Antistatic resin-made container and kit for production thereof

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Abstract

An antistatic resin-made container is formed by solution-bonding a plurality of resinous parts thereof to each other, preferably with acetonitrile as the solvent, wherein each resinous part is formed from an antistatic resin composition including (a) a polyacrylonitrile resin: 50-95 wt. % and (b) a hydrophilic polymer: 5-50 wt. %. The thus-formed antistatic resin-made container is suitable for accommodating a precision product, such as a photomask, or a semi-product thereof, which is produced in an extremely small number but requires a high level of antistatic property of the container therefor.
ANTISTATIC RESIN-MADE CONTAINER AND KIT FOR PRODUCTION THEREOF

FIELD OF THE INVENTION AND RELATED ART

[0001] The present invention relates to an antistatic resin-made container suitable for accommodating precision products or semi-products thereof which are produced in a very small number but require a high level of antistatic property, such as photomasks (including reticles) and pellicles as protective films for such photomasks, semiconductor wafer-related trial products, liquid crystal display (LCD)-related trial products, IC-product-related trial products, etc., and a kit for production of such an antistatic resin-made container.

[0002] Precision products such as photomasks as mentioned above extremely hate electrostatic attraction of fine particles, and the transportation or storage thereof is performed by using an antistatic resin-made container. For providing such an antistatic resin-made container, conventional techniques of applying or kneading an antistatic agent cannot provide a persistent antistatic effect, so that the use of an antistatic resin composition comprising a hydrophilic polymer and another thermoplastic resin has been studied in recent years for providing a permanent antistatic resin. There have been introduced methods of incorporating hydrophilic polymers, such as polyethylene oxide, polyether-esteramide and quaternary ammonium salt-containing copolymers, into thermoplastic resins, such as polystyrene, ABS and PMMA (“Japan Society of Static Electricity”, Vol. 21, No. 5, pp. 212-219 (1997)). Herein, “permanent antistatic property” is unlike a non-persistent antistatic property which may be obtained by application of an antistatic agent or bleeding-out to the surface of a shaped article of an antistatic agent kneaded into an ordinary thermoplastic resin and can be remarkably reduced by wiping of the surface, but means a permanently and persistently exhibited antistatic property which is developed by an antistatic agent stably held inside a thermoplastic resin constituting a shaped product and is not essentially reduced by wiping of the shaped product.

[0003] As a preferred example of such a permanently antistatic resin composition, the present applicant already developed a thermoplastic resin composition having permanent antistatic property and also good transparency, preferably by further incorporating an anionic surfactant into a thermoplastic resin composition comprising a graft copolymer of a rubber trunk polymer having an alkylene oxide group (Japanese Patent Publication (JP-B) 59-2462; corr. to GB-A 207046).

[0004] While the function mechanism of the above-mentioned thermoplastic resin composition exhibiting permanent antistatic property has not been fully clarified as yet, it is considered that a rubber trunk polymer comprising a monomer having an alkylene oxide group and a conjugated diene or an acrylate ester as one component is dispersed, at the time of processing, in the graft component resin or a mixture of the graft component resin and a thermoplastic resin as the matrix component in the form of mutual bridges, and an antistatic agent added thereto is selectively adsorbed principally by the rubber trunk polymer, so that when a charging member contacts the shaped body, electric charges of the opposite polarity are moved principally through the rubber trunk polymer phase adsorbing the antistatic agent to be quickly accumulated at the contact surface, thereby dissipating and neutralizing the charges given by the charging member.

[0005] The above-mentioned antistatic resin comprising a hydrophilic polymer and another thermoplastic resin is generally formed into a container by injection molding or sheet forming such as vacuum forming or air-pressure forming (hereinafter sometimes inclusively referred to as “injection molding, etc.”). However, the above-mentioned precision products, such as photomasks (including reticles) and pellicles as protective films thereof, LCD-related trial products and IC-product-related trial products, etc., and a kit for production thereof, which require a high antistatic property, are generally characterized in that they are extremely expensive (e.g., over several millions yen per piece of product) but are produced in only a small number for a variety of designs. Accordingly, it is extremely uneconomical for providing an expensive mold for injection molding or sheet forming for forming a container for each of said precision (semi)-products. For this reason, there has been taken a measure to form a somewhat larger-sized container commonly used for several sizes of precision (semi)-products by adjusting positions of precision (semi)-product-holding members disposed inside the container, but the increase of unnecessary internal space in the container increases the possibility of attachment of dirt, such as fine particles, onto the precision (semi)-products.

SUMMARY OF THE INVENTION

[0006] Accordingly, a principal object of the present invention is to economically provide a container for a precision (semi)-product which is produced in a very small number but requires a high antistatic property, while retaining a level of antistatic property comparable to an injection-molded product or a sheet-molded product.

[0007] According to the present invention, there is provided an antistatic resin-made container for a precision (semi)-product having a structure comprising a plurality of resinous parts bonded with a solvent to each other, wherein each of the plurality of resinous parts comprises an antistatic resin composition comprising (a) a polycrylonitrile resin: 50-95 wt. % and (b) a hydrophilic polymer: 5-50 wt. %.

[0008] In the present invention, a shaped product (e.g., in the form of a sheet) of an antistatic resin composition obtained by combining with a hydrophilic polymer (b) another thermoplastic resin comprising a polycrylonitrile resin (a) as a principal resin component to have enhanced mechanical properties, such as rigidity and wear resistance, is cut into a plurality of parts, which are bonded to each other with a solvent having a dissolving power to a polycrylonitrile resin, thereby forming a container for a precision (semi)-product exhibiting excellent antistatic property without resorting to injection molding or sheet forming. Herein, the term “solution bonding” refers to a technique of bonding a pair of resinous parts to each other with a solvent of the resin while partly dissolving the faces to be bonded of the resinous parts, and the solution bonding is used instead of using a resinous adhesive for polycrylonitrile resins (as disclosed in JP-A 60-53579 and JP-A 61-44966) in order to prevent the impairment of antistaticity of the entire container due to the formation of an insulating layer at the bonding boundary by the use of such a non-antistatic resin adhesive.
According to the present invention, there is also provided a kit for producing an antistatic resin-made container, including (1) an antistatic resin sheet comprising (a) a polycrylonitrile resin: 50-95 wt. % and (b) a hydrophilic polymer: 5-50 wt. %, and (2) solvent acetonitrile. By using the kit, the antistatic resin sheet is cut into sizes of parts suitable for storing a precision (semi-)product to be contained, and the parts are solution-bonded with each other, thereby allowing an order-made production of an antistatic resin container having a size fitted for a precision (semi-)product and exhibiting a level of antistatic property comparable to the one prepared by injection molding etc., without resorting to the injection molding, etc.

These and other objects, features and advantages of the present invention will become more apparent upon a consideration of the following description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings.

THE DRAWING

Figs. 1A to 1C are three-directional views of an outer structure of a main body of an antistatic resin-made container according to an embodiment of the present invention, including Fig. 1A (an upper plan view), Fig. 1B (a side view as viewed in a direction of arrow-headed B-B line in Fig. 1A) and Fig. 1C (a side view as viewed in a direction of arrow-headed C-C line in Fig. 1A).

DESCRIPTION OF PREFERRED EMBODIMENTS

Antistatic Resin Composition

The antistatic resin composition forming the antistatic resin-made container of the present invention comprises (a) a polycrylonitrile resin: 50-95 wt. %, and (b) a hydrophilic polymer: 5-50 wt. %.

Polycrylonitrile Resin

As a principal resin component of the antistatic resin composition, the polycrylonitrile resin (a) is used in combination with the hydrophilic polymer (b) used in a relatively small amount to provide an antistatic resin shaped product with enhanced mechanical properties, such as rigidity and wear resistance, while retaining a necessary level of antistatic property.

In the present invention, the term “polycrylonitrile resin” is used to inclusively refer to a rigid resin comprising polymerized units of unsaturated nitriles (including methacrylonitrile, α-chloro-acrylonitrile, etc., in addition to acrylonitrile) as a principal constituent of at least 30 wt. %, preferably 50 wt. % or more. As far as the condition is satisfied, the polycrylonitrile resin can contain polymerized units other than those of unsaturated nitriles inclusive of a rubbery component (preferably comprising a copolymer of unsaturated nitrile) for improving the impact resistance. Representative examples thereof may include those produced by processes disclosed in JP-B 46-25005 and JP-B 49-32789, and commercially available product sold under the name of “BAREX 210” (from BP Amoco).

The polycrylonitrile resin (a) may preferably exhibit a flexural rigidity of at least 2 GPa. The polycrylonitrile resin (a) is used in an amount occupying 50-95 wt. %, preferably 80-95 wt. %, of the antistatic resin composition (with respect to its resin content). Below 50 wt. %, desired mechanical properties cannot be attained, and the solution-bonding strength is also impaired.

Hydrophilic Polymer

As the hydrophilic polymer (b) constituting the antistatic resin composition for the antistatic resin-made container of the present invention together with the polycrylonitrile resin (a), hydrophilic polymers disclosed as permanent antistatic resins in the above-mentioned reference, “Japan Society of Static Electricity”, vol. 21, No. 5, pp. 212-219, particularly in Table 6 on page 216, may be used. Such hydrophilic polymers may be characterized as polymers which are solid and have a high ionic conductivity at room temperature. Specific examples thereof may include: polyether-type hydrophilic polymers, inclusive of polyethylene oxide, polyether-amine, polyether-amine-imide, ethylene oxide-epichlorohydrin copolymer, and a graft copolymer of a rubber trunk polymer having a polyalkylene oxide group; quaternary ammonium salt-type hydrophilic polymers, such as quaternary ammonium salt-containing (meth)acrylate copolymers, quaternary ammonium salt-containing maleimide copolymers, and quaternary ammonium salt-containing methacrylimide copolymers; sulfonic acid-type hydrophilic polymers, such as poly-sodium styrenesulfonate; betaine-type hydrophilic polymers, such as carbobetaine graft copolymers; and polymeric charge transfer combinant-type hydrophilic polymers. Among the above, polyether-type hydrophilic polymers having polyalkylene oxide groups including at least partially polyethylene oxide groups, are preferred, and particularly a graft copolymer basically identical to the one developed by the present applicant (JP-B 54-2462, cor. to GB-A 2070446, the disclosure of which is incorporated herein by reference) and having the following composition is preferably used.

That is, a graft copolymer (A) obtained by graft-polymerizing (iv) 5 to 95 wt. % of at least one species of ethylenically unsaturated monomer onto a rubber trunk polymer in an amount of 5 to 95 wt. % of parts (giving a total of 100 wt. % parts with the ethylenically unsaturated monomer), which rubber trunk polymer in turn is a copolymer of

(i) 50-95 wt. % of at least one monomer selected from conjugated dienes and acrylate esters,

(ii) 5-50 wt. % of at least one species of monomers each having an ethylenic unsaturation and 4 to 500 alkylene oxide groups, preferably including at least 4 ethylene oxide groups, and

(iii) 0-40 wt. % of at least one species of ethylenically unsaturated monomer copolymerizable with the conjugated diene or acrylate ester (i).

The hydrophilic polymer (b) is used in an amount of 5-50 wt. %, preferably 5-20 wt. %, of the antistatic resin composition (with respect to its resin content). Below 5 wt. %, the desired antistatic effect cannot be attained. In excess of 50 wt. %, the polycrylonitrile resin is reduced in amount correspondingly to impair the mechanical properties including rigidity, and also the solution-bonding strength.

Within an extent that the polycrylonitrile resin (a) and the hydrophilic polymer (b) satisfy the above-mentioned respective compositional ranges, another thermoplastic resin...
can be included in the antistatic resin composition of the present invention. Examples of such another thermoplastic resin may include: polyethylene, polypropylene, polyvinyl chloride, polyvinylidene chloride, aromatic vinyl polymers, nitrile resins, (meth)acrylic resins comprising homopolymers or copolymers of (meth)acrylate esters, ABS (acrylonitrile-butadiene-styrene) resin, acrylonitrile-styrene resin, polycarbonate resin, polystyrene resin, polyester resins, and fluorine-containing resins. It is preferred to use a resin having good compatibility with the hydrophilic polymer (a). However, such another thermoplastic resin should preferably be suppressed to at most 20 wt. % of the resin content of the antistatic resin composition so as to retain the antistatic property, mechanical property and solution-bonding strength characterizing the antistatic resin of the present invention.

[0026] In order to prevent the haze or discoloration with acidic gas or basic gas on the surface of the antistatic resin-made container of the present invention or the surface of the precision (semi-)product contained therein, it is also preferred to incorporate a polyvalent metal compound (c) having a valence of at least 2 in the antistatic resin composition of the present invention. Such a polyvalent metal compound (c) may preferably be used in an amount of 0.001-0.5 wt. %, more preferably 0.001-0.3 wt. %, further preferably 0.001-0.1 wt. %, per 100 wt. parts of the total resin content in the antistatic resin. Below 0.001 wt. %, the haze-prevention effect becomes scarce, and in excess of 0.5 wt. %, the bleeding-out of the metal compound (c) per se is liable to be problematic.

[0027] The polyvalent metal compound (c) may be added at any time of polymerization, blending, shaping, etc. In the case of addition at the time of blending or shaping, for example, a master batch containing the metal compound (c) at a concentration of, e.g., 10 wt. % may be added in an amount of 0.01-5 wt. %, parts per 100 wt. parts of the total resin. Examples of the polyvalent metal compound (c) having a valence of at least 2, preferably 2-4, may include: metal salts inclusive of alkaline earth metal salts, such as magnesium chloride, calcium chloride, magnesium oxide and aluminum oxide; and IIIA-group metal salts, such as aluminum chloride and aluminum stearate; and also metal oxides, such as titanium oxide, zircon oxide and tin oxide. The exact mechanism by which such a polyvalent metal compound prevents the occurrence of haze due to an acidic gas or a basic gas has not been clarified as yet, but it is presumed that the polyvalent metal forms a complex with an absorbed acidic gas or basic gas to obstruct the crystal growth of such a gaseous substance on a shaped product surface.

[0028] A surfactant (d) may be further added so as to be adsorbed on the hydrophilic polymer (a) to enhance the permanent antistatic property of the resultant antistatic resin composition, but can be omitted. In order to provide a good heat resistance, it is preferred to use an anionic surfactant having a thermal weight loss initiation temperature according to JIS-K7120 (hereinafter sometimes denoted by “Tmg”) of at least 250°C. The thermal weight loss initiation temperature has been recognized to have some degree of correlation with the structure of an anionic surfactant, and examples of the anionic surfactant having a thermal weight loss initiation temperature of at least 250°C. may include: Alkylbenzenesulfonic acid salts, alkylphosphatidene-sulfonic acid salts, aliphatic acid salts, perfluoro-alkylsulfonic acid salts, trifluoromethane-sulfonic acid salts, and perfluoro-alkylcarboxylic acid salts.

[0029] The selection of metal species constituting an anionic surfactant also has a relation with the effect of the anionic surfactant as an antistatic agent, and for the purpose of the present invention, a salt of an alkaline metal having an atomic number of 19 (corresponding to potassium) or more is preferred because of a large ionic diameter thereof suitable for providing a necessary antistatic property at a relatively small amount of addition, and also in view of a shorter time for blending with the polycrylonitrile resin (a) and the hydrophilic polymer (b) and better physical properties of the shaped product, particularly resistance to whitening with warm water.

[0030] The surfactant (d) may preferably be used in a proportion of 0.1-5 wt. %, parts per 100 wt. % of the total resin content in the antistatic resin. Below 0.1 wt. %, the antistatic property-improving effect is scarce, and in excess of 5 wt. %, the blending-out to the surface of a shaped product becomes remarkable to provide undesirable properties of the shaped product.

[0031] The antistatic resin composition of the present invention can further contain additives, as desired, such as an ultraviolet absorber, a thermal stabilizer, an antioxidant, a lubricant, a filler and dyes or pigments, in addition to the above-mentioned components, and the addition of these can be effected at any time of polymerization, blending, shaping, etc.

[0032] The antistatic resin-made container of the present invention has a structure formed by solution-bonding a plurality of parts each comprising the above-mentioned antistatic resin composition to each other. Each of the plurality of parts may be obtained as a shaped product of the antistatic resin composition or a cut product therefrom. The shape of the shaped product is basically arbitrary but may be a sheet-form product according to a preferred embodiment in view of the latitude of a user in cutting therefrom arbitrary shapes and sizes of parts for forming a shape of container for accommodating a precision (semi-)product having arbitrary shape and size. Such a sheet product may have a thickness on the order of 0.5-100 mm, particularly 1-20 mm. The sheet product may further have a flexural rigidity of at least 1.5 GPa, particularly 2.0 GPa or higher; a wear resistance represented by a Taber abrasion (according to JIS K7204) of at most 200 mg, particularly 150 mg or less; and an antistatic property represented by a volume resistivity (JIS K6911; 25°C, 23% RH) of at most ca. 10^{12} ohm.m, particularly ca. 10^{10} ohm.m or below.

[0033] The above-mentioned shaped product (e.g., in a sheet form) may be obtained by subjectioning the antistatic resin composition to forming methods, such as injection molding, extrusion or compression molding. It is also possible to shape the resin composition into a sheet or film having a smaller thickness, a tube, etc., if desired.

[0034] The antistatic resin-made container of the present invention may be obtained by solution-bonding a plurality of parts which may be a sheet product, for example, as mentioned above, as it is, if the sheet product has a desired size, or parts obtained by cutting such a sheet product into sizes corresponding to a precision (semi-)product to be contained therein.
As a solvent to be used for the solution bonding, a good solvent for the polyacrylonitrile resin (a) may be used, and among others, acetonitrile having a boiling point of 81.6°C is preferred in view of readiness of drying after the solution bonding. However, acetonitrile is toxic to some extent, the solution bonding should be performed by using a protector in an environment of good ventilation.

The kit for producing an antistatic resin-made container according to the present invention comprises at least one antistatic resin sheet (preferably having a size, e.g., including a side of at least 250 mm, suitable for providing arbitrary sizes of parts by cutting thereof) formed by shaping into sheet of the above-mentioned antistatic resin composition, and acetonitrile (solvent) stored in a container. It is also desirable to attach a handling note for the acetonitrile.

For example, for preparation of a rectangular antistatic resin-made container for storing a generally rectangular or disk-shaped precision (semi-)product, an antistatic resin sheet forming a bottom plate having nearly a shape of the container is cut out from an antistatic resin sheet in the kit, and four bar-shaped parts having length of 4 sides of the bottom plate and a width corresponding to or a little larger than the thickness of the precision (semi-)product are cut out also from such an antistatic resin sheet in the kit and are solution-bonded onto the four sides of the bottom plate to provide a main body of the container, which is then covered with a lid member formed in a similar manner as the main body to complete the container.

For the solution bonding in the above-mentioned case, for example, acetonitrile is applied in a small amount (e.g., ca. 160 g/m²) onto faces to be bonded of the bar-shaped parts, and the parts are put along and against the sides of the bottom plate under a pressing force of ca. 5 Pa, followed by holding for ca. 1 min. under warming at ca. 40°C as desired to evaporate the solvent acetonitrile and standing for ca. 24 hours so that a desired bonding strength is attained. The bonding strength (JIS K6850; 23°C, tensile speed=5 mm/min.) may preferably be at least 7 MPa, particularly 10 MPa or higher.

Incidentally, in the present invention, a container is formed by bonding parts thereof not by using a resinous adhesive but according to the solution bonding in order to avoid a local lowering in antistaticity by use of a resinous bonding agent since there are few adhesive resins showing good antistaticity.

The thus-formed antistatic resin-made container of the present invention is most suited for containing precision products or semi-products thereof, which are produced in a very small number but require a high level of antistatic property, such as photomasks (including reticles) and periles as protective films for such photomasks, semiconductor wafer-related trial products, LCD related trial products, IC-product-related trial products, etc.

EXAMPLES

Hereinbelow, the present invention will be described more specifically based on Examples, wherein "part(s)" means "part(s) by weight".

As a polyacrylonitrile resin (a), “BAREX 210” (flexural rigidity=3.38 GPa, made by BP/Amoco) was used. As a hydrophilic polymer (b), one prepared in the following example was used.

Production of Hydrophilic Polymer

(a) A rubber trunk polymer-forming composition:

<table>
<thead>
<tr>
<th>Component</th>
<th>Part(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butyl acrylate</td>
<td>39.0</td>
</tr>
<tr>
<td>Styrene</td>
<td>20.3</td>
</tr>
<tr>
<td>Allyl methacrylate</td>
<td>0.7</td>
</tr>
<tr>
<td>Methoxypolyethylene glycol</td>
<td>40.3</td>
</tr>
<tr>
<td>methacrylate (ii) (having average ca. 23 ethylene oxide groups)</td>
<td></td>
</tr>
<tr>
<td>Formaldehyde sodium sulfate</td>
<td>0.08</td>
</tr>
<tr>
<td>tert-Butyl hydroperoxide</td>
<td>0.1</td>
</tr>
<tr>
<td>Iron (II) ethylenediamine-</td>
<td>0.005</td>
</tr>
<tr>
<td>tetraacetate</td>
<td></td>
</tr>
<tr>
<td>Diethylene diosodium pyrophosphate</td>
<td>0.05</td>
</tr>
<tr>
<td>Tetrasodium pyrophosphate</td>
<td>0.05</td>
</tr>
<tr>
<td>Sodium dodecylbenzenesulfonate</td>
<td>0.5</td>
</tr>
<tr>
<td>Deionized water</td>
<td>290</td>
</tr>
</tbody>
</table>

(b) To the above latex of rubber trunk polymer (70 parts as solid matter), a mixture of ethylenically unsaturated monomer (iv):

<table>
<thead>
<tr>
<th>Component</th>
<th>Part(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methyl methacrylate</td>
<td>24.0</td>
</tr>
<tr>
<td>Styrene</td>
<td>3.7</td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td>2.0</td>
</tr>
<tr>
<td>Normal-octyl mercaptan</td>
<td>0.3</td>
</tr>
<tr>
<td>Formaldehyde sodium sulfate</td>
<td>0.08</td>
</tr>
<tr>
<td>tert-Butyl hydroperoxide</td>
<td>0.1</td>
</tr>
<tr>
<td>Deionized water</td>
<td>70</td>
</tr>
</tbody>
</table>

was added, and the mixture was aerated with nitrogen and subjected to graft copolymerization at 50°C for 4 hours. The latex was taken out and warmed at 70°C, and 1000 parts of hydrochloric acid aqueous solution (concentration: 1.5 wt. %) at 70°C was added to cause precipitation. After dewatering and washing, the precipitate was dried to obtain a white powdery hydrophilic polymer (b).

Antistatic Resin Composition and Measurement of Properties

100-40 parts of the above polyacrylonitrile resin (a), 0-60 parts of the above hydrophilic polymer (b) and 0-0.3 part of potassium nonafluorobutane-sulfonate as an anionic surfactant, were blended in various ways to obtain 6 types of compositions.

Then, each composition was kneaded on an 8 inch-roll kneader (made by Kansai Roll K.K.) and formed at 140-180°C into 10 sheets each with planar sizes of 1000 mm x 300 mm and a thickness of 0.5 mm. Then, the 10 sheets were pressed at 180-200°C by a press-forming machine (made by Shinto Kinzoku Kogyosho K.K.) to form an antistatic resin sheet measuring planar sizes of 250 mm x 250 mm and a thickness of 5 mm. Various samples were cut out from the antistatic resin sheet and used for the following measurements.
(Volumetric Intrinsic Resistivity)

An antistatic resin sheet sample of 50 mm x 50 mm in planar sizes and 5 mm in thickness was formed for each composition and, after moisture conditioning at a temperature of 23° C. and a humidity of 23% RH for 3 days, subjected to measurement of a volumetric intrinsic resistivity by using an ultra-super insulation meter (“SM-10E”, made by To a Dempa Kogyo K.K.) according to JIS K6911.

(Bonding Strength)

Two antistatic resin sheets each measuring 100 mm x 25 mm in planar sizes and 5 mm in thickness (according to Shape and size (2) of a test piece (bonding plate) shown in FIG. 2 of JIS K6850) were formed for each composition, and 50 mg of acetonitrile (as a bonding solvent) was applied in planar sizes of 12.5 mm x 25 mm (area: 312.5 mm²). Then, the two sheets were held under a pressing force of 5 Pa for 1 min., followed by standing at a temperature of 23° C. and a humidity of 50% RH for 3 days. Then, by using a tensile tester (“AUTOGRAPH AG-200E”), made by Shimadzu Seisakusho K.K.), two ends of the bonded test pieces were clamped for holding with clamping planar sizes of 37.5 mm x 25 mm and pulled at a tensile speed of 5 mm/min, until the test pieces were broken to measure a bonding strength.

The component ratios and the measurement results of volumetric intrinsic resistivity and bonding strength for the respective compositions are inclusively shown in Table 1 below.

<table>
<thead>
<tr>
<th>Example</th>
<th>Polyacrylonitrile (a)</th>
<th>Hydrophilic Polymer (b)</th>
<th>Volumetric Intrinsic Resistivity (Ω·m)</th>
<th>Bonding Strength (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comp. 1</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>1 x 10⁷</td>
</tr>
<tr>
<td>1</td>
<td>95</td>
<td>5</td>
<td>0.3</td>
<td>1 x 10²</td>
</tr>
<tr>
<td>2</td>
<td>92</td>
<td>8</td>
<td>0.3</td>
<td>1 x 10⁷</td>
</tr>
<tr>
<td>3</td>
<td>90</td>
<td>10</td>
<td>0.3</td>
<td>8 x 10⁷</td>
</tr>
<tr>
<td>4</td>
<td>88</td>
<td>12</td>
<td>0.3</td>
<td>6 x 10⁷</td>
</tr>
<tr>
<td>Comp. 2</td>
<td>40</td>
<td>60</td>
<td>0.3</td>
<td>1 x 10⁷</td>
</tr>
</tbody>
</table>

*KNFBS: potassium nonafluorobutanesulfonate
*Measured according to JIS K6911 (23° C., 23% RH)
*Measured according to JIS K6850 (23° C., 5 mm/min.)

In view of the above Table 1, it is understood that antistatic resin compositions with good antistatic property (i.e., low volumetric intrinsic resistivity) and bonding strength in combination were obtained in the prescribed compositional ranges according to the present invention with respect to the polyacrylonitrile resin (a) and hydrophilic polymer (b).

Production of Container

From an antistatic resin sheet measuring 250 mm x 250 mm in planar sizes and 5 mm in thickness formed from the antistatic resin composition of Example 3 above, an outer structure of a main body of a container for a 6-inch photomask having inner sizes of 230 mm x 230 mm x depth 50 mm as shown in FIGS. 1A (top plan view) and 1B and 1C (side views as viewed in the directions of B-B line and C-C line in FIG. 1A respectively) was produced in the following manner.

Thus, from the antistatic resin sheet of 250 mm x 250 mm in planar sizes and 5 mm in thickness,

1 bottom sheet 1 of 240 mm x 240 mm in planar sizes and 5 mm in thickness,

2 side sheets 2 of 240 mm x 50 mm in planar sizes and 5 mm in thickness, and

2 side sheets 3 of 230 mm x 50 mm in planar sizes and 5 mm in thickness, were cut out as parts for providing a container. After applying acetonitrile at a rate of 1.60 g/m² onto each bonding face of the side sheets 2 and 3, the side sheets 2 and 3 were disposed as shown in FIGS. 1A-1C (with dashed lines representing bonding boundaries) and were held under a pressing force of 1 Pa for 1 min., followed by standing at 230° C. and 50% RH for 3 days, to form an outer structure of a main body (to be combined with a lid member having a similar structure) as illustrated in FIGS. 1A-1C.

The above-prepared container structure was dropped from a height of 75 cm onto a concrete-surfaced floor so that a side wall thereof was directed downwards, whereas no breakage was observed at the bonding boundaries.

Separately, from a container structure prepared in the same manner as above, 10 bar-strip samples each measuring 50 mm x 5 mm in planar sizes and 5 mm in thickness were cut out so as to include a bonding boundary and, after being moisture-conditioned at 23° C. and 23% RH for 3 days, were subjected to measurement of volumetric intrinsic resistivity by using an ultra-super insulation meter (“SM-10E”, made by To a Dempa Kogyo K.K.), thereby exhibiting a volumetric intrinsic resistivity of 8 x 10⁷ ohm.m on an average.

From the above results, it is understood that a container exhibiting a good bonding strength and a good antistatic property including a bonded part (boundary) thereof.

As described above, according to the present invention, a plurality of resinous parts comprising an antistatic resin composition formed of a polyacrylonitrile resin (a) and a hydrophilic polymer in appropriate proportions are solution bonded with each other preferably by using acetonitrile as the solvent, whereby it becomes possible to provide an antistatic resin-made container suitable for accommodating precision products or semiconduct products thereof which are produced in a very small number but require a high level of antistatic property, such as photomasks (including reticles) and percles as protective films for such photomasks, semiconduct wafer-related trial products, LCD-related trial products, IC-product-related trial products, etc., and also a kit for production of such an antistatic resin-made container.

What is claimed is:

1. An antistatic resin-made container for a precision (semi)product having a structure comprising a plurality of resinous parts bonded with a solvent to each other, wherein each of the plurality of resinous parts comprises an antistatic resin composition comprising (a) a polyacrylonitrile resin: 50-95 wt. % and (b) a hydrophilic polymer: 5-50 wt. %.
2. An antistatic resin-made container according to claim 1, wherein the antistatic resin composition comprises 80-95 wt. % of the polyacrylonitrile resin (a) and 5-20 wt. % of the hydrophilic polymer (b).

3. An antistatic resin-made container according to claim 1, wherein the hydrophilic polymer (a) is a polyalkylene oxide group-containing polymer.

4. An antistatic resin-made container according to claim 3, wherein the hydrophilic polymer (b) is a graft-copolymer obtained by graft-polymerizing (iv) 5 to 95 wt. parts of at least one species of ethylenically unsaturated monomer onto a rubber trunk polymer in an amount of 5 to 95 wt. parts (giving a total of 100 wt. parts together with the ethylenically unsaturated monomer), which rubber trunk polymer in turn is a copolymer of
   (i) 50-95 wt. % of at least one monomer selected from conjugated dienes and acrylate esters,
   (ii) 5-50 wt. % of at least one species of monomers each having 4 to 500 alkylene oxide groups and an ethylenic unsaturation, and
   (iii) 0-40 wt. % of at least one species of ethylenically unsaturated monomer copolymerizable with the conjugated diene or acrylate ester (i).

5. An antistatic resin-made container according to claim 1, wherein the antistatic resin composition further comprises a surfactant.

6. An antistatic resin-made container according to claim 1, wherein the antistatic resin composition further comprises a polyvalent metal compound.

7. An antistatic resin-made container according to claim 1, wherein the polyacrylonitrile resin (a) exhibits a flexural rigidity of at least 2 GPa.

8. A kit for producing an antistatic resin-made container, including (1) an antistatic resin sheet comprising (a) a polyacrylonitrile resin: 50-95 wt. % and (b) a hydrophilic polymer: 5-50 wt. %, and (2) solvent acetonitrile.

9. A kit according to claim 8, wherein the antistatic resin sheet has thickness of 1-20 mm.

10. A kit according to claim 8 wherein the antistatic resin sheet has a flexural rigidity of at least 1.5 GPa, a Taber abrasion of at most 200 mg and a volumetric intrinsic resistivity of at most $10^{12}$ ohm.m.

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