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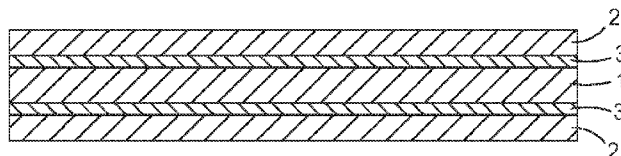


FIG. 1

(57) Abstract: Disclosed is an antistatic surface protection film including: a core layer including a polystyrene-based polymer; a skin layer laminated on each of both surfaces of the core layer, which includes a polyethylene-based polymer and an antistatic agent; and a tie layer between the core layer and the skin layer, which binds the core layer and the skin layer, wherein, the tie layer includes a polymer having a repeating unit compatible with the polystyrene-based polymer and another repeating unit compatible with the polyethylene-based polymer.



ANTISTATIC SURFACE PROTECTION FILM

TECHNICAL FIELD

The present invention relates to an antistatic surface protection film, which can protect the surface of a display or its component from static electricity occurring during transfer and/or storage of the display or its component.

BACKGROUND

In general, a display or its component, such as LCD, passes through many transfer and storage steps from manufacture at a factory until delivery to a consumer. When the display or its component is transferred or stored, the surface of the display or its component is protected with a surface protection film in order to prevent damage to the surface.

The surface protection film includes a film such as a polypropylene film, a vinyl chloride film, a polyethylene terephthalate film, etc. Such surface protection film is applied to a surface of a display or its component in various ways. For example, a surface protection film having an adhesive layer on one surface thereof is adhered to the surface of a display or its component, or an adhesive tape is adhered to the circumferential portion of a surface protection film placed on the surface of a display or its component so as to fix the film on the display or its component.

Before a display or its component having such a surface protection film adhered or fixed on the surface thereof is used, the surface protection film is required to be removed from the surface of the display or its component. Herein, static electricity may occur between the surface of the display or its component and the film. Accordingly, impurities or dust may be attached to the display or its component by attraction of the occurred static electricity, and also, electrostatic discharge (ESD) may cause damage to the display or its component.

Therefore, in order to prevent the occurrence of static electricity, an adhesive layer or an adhesive tape including an antistatic agent, such as an ICP (inherently conductive polymer) or a surfactant, has been conventionally applied to a surface of a surface protection film. However, in order to prevent the occurrence of static electricity, a large amount of an antistatic agent has been required to be added to an adhesive layer or an adhesive tape, thereby reducing the viscosity of the adhesive layer or the adhesive tape. Accordingly, when a display or its component is stored or transferred, the adhesive layer

may be easily separated from the surface protection film, or the adhesive tape may be separated from the surface protection film and the display or its component. As a result, the surface protection film may be separated from the surface of the displays or its component, and thus cannot protect the surface of the displays or its component from damage.

Also, since the surface protection film is generally too flexible, the covering of the surface protection film on the surface of the display or its component may reduce its workability. Even so, in the case of a stiff surface protection film, when the surface protection film is removed from the surface of a display or its component, scratches may be caused on the surface of the display or its component by the film.

SUMMARY

Therefore, the present invention has been made in view of the above-mentioned problems, and the present inventors tried to prepare an antistatic surface protection film, which can protect the surface of a display or its component from damage during transfer and/or storage of the display or its component, and can be easily attached to/removed from the surface of the display or its component without causing scratches on the surface of the display or its component.

In the result, the present inventors have found that when a skin layer including a polyethylene-based polymer and an antistatic agent is laminated on each of both surfaces of a core layer including a polystyrene-based polymer by a tie layer including a polymer compatible with both the polystyrene-based polymer and the polyethylene-based polymer, it is possible to prepare an antistatic surface protection film having a soft surface, and an improved workability for adhesion/attachment of the film. The present invention is based on the above facts.

According to an aspect of the present invention, there is provided an antistatic surface protection film including: a core layer including a polystyrene-based polymer; a skin layer laminated on each of both surfaces of the core layer, which includes a polyethylene-based polymer and an antistatic agent; and a tie layer between the core layer and the skin layer, which binds the core layer and the skin layer, wherein, the tie layer includes a polymer having a repeating unit compatible with the polystyrene-based polymer and another repeating unit compatible with the polyethylene-based polymer.

According to another aspect of the present invention, there is provided a method of preparing an antistatic surface protection film, the method including the steps of: i) preparing a core layer forming polymer material by using a polystyrene-based polymer; ii) preparing a skin layer forming polymer material by mixing a polyethylene-based polymer and an antistatic agent; iii) preparing a tie layer forming polymer material by using a polymer including a moiety compatible with the polystyrene-based polymer and another moiety compatible with the polyethylene-based polymer; and iv) co-extruding the core layer forming polymer material, the skin layer forming polymer material, and the tie layer forming polymer material.

An antistatic surface protection film according to the present invention has a structure where a skin layer including a polyethylene-based polymer and an antistatic agent is laminated on each of both surfaces of a core layer including a polystyrene-based polymer, by a tie layer including a polymer including compatible with both the polystyrene-based polymer and the polyethylene-based polymer. Therefore, it is possible to protect the surface of a display or its component from damage during transfer and/or storage of the display or its component and to easily attach/remove the film to/from the surface of the display or its component without causing scratches on the surface of the display or its component.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view illustrating an antistatic surface protection film according to the present invention.

FIG. 2 is a schematic view illustrating a process of fabricating an antistatic surface protection film according to the present invention.

FIG. 3 is a graph illustrating storage modulus of films according to Examples 1 to 3 and Comparative Examples 1 to 3.

DETAILED DESCRIPTION

Hereinafter, the present disclosure will be described in detail.

An antistatic surface protection film according to the present invention has a structure where a core layer 1 including a polystyrene-based polymer and a skin layer 2 including a polyethylene-based polymer and an antistatic agent are combined by a tie layer 3, the tie layer 3 including a polymer having a repeating unit compatible with the

polystyrene-based polymer and another repeating unit compatible with the polyethylene-based polymer (see FIG. 1). Such an antistatic surface protection film according to the present invention has low surface resistance, a soft surface, and appropriate stiffness. Therefore, the antistatic surface protection film according to the present invention can be easily adhered to and detached (removed) from a surface of a display or its component without the occurrence of scratches on the surface of the display or its component. Also, the antistatic surface protection film according to the present invention can protect a surface of the display or its component from static electricity or external physical impact.

According to an embodiment of the present invention, the core layer 1 includes a polystyrene-based polymer. The polystyrene-based polymer has a structure where a phenyl group is attached to a hydrocarbon backbone, and may be obtained by radical vinyl polymerization of a styrene monomer. Examples of the styrene monomer include styrene, α -methylstyrene, p-methylstyrene, etc. When such a core layer is present on the antistatic surface protection film according to the present invention, only one sheet of the surface protection film can be easily adhered to and detached (removed) from the display or its component.

However, the polystyrene-based polymer is brittle, and thus the core layer has slightly insufficient flexibility. In order to increase the flexibility, in the core layer according to the present invention, in addition to the polystyrene-based polymer, a styrene-butadiene copolymer may be further included. Accordingly, the core layer can have slightly flexibility (that is slightly stiffness), thereby improving the workability for adhering/detaching (removing) a film.

According to an embodiment of the present invention, the styrene-butadiene copolymer is preferably included in an amount of about 10 to 100 parts by weight based on 100 parts by weight of the polystyrene-based polymer. When the amount of the styrene-butadiene copolymer is less than 10 parts by weight, the film may be broken during a winding operation for a roll-type formation, and on the other hand, when the amount of the styrene-butadiene copolymer is more than 100 parts by weight, the operation efficiency may be degraded due to low stiffness of the film.

Since the core layer including the polystyrene-based polymer is a supporting layer of the antistatic surface protection film according to the present invention, the thickness of the core layer is preferably about 50 to 80% with respect to the total thickness of the

surface protection film. According to an embodiment of the present invention, when the total thickness of a film is about 70 to 120 μ m, the thickness of a core layer is about 40 to 90 μ m.

On each of both surfaces of such a core layer, the skin layer 2 including a polyethylene-based polymer and an antistatic agent is laminated. The skin layer plays a role of providing an antistatic property to the antistatic surface protection film according to the present invention. The thickness of the skin layer is not particularly limited, but according to an embodiment of the present invention, it may be about 10 to 20 μ m.

Examples of the polyethylene-based polymer included in the skin layer include a high density polyethylene (HDPE) polymer, a low density polyethylene (LDPE) polymer, a linear low density polyethylene (LLDPE) polymer, an ethylene vinyl acetate (EVA) polymer, or a mixture of at least two of these polymers. The surface of the skin layer including such a polyethylene-based polymer is soft, and thus the surface protection film according to the present invention does not cause scratches on the surface of the display or its component.

Also, the skin layer including such a polyethylene-based polymer includes an antistatic agent for providing an antistatic property. The antistatic agent that may be used in the present invention is not particularly limited, as long as the antistatic agent is known in the art. According to an embodiment of the present invention, as the antistatic agent, a surfactant or an ionomer, etc. may be used.

The surfactant is classified into anionic, cationic, amphoteric, and non-ionic surfactants. Examples of the cationic surfactant include a quaternary ammonium compound, etc.; examples of the anionic surfactant include alkylsulfonate, alkylsulfate, alkylphosphite, sodium alkylsulfonate, etc.; examples of the non-ionic surfactant include ethoxylated alkylamine, fatty acid ester, glyceride alkylamine, polyethylene glycol ester, etc.; and examples of the amphoteric surfactant include alkylbetain, alkylalanine, etc.

As the ionomer, a polymer including ions of metals of groups 1~16 of the Periodic Table may be used in the present invention without particular limitations. Examples of the metal ions include Na⁺, K⁺, Li⁺, Zn²⁺, etc.

Examples of the ionomer include an ethylene-based ionomer, styrene-based ionomer, a rubber-based ionomer, a fluoro-based ionomer, sulfonated EPDM-based ionomer, a carboxylated nitrile-based ionomer, and a mixture of at least two of these

materials. More specifically, the examples include a poly(ethylene-co-methacrylic acid) ionomer, a poly(butadiene-co-acrylic acid) ionomer, a perfluorosulfonate ionomer, a perfluorocarboxylate ionomer, a telechelic polybutadiene ionomer, a sulfonated ethylene-propylene terpolymer ionomer, a poly(styrene-co-acrylic acid) ionomer, a sulfonated butyl elastomer ionomer, a sulfonated polypentenamer ionomer, a poly(styrene-co-butadiene-co-acrylic acid) ionomer, a poly(butadiene-co-acrylonitrile-co-acrylic acid) ionomer, and a mixture of at least two of these materials.

The antistatic agent may be included in an amount of about 10 to 50 parts by weight based on 100 parts by weight of the polyethylene-based polymer. When the amount of the antistatic agent is less than 10 parts by weight, a desired antistatic property cannot be achieved, and on the other hand, when the amount is more than 50 parts by weight, the physical properties of the polyethylene-based polymer may be degraded due to a large amount of the antistatic agent, and also the preparation cost may be increased.

However since a polyethylene-based polymer of the skin layer is incompatible with a polystyrene-based polymer of the core layer, it is difficult to laminate the skin layer on each of both surfaces of the core layer. Accordingly, in order to laminate the skin layer on each of both surfaces of the core layer, an additional layer between both layers, which includes a material for binding both layers, is required. For example, in preparing the surface protection film according to the present invention by co-extrusion, a tie layer including a polymer having a repeating unit compatible with the polystyrene-based polymer and another repeating unit compatible with the polyethylene-based polymer is required between the core layer and the skin layer.

Therefore, in the interface between the tie layer and the core layer, a repeating unit of the tie layer, which is compatible with the polystyrene-based polymer, is diffused into the surface of the core layer, or forms a covalent bond with the polystyrene-based polymer, thereby allowing the tie layer to be attached to the core layer. Also, in the interface between the tie layer and the skin layer, another repeating unit of the tie layer, which is compatible with the polyethylene-based polymer, is diffused into the surface of the skin layer, or forms a covalent bond with the polyethylene-based polymer, thereby allowing the tie layer to be attached to the skin layer. In the result, on each of both surfaces of the core layer, the skin layer can be attached by the tie layer. Accordingly, in using the

surface protection film according to the present invention, the skin layer is not separated from the core layer.

Examples of the polymer having a repeating unit compatible with the polystyrene-based polymer and another repeating unit compatible with the polyethylene-based polymer include an ethylene-alkyl(meth)acrylate copolymer, etc.

The thickness of the tie layer is not particularly limited, but may be about 3 to 7 μ m, according to an embodiment of the present invention.

The antistatic surface protection film according to the present invention may be prepared by various laminated sheet preparation methods known in the art, but it is preferable that co-extrusion is used to simultaneously form the core layer, the skin layer, and the tie layer.

According to an embodiment of the present invention, the antistatic surface protection film according to the present invention may be prepared by the steps of: i) preparing a core layer forming polymer material by using a polystyrene-based polymer; ii) preparing a skin layer forming polymer material by mixing a polyethylene-based polymer and an antistatic agent; iii) preparing a tie layer forming polymer material by using a polymer including a moiety compatible with the polystyrene-based polymer and another moiety compatible with the polyethylene-based polymer; and iv) co-extruding the core layer forming polymer material, the skin layer forming polymer material, and the tie layer forming polymer material. Herein, the steps of preparing the core layer forming polymer material, the skin layer forming polymer material, and the tie layer forming polymer material are not in a time order.

In the step of co-extruding, as shown in FIG. 2, a core layer forming polymer material 101 is extruded through an annular die 401 from a first extruder 102 at about 200°C. At the same time, a tie layer forming polymer material 301, 301' is extruded through the annular die 401 from each of third extruders 302, 302' at about 160°C, or alternatively, a single extruder provides the tie layer forming material for both tie layers. Also, a skin layer forming polymer material 201, 201' is extruded through the annular die 401 from each of second extruders 202, 202' at about 200°C or alternatively, a single extruder provides the skin layer forming material for both skin layers. Herein, the one annular die 401 is connected to the output openings of the first extruder 102, the second extruders 202, 202', and the third extruders 302, 302'. The layer forming polymer

materials are passed through the one annular die 401, and thus are co-extruded into a tube-type film in which the materials are concentrically laminated in sequence, and at this time the extruded tube-type film is expanded by an air ring 402 and becomes a multilayered tubular bubble 501. Then, the multilayered tubular bubble 501 is slit by a slit (is not indicated) and thereafter opened into a flat sheet then passed between a couple of nip rolls 403, and thus becomes a flat multilayered film 502. Next, the flat multilayered film 502 is finally wound by a winding roll (is not indicated).

The multilayered film 502 prepared through such co-extrusion has a five-layered structure where the skin layer 2 on each of both surfaces of the core layer 1 is laminated to the core layer 1 by the tie layer 3. Herein, in the interface between the core layer 1 and the tie layer 3, a polystyrene-based polymer forms a covalent bond with a repeating unit compatible with the polystyrene-based polymer. Also, in the interface between the tie layer and the skin layer, a polyethylene-based polymer forms a covalent bond with a repeating unit compatible with the polyethylene-based polymer. Accordingly, the core layer 1 and the skin layer 2 can be bound by the tie layer 3. Therefore, in using the antistatic surface protection film according to the present invention, the core layer and the skin layer are not delaminated from each other.

Herein, the core layer forming polymer material may be in the form of a pellet-type polystyrene-based polymer, a granule-type polystyrene-based polymer, a powder-type polystyrene-based polymer, or partially polymerized polystyrene-based polymer syrup. Also, in order to increase the flexibility of the core layer, the core layer forming polymer may further include various types of styrene-butadiene copolymers. When the core layer forming polymer material is in a state of polymer syrup, the viscosity may be within a range of about 1,000 to 100,000 cPs.

Also, the skin layer forming polymer material may be in the form of a mixture of a pellet-type polyethylene-based polymer and an antistatic agent, a mixture of a granule-type polyethylene-based polymer and an antistatic agent, a mixture of a powder-type polyethylene-based polymer and an antistatic agent, or a mixture of partially polymerized polyethylene-based polymer syrup and an antistatic agent. When the skin layer forming polymer material is in a state of polymer syrup, the viscosity may be within a range of about 1,000 to 100,000 cPs.

Also, the tie layer forming polymer material may be in the form of a polymer having a repeating unit compatible with the polystyrene-based polymer and another repeating unit compatible with the polyethylene-based polymer, and a pellet-type material, a granule-type material, a powder-type material, or partially polymerized polymer syrup.

5 When the tie layer forming polymer material is in a state of polymer syrup, the viscosity may be within a range of about 1,000 to 100,000 cPs.

Also, in the step of co-extruding, it is preferable that the temperature is adjusted in order to form a covalent bond between a polystyrene-based polymer and a moiety compatible with the polystyrene-based polymer, or a polyethylene-based polymer and another moiety compatible with the polyethylene-based polymer. According to an
10 embodiment of the present invention, the step of co-extruding is preferably performed at about 160 to 200°C.

Reference will now be made in detail to the preferred embodiments of the present invention. However, the following examples are illustrative only, and the scope of the
15 present invention is not limited thereto.

EXAMPLE 1

As a core layer forming polymer material, about 100 parts by weight of a pellet-type polystyrene polymer (available under the trade designation G144 from Dong-Bu Hitek) was prepared.

20 Also, as a skin layer forming polymer material, a mixture of about 80 parts by weight of a pellet-type low density polyethylene polymer (available under the trade designation 5302 from Hanwha Chemical) and about 20 parts by weight of a pellet-type potassium containing ionomer (available under the trade designation ENTIRA SD-100 from DuPont-MDP) as an antistatic agent was prepared.

25 Also, as a tie layer forming polymer material, about 100 parts by weight of a pellet-type ethylene-acrylate copolymer (available under the trade designation BYNEL 22E78 from DuPont) was prepared.

Into a first extruder positioned at a center, the prepared core layer forming polymer material was fed, into each of two third extruders positioned at both sides of the first
30 extruder, the prepared tie layer forming polymer material was fed, and into each of two second extruders positioned at both outsides of the third extruders, the prepared skin layer forming polymer material was fed. Then, each of the layer forming polymer materials

was passed through one annular die from the first extruder, the second extruders and the third extruders, and thereby was co-extruded into a tube-type multilayered film (in which an core layer, tie layers, and skin layers are concentrically laminated in sequence).

Herein, the extrusion temperatures of the first extruder, the second extruders, and the third extruders were 200°C, 200°C, and 160°C, respectively. Next, the co-extruded tube-type multilayered film was expanded by an air ring and then was formed into a multilayered tubular bubble. Then, the multilayered tubular bubble was slit and opened, then passed through a couple of nip rolls to obtain a flat five-layered antistatic surface protection film. The thickness of the obtained five-layered film was about 100µm, wherein the thickness of the core layer was about 65µm, the thickness of the skin layers were about 10.5µm, and the thickness of the tie layers were about 7µm.

EXAMPLE 2

An antistatic surface protection film was fabricated in the same manner as described in Example 1, except that as a core layer forming polymer material, a mixture of about 70 parts by weight of a pellet-type polystyrene polymer (available under the trade designation G144 from Dong-Bu Hitek) and about 30 parts by weight of a pellet-type styrene-butadiene copolymer (available under the trade designation K-RESIN KR-10 from Chevron) was prepared.

EXAMPLE 3

An antistatic surface protection film was fabricated in the same manner as described in Example 1, except that as a core layer forming polymer material, a mixture of about 50 parts by weight of a pellet-type polystyrene polymer (available under the trade designation G144 from Dong-Bu Hitek) and about 50 parts by weight of a pellet-type styrene-butadiene copolymer (available under the trade designation K-RESIN KR-10 from Chevron) was prepared.

EXAMPLE 4

An antistatic surface protection film was fabricated in the same manner as described in Example 1, except that as a skin layer forming polymer material, a mixture of about 90 parts by weight of a pellet-type low density polyethylene polymer (available under the trade designation 5302 from Hanwha Chemical) and about 10 parts by weight of

a pellet-type potassium containing ionomer (available under the trade designation MK-400 from Mitsui-DuPont) as an antistatic agent was prepared.

EXAMPLE 5

An antistatic surface protection film was fabricated in the same manner as described in Example 1, except that as a skin layer forming polymer material, a mixture of about 85 parts by weight of a pellet-type low density polyethylene polymer (available under the trade designation 5302 from Hanwha Chemical) and about 15 parts by weight of a pellet-type potassium containing ionomer (available under the trade designation MK-400 from Mitsui-DuPont) as an antistatic agent was prepared.

EXAMPLE 6

An antistatic surface protection film was fabricated in the same manner as described in Example 1, except that as a skin layer forming polymer material, a mixture of about 80 parts by weight of a pellet-type low density polyethylene polymer (available under the trade designation 5302 from Hanwha Chemical) and about 20 parts by weight of a pellet-type potassium containing ionomer (available under the trade designation MK-400 from Mitsui-DuPont) as an antistatic agent was prepared.

COMPARATIVE EXAMPLE 1

Polystyrene-based antistatic film manufactured by Mitsubishi Plastics with a thickness of about 100 μ m was used.

COMPARATIVE EXAMPLE 2

A polyester film available under the trade designation HH10 from SKC with a thickness of 100 μ m was used.

COMPARATIVE EXAMPLE 3

High density polyethylene-based antistatic film manufactured by PMK with a thickness of 100 μ m was used.

EXPERIMENTAL EXAMPLE 1

In order to determine the antistatic property of an antistatic surface protection film according to the present invention, on each of the films obtained from Examples 1 to 6, and Comparative Examples 1 and 2, surface resistance was measured based on ASTM D257-07. Especially, on each of the films obtained from Examples 4 to 6, surface

resistance was measured to determine the changes in the antistatic property according to the content of an antistatic agent included in a skin layer. Herein, the surface resistance was measured at about 22°C, at relative humidity of 33%. Tables 1 and 2 show the measurement results.

5 **TABLE 1**

	Ex. 1	Ex. 2	Ex. 3	Comp. Ex. 1	Comp. Ex. 2
Surface resistance (Ω/m^2)	10^8	10^8	10^8	10^{10}	10^9

As noted in Table 1, the films obtained from Comparative Examples 1 and 2 have surface resistance of about $10^{10} \Omega/\text{m}^2$, and about $10^9 \Omega/\text{m}^2$, respectively. In contrast, the films obtained from Examples 1 to 3 have surface resistance of about $10^8 \Omega/\text{m}^2$, respectively. Therefore, it is determined that the antistatic surface protection film according to the present invention has a little higher antistatic property compared to a conventional film.

10

TABLE 2

	Ex. 4	Ex. 5	Ex. 6
Surface resistance(Ω/m^2)	3.10×10^{13}	7.54×10^{12}	3.02×10^{10}

As noted in Table 2, as the content of an antistatic agent is increased, surface resistance of the films obtained from Examples 4 to 6 is lowered. Especially, in order to adjust the surface resistance to be less than about $10^{12} \Omega/\text{m}^2$, it is proper that the content of an antistatic agent is similar to that of the film obtained from Example 6.

15

EXPERIMENTAL EXAMPLE 2

In order to determine a scratch on the surface of a display or its component by an antistatic surface protection film according to the present invention, on each of the films obtained from Examples 1 to 3, and Comparative Examples 1 and 2, hardness was measured based on ASTM D 3363-05. Herein, the hardness is represented in (Soft) 3B→2B→B→HB→H→2H→3H→4H (Hard). Table 3 shows the measurement results.

20

TABLE 3

	Ex. 1	Ex. 2	Ex. 3	Comp. Ex. 1	Comp. Ex. 2
Hardness	3B	3B	3B	2B	3H

As noted in Table 3, compared to the film obtained from Comparative Example 2 having a hardest surface of 3H, the antistatic surface protection films obtained from Examples 1 to 3 have soft surfaces of 3B.

Accordingly, it is determined that when an antistatic surface protection film according to the present invention is adhered to or detached (removed) from a display or its component, the occurrence of a scratch on the surface of the display or its component by the film may be decreased.

EXPERIMENTAL EXAMPLE 3

In order to determine the easiness in adhering/detaching an antistatic surface protection film according to the present invention, storage modulus and tensile strength were measured.

<Storage Modulus>

On each of the films obtained from Examples 1 to 3, and Comparative Examples 1 to 3, storage modulus was measured by DMA Q800™ (TA Instrument) at 40°C with an amplitude of 20μm, for 5 minutes. FIG. 3 shows the measurement results.

<Tensile Strength>

On each of the films obtained from Examples 1 to 3, and Comparative Examples 1 and 2, tensile strength was measured based on ASTM D 882-02. Table 4 shows the measurement results.

TABLE 4

		Ex. 1	Ex. 2	Ex. 3	Comp. Ex. 1	Comp. Ex. 2
Tensile strength (kg/mm ²)	MD	2.818	3.043	3.309	3.543	13.717
	TD	2.145	2.688	2.324		8.133

1) According to the results of storage modulus, the storage modulus of the film obtained by Comparative Example 3 is about 120MPa, which is too flexible to have appropriate workability. On the other hand, the storage modulus of the film obtained by Comparative Example 2 is about 4,300MPa, which is too stiff.

Compared to the above films, the antistatic surface protection films obtained by Examples 1 to 3 have storage modulus between the film obtained by Comparative Example 2 and the film obtained by Comparative Example 3. In other words, the antistatic surface protection films obtained by Examples 1 to 3 are slightly inflexible (that is slightly stiff). Also, as the content of a styrene-butadiene copolymer included in a core

layer of the antistatic surface protection film is increased (Example 1 → Example 3), the storage modulus is lowered from about 2000 MPa to about 1600 MPa, thereby improving the flexibility of the film.

2) According to the results of tensile strength, each of MD(Machine Direction) tensile strength and CD(Cross Direction) tensile strength of the film obtained by Comparative Example 1 is about 3.543 kg/mm³. Also, in the film obtained by Comparative Example 2, MD tensile strength is about 13.717 kg/mm³, and CD tensile strength is about 8.133 kg/mm³.

Compared to the above films, the antistatic surface protection film obtained by Example 1 has MD tensile strength of about 2.818 kg/mm³, and CD tensile strength of 2.145 kg/mm³. Also, as the content of a styrene-butadiene copolymer included in a core layer of the antistatic surface protection film according to the present invention is increased (Example 1 → Example 3), MD tensile strength is increased from about 2.818 to 3.309 kg/mm³. However, according to the content of a styrene-butadiene copolymer, CD tensile strength is increased from about 2.145 to 2.688 kg/mm³, and then dropped back down to 2.324 kg/mm³.

3) Compared to a conventional film, in the case of the antistatic surface protection film according to the present invention, only one sheet of the film can be easily adhered to and detached from a display or its component without any deformation of the film such as break or fold. In other words, it is determined that when the antistatic surface protection film according to the present invention is used, the operation efficiency of adhering/detaching the film may be improved.

In addition, since the antistatic surface protection film according to the present invention is detached without break or fold, scratches by the film do not occur on the surface of a display or its component. Also, it is determined that as the content of a styrene-butadiene copolymer included in a core layer is increased, deformation of the film may be prevented.

While this invention has been described in connection with what is presently considered to be the most practical and exemplary embodiment, it is to be understood that the invention is not limited to the disclosed embodiment and the drawings, but, on the

contrary, it is intended to cover various modifications and variations within the spirit and scope of the appended claims.

WHAT IS CLAIMED IS

1. An antistatic surface protection film comprising:
a core layer comprising a polystyrene-based polymer;
a skin layer laminated on each of both surfaces of the core layer, which
5 comprises a polyethylene-based polymer and an antistatic agent; and
a tie layer between the core layer and the skin layer, which binds the core layer
and the skin layer,
wherein, the tie layer comprises a polymer having a repeating unit compatible
with the polystyrene-based polymer and another repeating unit compatible
10 with the polyethylene-based polymer.
2. The antistatic surface protection film as claimed in claim 1, wherein the core
layer, the skin layer and the tie layer are formed by co-extrusion.
3. The antistatic surface protection film as claimed in claim 1, wherein the core
layer further comprises a styrene-butadiene copolymer.
- 15 4. The antistatic surface protection film as claimed in claim 3, wherein the styrene-
butadiene copolymer is included in an amount of 10 to 100 parts by weight based
on 100 parts by weight of the polystyrene-based polymer.
5. The antistatic surface protection film as claimed in claim 1, wherein the
polyethylene-based polymer is selected from the group consisting of a high
20 density polyethylene (HDPE) polymer, a low density polyethylene (LDPE)
polymer, a linear low density polyethylene (LLDPE) polymer, an ethylene vinyl
acetate (EVA) polymer, and a mixture of at least two of these polymers.
6. The antistatic surface protection film as claimed in claim 1, wherein the antistatic
agent is a surfactant or an ionomer.
- 25 7. The antistatic surface protection film as claimed in claim 6, wherein the
surfactant is selected from the group including an anionic surfactant, a cationic
surfactant, an amphoteric surfactant, and a non-ionic surfactant.
8. The antistatic surface protection film as claimed in claim 7, wherein the cationic
surfactant comprises a quaternary ammonium compound; the anionic surfactant
30 comprises alkylsulfonate, alkylsulfate, alkylphosphite, or sodium alkylsulfonate;

the amphoteric surfactant comprises alkylbetain or alkylalanine; and the non-ionic surfactant comprises ethoxylated alkylamine, fatty acid ester, glyceride alkylamine, or polyethylene glycol ester.

9. The antistatic surface protection film as claimed in claim 6, wherein the ionomer
5 comprises a metal ion selected from the group consisting of ions of metals of groups 1~16 of the Periodic Table.
10. The antistatic surface protection film as claimed in claim 9, wherein the metal ion is selected from the group consisting of Na^+ , K^+ , Li^+ , and Zn^{2+} .
11. The antistatic surface protection film as claimed in claim 6, wherein the ionomer
10 is selected from the group consisting of an ethylene-based ionomer, a styrene-based ionomer, a rubber-based ionomer, a fluoro-based ionomer, sulfonated EPDM-based ionomer, a carboxylated nitrile-based ionomer, and a mixture of at least two of these materials.
12. The antistatic surface protection film as claimed in claim 6, wherein the ionomer
15 is selected from the group including a poly(ethylene-co-methacrylic acid) ionomer, a poly(butadiene-co-acrylic acid) ionomer, a perfluorosulfonate ionomer, a perfluorocarboxylate ionomer, a telechelic polybutadiene ionomer, a sulfonated ethylene-propylene terpolymer ionomer, a poly(styrene-co-acrylic acid) ionomer, a sulfonated butyl elastomer ionomer, a sulfonated
20 polypentenamer ionomer, a poly(styrene-co-butadiene-co-acrylic acid) ionomer, a poly(butadiene-co-acrylonitrile-co-acrylic acid) ionomer, and a mixture of at least two of these materials.
13. The antistatic surface protection film as claimed in claim 1, wherein the antistatic
25 agent is included in an amount of 10 to 50 parts by weight based on 100 parts by weight of the polyethylene-based polymer.
14. The antistatic surface protection film as claimed in claim 1, wherein the polymer having the repeating unit compatible with the polystyrene-based polymer and the repeating unit compatible with the polyethylene-based polymer is an ethylene-alkyl(meth)acrylate copolymer.

15. A method of fabricating an antistatic surface protection film, the method comprising the steps of:
- i) preparing a core layer forming polymer material by using a polystyrene-based polymer;
 - 5 ii) preparing a skin layer forming polymer material by mixing a polyethylene-based polymer and an antistatic agent;
 - iii) preparing a tie layer forming polymer material by using a polymer having a moiety compatible with the polystyrene-based polymer and another moiety compatible with the polyethylene-based polymer; and
 - 10 iv) co-extruding the core layer forming polymer material, the skin layer forming polymer material, and the tie layer forming polymer material.
16. The method as claimed in claim 15, wherein the core layer forming polymer material further comprises a styrene-butadiene copolymer.
17. The method as claimed in claim 15, wherein the step iv) is performed at 160 to
15 200°C.

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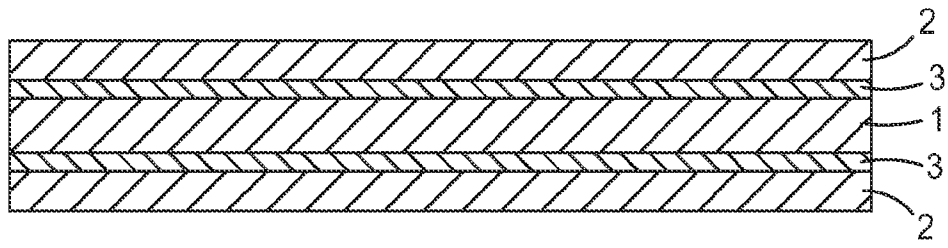


FIG. 1

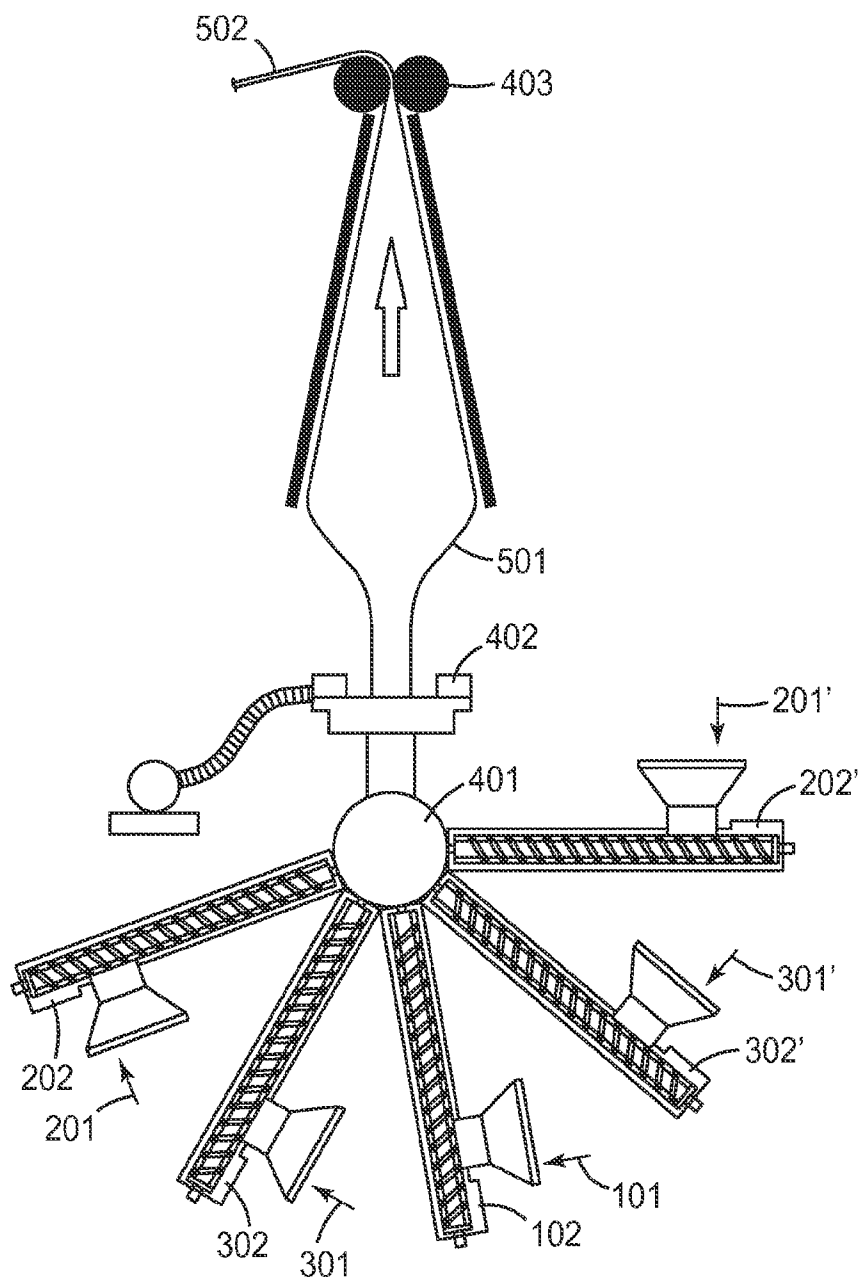


FIG. 2

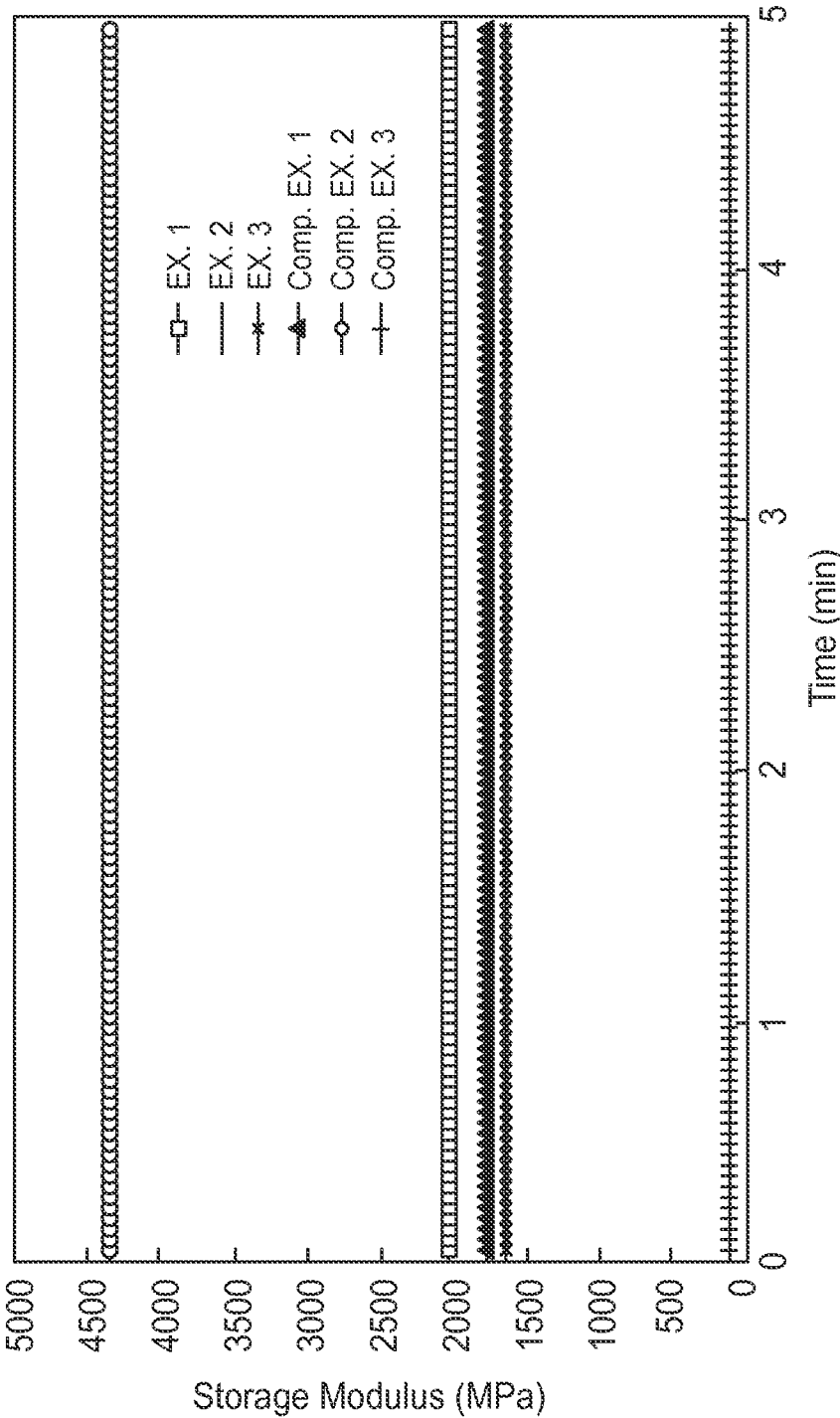


FIG. 3