated use upon water washing and a possibility of becoming wet with water.

The ratio (RS_8/RS_6) of surface resistance (RS_8) at 25°C, relative humidity 15% of the conductive layer of the concave, the concave having a thickness corresponding to 0.5 to 0.7-fold of the thickness of the flange, to RS_6 is not more

than 100, preferably not more than 80, more preferably not more than 50. Therefore, the reduction in antistatic property due to the stretch or heat during press forming is small.

When the highly antistatic laminate of the present invention is used as a package material, particularly a buffering package material, as shown in Fig. 1, for example, a pair of stretch films 2 sandwich an article 3 such as an electronic material and the like, and a pair of opposing ends of the stretch films 2 are fixed in the container 1 (in Fig. 1, these ends are fixed by frame 5). The highly antistatic laminate of the present invention can be used as the stretch film 2.

When the highly antistatic laminate of the present invention is used as a substrate for carrier tape, tray, magazine, package material, IC card and the like, it is superior in antistatic property under low humidity, after immersion in water and after forming, and allows repetitive use upon water washing, because the antistatic property of the concave after forming is almost free of reduction.

The present invention is explained in more detail in the following by way of Examples, to which the present invention is not limited. The evaluation methods used in the present invention are shown in the following.

1. Haze

According to JIS K 7105, haze was determined using a haze meter 1001DP manufactured by NIPPON DENSHOKU.

2. Surface resistance (RS_0 , RS_3 , RS_6)

The conductive layer of the highly antistatic laminate (the conductive layer of the flange in case of the tray and carrier tape) was subjected to determination under voltage of 500V, 25°C, 15%RH using a surface resistance meter manufactured by TAKEDA RIKEN.

With regard to the tray and carrier tape, the surface resistance (RS_5 , RS_8) of the conductive layer of the concave having a thickness corresponding to 0.5 to 0.7-fold of the thickness of the flange is 1 was determined at 25°C, relative humidity 15%, and the ratios (RS_5/RS_3 , RS_8/RS_6) to (RS_3 , RS_6) were determined.

With regard to the tray and carrier tape, the thickness of the flange and the concave was confirmed with a digital thickness meter and the surface resistance was measured. The average of the thicknesses at 5 points was calculated for both the thickness and surface resistance.

3. Water resistance (variation in surface resistance) of conductive layer

A highly antistatic laminate, tray or carrier tape was immersed in pure water at 40°C for 1 hour, and the surface resistance (RS_1 , RS_4 , RS_7) of the conductive layer (the conductive layer of the flange in case of the tray and carrier tape) was measured at 25°C, 15% RH. The water resistance was evaluated by the ratio (RS_1/RS_0 , RS_4/RS_3 , RS_7/RS_6) to the surface resistance (RS_0 , RS_3 , RS_6) of the conductive layer before immersion.

4. Variation in surface resistance after elongation

Using a biaxially orientation apparatus manufactured by TOYO SEIKI, a highly antistatic laminate (92 mm × 92 mm) was stretched monoaxially by 150% under a nitrogen atmosphere, preheating time 15 seconds and tensile rate 5 m/min. The temperature at this time was 110°C, 130°C, 110°C, 100°C and 150°C for the substrate I, II, III, IV and V, respectively.

The surface resistance (RS_2) of the conductive layer after stretching was determined at 25°C, 15% RH and the ratio (RS_2/RS_0) to the surface resistance (RS_0) of the conductive layer before stretching was obtained.

5. Resistance to blocking

The conductive layer of the highly antistatic laminate and the back of the substrate (the side without conductive layer) of the other highly antistatic laminate were superposed at 40°C, 80% RH, and a load of 100 g/cm² was applied. The laminate was left standing for 24 hr and the two samples were peeled off. The evaluation followed the criteria below.

No resistance during peeling : ○

Some degree of resistance during peeling : △

Considerable resistance during peeling : ×

Synthetic Example 1: Synthesis of sulfonated polyaniline and preparation of a water/alcohol solution (Paq) thereof

2-Aminoanisole-4-sulfonic acid (100 mmol) was dissolved by stirring in an aqueous ammonium solution (4 mol/L) at 23°C and an aqueous solution of ammonium peroxodisulfate (100 mmol) was added dropwise. After the completion of the dropwise addition, the mixture was further stirred at 23°C for 10 hours. The reaction product was filtered, washed and dried to give a polymer (13 g) as a powder. The above-mentioned polymer (3 parts by weight) was dissolved

by stirring in an aqueous sulfuric acid solution (0.3 mol/L, 100 parts by weight) at room temperature to give sulfonated polyaniline. At this time, the sulfonic acid group content of sulfonated polyaniline was 100%. The above-mentioned sulfonated polyaniline (2 parts by weight) was dissolved in a mixture of water (50 parts by weight) and isopropanol (50 parts by weight) to give a water/alcohol solution (Paq).

Synthetic Example 2: Synthesis of sulfonic acid salt group-containing copolymerized polyester (A) and preparation of a water/alcohol dispersion (Aaq) thereof

10 A sulfonic acid salt group-containing copolymerized polyester was synthesized by the following method and a dispersion thereof was prepared as in the following. As the dicarboxylic acid component, dimethyl terephthalate (48 mol%), dimethyl isophthalate (48 mol%) and sodium 5-sulfoisophthalate (4 mol%) were used and as the glycol component, ethylene glycol (80 mol%) and diethylene glycol (20 mol%) were used for ester exchange reaction and condensation polymerization reaction by a conventional method. The obtained sulfonic acid salt group-containing copolymerized polyester had a glass transition temperature of 61°C. This sulfonic acid salt group-containing copolymerized polyester (300 parts) and n-butyl cellosolve (150 parts) were stirred with heating to give a viscous solution. Thereto was gradually added water (550 parts) with stirring to give a homogeneous pale-white aqueous dispersion having a solid content of 30 wt%. This dispersion was added to a mixture of an equivalent amount of water and isopropanol to give a sulfonic acid salt group-containing copolymerized polyester aqueous dispersion (Aaq) having a solid content of 8 wt%.

25 **Synthetic Example 3:** Synthesis of graft polyester (B) and preparation of aqueous dispersion (Baq) thereof

Into a stainless steel autoclave equipped with a stirrer, a thermometer and a partial reflux condenser, were charged dimethyl terephthalate (5 mol), dimethyl isophthalate (4.5 mol), ethylene glycol (6.5 mol), 1, 3-propylene glycol (3.5 mol) and tetra-n-butyl titanate (0.002 mol) and ester exchange reaction was carried out from 160°C to 220°C over 4 hours. Then, fumaric acid (0.5 mol) was added and the mixture was heated from 200°C to 220°C over 1 hour. The reaction system was gradually depressurized and the mixture was reacted under depressurization

at 0.2 mmHg for 1.5 hours to give polyester (Bo).

Then, into a reactor equipped with a stirrer, a thermometer, a refluxing device and a quantitative filtration device were charged the above-mentioned polyester (Bo) (300 parts), methyl ethyl ketone (360 parts) and isopropyl alcohol (120 parts) and the mixture was stirred with heating to dissolve the resin under reflux. When the resin was completely dissolved, a mixture of maleic acid (25 parts), ethyl acrylate (65 parts) and octyl mercaptane (1.5 parts) and a solution of azobisisobutyronitrile (6 parts) dissolved in a mixture of methyl ethyl ketone (90 parts) and isopropyl alcohol (30 parts) were respectively added dropwise to the polyester solution over 1.5 hours, which was followed by reaction for 3 hours to give a graft polymer (B) solution. This graft polymer solution was cooled to room temperature and triethylamine (59 parts) was added for neutralization. Then, ion exchange water (800 parts) was added and the mixture was stirred for 30 minutes. The mixture was heated to remove the residual solvent to give an aqueous dispersion. This dispersion was added to an equivalent mixture of water and isopropanol to give an alcohol/aqueous dispersion (Baq) having a solid content of 8 wt%.

Synthetic Example 4: Preparation of aqueous dispersion (Caq) containing polyvinyl alcohol/aqueous polyisocyanate crosslinking agent

A 10% aqueous solution of polyvinyl alcohol (saponification percentage 98%) was prepared and ELASTRON BN69 (10 parts by weight) manufactured by Daiichi Kogyo Seiyaku was added thereto per 100 parts by weight of the solid content of polyvinyl alcohol to give a polyvinyl alcohol/crosslinking agent-containing aqueous dispersion (Caq).

Synthetic Example 5: Preparation of substrate sheet

The substrate sheets used in the Examples are the following, the production method of which is shown in the following.

[substrate sheet I]

PET (polyethylene terephthalate) was melt-extruded at 290°C and cooled on a cooling roll at 30°C to give a 500 μm thick unoriented sheet. The sheet was used as the substrate sheet I. Visible light transmittance 95%

[substrate sheet II]

PEN (polyethylene naphthalate) was melt-extruded at 300°C and cooled

on a cooling roll at 30°C to give a 500 μm thick unoriented sheet. The sheet was used as the substrate sheet II. Visible light transmittance 94%

[substrate sheet III]

- 5 A copolymer wherein 30 mol% of ethylene glycol component of polyethylene terephthalate had been substituted by cyclohexanedimethanol was melt-extruded at 290°C and cooled on a cooling roll at 30°C to give a 500 μm thick unoriented sheet. The sheet was used as the substrate sheet III. Visible light transmittance 95%

[substrate sheet IV]

- 10 A copolymer wherein 30 mol% of ethylene glycol component of polyethylene terephthalate had been substituted by neopentyl glycol was melt-extruded at 290°C and cooled on a cooling roll at 30°C to give a 500 μm thick unoriented sheet. The sheet was used as the substrate sheet IV. Visible light transmittance 95%

- 15 [substrate sheet V]

Polycarbonate was melt-extruded at 290°C and cooled on a cooling roll at 30°C to give a 500 μm thick unoriented sheet. The sheet was used as the substrate sheet V. Visible light transmittance 95%

Examples 1 - 1 to 1 - 5

- 20 The sulfonated polyaniline solution (Paq) obtained in Synthetic Example 1 and the sulfonic acid salt group-containing copolymerized polyester dispersion (Aaq) obtained in Synthetic Example 2 were mixed in a solid ratio (weight ratio) of 20/80, and nonion surfactant Emulgen 810 (manufactured by Kao Corporation) was added to a weight ratio to the sulfonated polyaniline in the solution (Paq) of 8/100, and the polyvinyl alcohol/aqueous polyisocyanate crosslinking agent-
25 containing aqueous dispersion (Caq) was added to a solid ratio (weight ratio) to the dispersion (Aaq) of 20/100 to give a coating liquid of this Example.

The above-mentioned coating liquid was applied to the substrate sheets I, II, III, IV and V to the solid concentration of 0.5 g/m² and dried with hot air at 70°C.

- 30 The evaluation results of these sheets are shown in Table 1.

Examples 2 - 1 to 2 - 5

In the same manner as in Example 1 except that the graft polyester dispersion (Baq) obtained in Synthetic Example 3 was used instead of the

dispersion (Aaq) obtained in Synthetic Example 2, a coating liquid was prepared.

The above-mentioned coating liquid was applied to the substrate sheets I, II, III, IV and V to the solid concentration of 0.5 g/m² and dried with hot air at 70°C. The evaluation results of these sheets are shown in Table 1.

5 **Examples 3 - 1 to 3 - 5**

In the same manner as in Example 1 except that glycerol polyglycidyl ether was used instead of the aqueous dispersion (Caq) obtained in Synthetic Example 4 and that glycerol polyglycidyl ether was added such that the solid ratio (weight ratio) to the dispersion (Aaq) obtained in Synthetic Example 2 is 2/100, a coating liquid was prepared.

The above-mentioned coating liquid was applied to the substrate sheets I, II, III, IV and V to the solid concentration of 0.5 g/m² and dried with hot air at 70°C. The evaluation results of these sheets are shown in Table 1.

Examples 4 - 1 to 4 - 5

The sulfonated polyaniline solution (Paq) obtained in Synthetic Example 1, the sulfonic acid salt group-containing copolymerized polyester dispersion (Aaq) obtained in Synthetic Example 2 and SUMIMAL M-30W (methylated melamine resin, manufactured by Sumitomo Chemical Industries, Ltd.) were admixed in a solid ratio (weight ratio) of 10/85/5 and added to a mixed solvent (water/isopropanol=50/50 (weight ratio)) to give a solution having a solid concentration of 2 - 5%. To this solution was added Megafac F-142D (fluorine surfactant, manufactured by DAINIPPON INK AND CHEMICALS, INC.) in a proportion of 0.08 wt% to give a coating liquid.

The above-mentioned coating liquid was applied to the substrate sheets I, II, III, IV and V to the solid concentration of 0.3 g/m² and dried with hot air at 70°C. The evaluation results of these sheets are shown in Table 1.

Comparative Examples 1, 2

In the same manner as in Examples 1 and 2 except that aqueous dispersion (Caq) obtained in Synthetic Example 4 was not added, a coating liquid was prepared, from which a sheet was obtained in the same manner as in Examples 1, 2.

Comparative Example 3

In the same manner as in Example 3 except that glycerol polyglycidyl ether

was not added, a coating liquid was prepared, from which a sheet was obtained in the same manner as in Examples 1, 2.

The evaluation results of these sheets are shown in Table 1.

Table 1

	subst- rate	RS ₀	RS ₁	RS ₁ /RS ₀	RS ₂	RS ₂ /RS ₀	V.L.T.*	haze	block- ing
1-1	I	3.7×10 ⁸	9.3×10 ⁸	2.5	9.6×10 ⁸	2.6	88%	2.8	○
1-2	II	2.6×10 ⁸	4.2×10 ⁸	1.6	5.7×10 ⁸	2.2	87%	2.5	○
1-3	III	4.5×10 ⁸	1.1×10 ⁹	2.5	1.5×10 ⁹	3.4	87%	2	○
1-4	IV	3.8×10 ⁸	1.1×10 ⁹	3	1×10 ⁹	2.7	88%	2.3	○
1-5	V	3.5×10 ⁸	9.5×10 ⁸	2.7	9.1×10 ⁸	2.6	88%	2.2	○
2-1	I	1×10 ⁸	1.8×10 ⁸	1.8	2.1×10 ⁸	2.1	89%	2.8	○
2-2	II	1.1×10 ⁸	1.7×10 ⁸	1.5	2.9×10 ⁸	2.6	89%	2.9	○
2-3	III	1×10 ⁸	1.3×10 ⁸	1.3	3.4×10 ⁸	3.4	89%	3	○
2-4	IV	1.2×10 ⁸	1.4×10 ⁸	1.2	3.8×10 ⁸	3.2	89%	2.5	○
2-5	V	1.2×10 ⁸	1.3×10 ⁸	1.1	3.6×10 ⁸	3	90%	2.1	○
3-1	I	7.2×10 ⁸	7.9×10 ⁸	1.1	2.9×10 ⁹	4	89%	2.5	○
3-2	II	6.3×10 ⁸	8.2×10 ⁸	1.3	2×10 ⁹	3.2	88%	2.3	○
3-3	III	7.6×10 ⁸	9.1×10 ⁸	1.2	2.1×10 ⁹	2.7	90%	2	○
3-4	IV	7.6×10 ⁸	7.6×10 ⁸	1	1.9×10 ⁹	2.5	88%	2.1	○
3-5	V	7.5×10 ⁸	9×10 ⁸	1.2	1.9×10 ⁹	2.5	90%	2.4	○
4-1	I	4.2×10 ⁸	5.5×10 ⁸	1.3	1×10 ⁹	2.4	88%	2.1	○
4-2	II	3×10 ⁸	4.5×10 ⁸	1.5	7.8×10 ⁸	2.6	88%	2.3	○
4-3	III	3.4×10 ⁸	4.1×10 ⁸	1.2	1×10 ⁹	3	89%	2.1	○
4-4	IV	2.9×10 ⁸	3.2×10 ⁸	1.1	6.1×10 ⁸	2.1	89%	2.1	○
4-5	V	2.8×10 ⁸	3.6×10 ⁸	1.3	6.2×10 ⁸	2.2	88%	2.2	○
Com. Ex.1	I	2×10 ⁸	>10 ¹⁵	>10000	4.4×10 ⁸	2.2	89%	2.2	△
Com. Ex.2	I	7.8×10 ⁸	>10 ¹⁵	>10000	2×10 ⁹	2.5	89%	1.9	×
Com. Ex.3	I	8×10 ⁸	>10 ¹⁵	>10000	2×10 ⁹	2.5	85%	1.8	△

* V.L.T. : visible light transmittance of highly antistatic laminate

Example 5: tray

Using vacuum forming machine (PLAVAC) manufactured by Sanwa Kogyo Kabushiki Kaisha and under the conditions of 110°C, 13 seconds pre-heating and 55°C, 15 seconds forming, a tray having concaves (9 cm×6 cm, depth 4 cm) in 3 rows×4 lines and a 3 cm wide flange was prepared. The sheets obtained in Examples 1-1, 1-3, 2-1, 3-1, 4-1, 4-3 and 4-5 were used.

The evaluation results of these sheets are shown in Table 2.

Example 6: carrier tape

Under the same forming conditions with the tray, a 50 cm×50 cm sheet having one row of concaves (8 mm×8 mm, depth 5 mm) was prepared. One row of concaves was cut into 20 mm strip, which was joined with a different strip to give a model carrier tape. The sheets obtained in Examples 1-1, 1-3, 2-1, 3-1, 4-1, 4-3 and 4-5 were used.

The evaluation results of these sheets are shown in Table 3.

Table 2

tray

sub- strate	RS_3	RS_5	RS_5/RS_3	thickness ratio	RS_4	RS_4/RS_3
1-1	6.00×10^8	4.98×10^9	8.3	0.64	9.60×10^8	1.6
1-3	4.70×10^8	2.44×10^9	5.2	0.61	9.40×10^8	2
2-1	3.20×10^8	1.34×10^9	4.2	0.58	3.84×10^8	1.2
3-1	1.10×10^9	6.27×10^9	5.7	0.6	1.54×10^9	1.4
4-1	5.80×10^8	2.61×10^9	4.5	0.55	6.96×10^8	1.2
4-3	4.60×10^8	2.58×10^9	5.6	0.58	5.06×10^8	1.1
4-5	5.40×10^8	2.97×10^9	5.5	0.58	9.18×10^8	1.7

5

Table 3

tape

sub- strate	RS_6	RS_8	RS_8/RS_6	thickness ratio	RS_7	RS_7/RS_6
1-1	5.20×10^8	5.93×10^9	11.4	0.52	6.76×10^8	1.3
1-3	5.00×10^8	3.95×10^9	7.9	0.6	9.00×10^8	1.8
2-1	3.40×10^8	1.97×10^9	5.8	0.55	3.74×10^8	1.1
3-1	1.10×10^8	9.13×10^8	8.3	0.52	1.32×10^8	1.2
4-1	5.50×10^8	3.74×10^9	6.8	0.55	6.05×10^8	1.1
4-3	4.80×10^8	3.46×10^9	7.2	0.52	7.20×10^8	1.5
4-5	5.20×10^8	4.63×10^9	8.9	0.55	8.32×10^8	1.6

Example 7: packaging material

Polyethylene and polyurethane were multi-layer extruded and a polyethylene-polyurethane (thickness of each layer 100 microns, 80 microns) two-layer film was obtained using an inflation film forming machine, which was
5 used as the substrate sheet VI.

The coating liquid of Example 2 was applied to the surface of polyurethane of substrate sheet VI. After thorough drying, the polyethylene layer was peeled off to give a conductive polyurethane film. The conductive layer of this film had surface resistance at 25°C, 15% RH was $2 \times 10^9 \Omega / \square$. The surface resistance at
10 25°C, 15% RH of this film after 150% stretching was not more than $10^{10} \Omega / \square$.

As shown in Fig. 1, this film 2 was adhered to a corrugated paper frame 5 (25 cm×30 cm with a 15 cm×20 cm opening) with a two-sided tape. A circuit substrate 3 was sandwiched between these two corrugated paper frame 5 with the film 2, and placed in a corrugated paper box 1 in such a manner that the circuit
15 substrate 3 is retained in the air in the box 1 by the aid of the films.

The highly antistatic laminate of the present invention is superior in antistatic property, transparency, water resistance and resistance to blocking, because the conductive layer has been cured by the reaction of a conductive
20 polymer, a thermoplastic polymer and a crosslinking agent.

This application is based on a patent application No. 174748/1998 filed in Japan, the content of which is hereby incorporated by reference.

WHAT IS CLAIMED IS

1. A highly antistatic laminate comprising a substrate and a conductive layer laminated on at least one side of the substrate, said conductive layer comprising a conductive polymer and having been cured.
5
2. The highly antistatic laminate of claim 1, wherein the conductive layer further comprises a thermoplastic polymer.
3. The highly antistatic laminate of claim 1 or claim 2, wherein the conductive
10 layer is cured by crosslinking reaction with a crosslinking agent.
4. The highly antistatic laminate of claim 1, wherein the conductive polymer is a conductive polymer soluble in water or an organic solvent.
- 15 5. The highly antistatic laminate of claim 1, wherein the conductive polymer is polyaniline or a derivative thereof.
6. The highly antistatic laminate of claim 1, wherein the conductive polymer is sulfonic acid group-containing polyaniline or a derivative thereof.
20
7. The highly antistatic laminate of claim 1, wherein the conductive polymer comprises an alkoxy-substituted aminobenzenesulfonic acid as a polymerizable component.
- 25 8. The highly antistatic laminate of claim 1, wherein the conductive polymer comprises aminoanisolessulfonic acid as a polymerizable component.
9. The highly antistatic laminate of claim 2, wherein the thermoplastic polymer is a polyester having a hydrophilic group.
30
10. The highly antistatic laminate of claim 2, wherein the thermoplastic polymer is a copolymerized polyester obtained by copolymerizing a dicarboxylic acid having a hydrophilic group in a proportion of 0.5-15 mol% of the entire dicarboxylic acid



component or a diol having a hydrophilic group in a proportion of 0.5-15 mol% of the entire diol component or both of these components.

11. The highly antistatic laminate of claim 2, wherein the thermoplastic polymer
5 is a graft polyester obtained by graft polymerization of a vinyl monomer having a hydrophilic group to polyester.

12. The highly antistatic laminate of claim 3, wherein the crosslinking agent is at
least one member selected from the group consisting of a multifunctional epoxy
10 compound, a multifunctional isocyanate compound, a multifunctional oxazoline compound, a multifunctional vinyl compound, a multifunctional acrylic compound, a multifunctional carboxylic acid compound, a multifunctional amine compound, a multifunctional hydroxy compound and a multifunctional mercapto compound.

13. The highly antistatic laminate of claim 1 or claim 2, wherein the conductive
layer is cured by self-crosslinking of a conductive polymer or a thermoplastic
polymer or a conductive polymer and a thermoplastic polymer.

14. The highly antistatic laminate of claim 1, wherein the conductive layer
20 further comprises a surfactant.

15. The highly antistatic laminate of claim 1, wherein the substrate is a film or
sheet made from an organic resin, and the highly antistatic laminate has a haze of
25 not more than 5.0.

16. The highly antistatic laminate of claim 1, wherein the substrate is a film or
sheet made from a material selected from the group consisting of polyester,
polycarbonate, polyolefin and polyurethane.

17. A highly antistatic laminate comprising a substrate and a conductive layer
laminated on at least one side of the substrate,

said conductive layer having a surface resistance (RS_0) at 25°C, relative



humidity 15% of not more than $10^{11} \Omega / \square$, and a ratio (RS_1/RS_0) of surface resistance (RS_1) at 25°C, relative humidity 15% after immersing the highly antistatic laminate in pure water at 40°C for one hour, to RS_0 of not more than 10.

- 5 18 The highly antistatic laminate of claim 17, wherein the conductive layer further has a ratio (RS_2/RS_0) of surface resistance (RS_2) at 25°C, relative humidity 15% after stretching the highly antistatic laminate by 150%, to RS_0 of not more than 10.
- 10 19. The highly antistatic laminate of claim 17 or claim 18, wherein the conductive layer comprises a conductive polymer and have been cured.
20. A container for electronic parts, which is obtained by forming the highly antistatic laminate of claim 1, 17 or 18.
- 15 21. The container of claim 20, which is a tray.
22. A carrier tape for electronic parts, which is obtained by forming the highly antistatic laminate of claim 1, 17 or 18.
- 20 23 A tray for electronic parts, which is obtained by forming a highly antistatic laminate comprising a substrate and a conductive layer laminated on at least one side of the substrate, which tray comprises a concave and a flange on the outer periphery thereof,
- 25 wherein a surface resistance (RS_3) at 25°C, relative humidity 15% of the conductive layer of the flange is not more than $10^{11} \Omega / \square$, a ratio (RS_4/RS_3) of surface resistance (RS_4) at 25°C, relative humidity 15% of the conductive layer of the flange after immersing the tray in pure water at 40°C for one hour, to RS_3 is not more than 10, and a ratio (RS_5/RS_3) of surface resistance (RS_5) at 25°C, relative
- 30 humidity 15% of the conductive layer of the concave having a thickness corresponding to 0.5 to 0.7-fold of the thickness of the flange, to RS_3 is not more than 100.



* C L M S *

24. The tray for electronic parts of claim 23, which is obtained by forming the highly antistatic laminate of claim 1, 17 or 18.

25. A carrier tape for electronic parts, which is obtained by forming a highly antistatic laminate comprising a substrate and a conductive layer laminated on at least one side of the substrate, which carrier tape comprises plural concaves to house plural electronic parts disposed along the longitudinal direction and a flange on the outer periphery thereof,

wherein a surface resistance (RS_6) at 25°C, relative humidity 15% of the conductive layer of the flange is not more than $10^{11} \Omega / \square$, a ratio (RS_7/RS_6) of a surface resistance (RS_7) at 25°C, relative humidity 15% of the conductive layer of the flange after immersing the carrier tape in pure water at 40°C for one hour, to RS_6 is not more than 10, and a ratio (RS_8/RS_6) of a surface resistance (RS_8) at 25°C, relative humidity 15% of the conductive layer of the concave having a thickness corresponding to 0.5 to 0.7-fold of the thickness of the flange, to RS_6 is not more than 100.

26. The carrier tape for electronic parts of claim 25, which is obtained by forming the highly antistatic laminate of claim 1, 17 or 18.

20

27. A buffering package material comprising a container and a pair of stretch films for carrying an article to be packaged therebetween, said stretch films having a pair of opposing ends fixed in the container, wherein said stretch films are the members selected from the group consisting of the highly antistatic laminates of claim 1, 17 or 18.

25

28. An IC card which is obtained by using the highly antistatic laminate of claim 1, 17 or 18 as a substrate for the card.

