

SPECIFICATION

ADHESIVE SHEET

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TECHNICAL FIELD

The present disclosure relates to an adhesive sheet, in particular to an adhesive sheet having excellent adhesiveness, haze stability over time, antistatic property, adhesion storage, and thermal resistance and easily peelable after use without causing adhesive residue contamination.

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BACKGROUND

Generally, adhesives are in the state of soft solids (visco-elastomers) in the temperature range near room temperature and have the property of being easily bonded to an adherend by pressure. By taking advantage of such a property, adhesives are widely used in the form of substrate-bearing adhesive sheets having an adhesive layer provided on the surface of at least one side of the substrate for the purposes of, for example, fixing various articles or protecting surfaces of various articles, or decoration or the like to obtain desired appearances.

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Among the above applications, the adhesive sheets sometimes have problems such as a difficulty in balancing the adhesiveness, no deterioration of haze over time, antistatic properties, adhesion storage, and thermal resistance. In addition, the adhesive sheets will be peeled off at the stage where they are no longer needed, but at the time of peeling off the adhesive sheets, it may sometimes cause damage to the adherend or adhesive residue contamination, etc.

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SUMMARY

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Technical Problem

The present disclosure has been made to address the above-mentioned existing problems. An objective of the present disclosure is to provide an adhesive sheet that is excellent in adhesiveness, haze stability over time, antistatic property, adhesion storage, and thermal resistance and is easily peelable after use without causing adhesive residue contamination.

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Solution to Problem

To address the above-mentioned problems, the present inventors have conducted intensive studies and found that the above problems are solved by controlling the arithmetic average surface roughness Ra or the maximum height Rz of the frosted surface of the release film within a specific range and the adhesive sheet present in a winding form or stacked form,

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bringing the frosted surface of the release film into contact with the surface of the substrate layer away from the bonding face of the adhesive layer, and setting the haze of the adhesive sheet after removal of the release film at 10% to 80%, thereby completing the present disclosure.

5 That is, the present disclosure is as follows:

 [1]. An adhesive sheet comprising a substrate layer, an adhesive layer disposed on a side of the substrate layer, and a release film disposed on a side of the adhesive layer opposite to the substrate layer, wherein a side of the release film away from a bonding face of the adhesive layer is a frosted surface, the frosted surface has an arithmetic average surface roughness Ra of
10 0.25 μm or more, or the surface of the frosted surface has a surface roughness with a maximum height (Rz) of 1.5 μm or more,

 the adhesive sheet is present in a winding form or stacked form, the frosted surface of the release film is in contact with the surface of the substrate layer away from the bonding face of the adhesive layer, and the adhesive sheet has a haze of 10% to 80% measured following
15 removal of the release film under an environment of 23°C and 50% relative humidity after being left at 50°C for 72 h.

 [2]. The adhesive sheet according to [1], wherein the adhesive sheet has a peel force A of 0.3 to 2.0 N/20 mm when peeled at 23°C in the 180° direction at a tensile speed of 300 mm/min;

20 the adhesive sheet has a peel force B of 0.5 to 2.5 N/20 mm when peeled in the 180° direction at a tensile speed of 300 mm/min after being adhered to an adherend at 23°C and left at 50°C for 24 h; and

 a difference between the peel force B and the peel force A, i.e., peel force B minus peel force A, is 0.1 to 0.8 N/20 mm.

25 [3]. The adhesive sheet according to [1], wherein the adhesive sheet has a peel force C of 1.0 to 5.0 N/20 mm when peeled at 23°C in the 180° direction at a tensile speed of 10 m/min;

 the adhesive sheet has a peel force D of 5.0 to 9.0 N/20 mm when peeled at 23°C in the 20° direction at a tensile speed of 10 m/min; and

30 a difference between the peel force D and the peel force C, i.e., peel force D minus peel force C, is 4.0 to 8.0 N/20 mm.

 [4]. The adhesive sheet according to [1], wherein the adhesive sheet has a peel force E of 1.5 to 5.5 N/20 mm when peeled in the 180° direction at a tensile speed of 10 m/min after being adhered to the adherend at 23°C and left at 50°C for 24 h;

35 the adhesive sheet has a peel force F of 5.5 to 9.5 N/20 mm when peeled at 23°C in the 20° direction at a tensile speed of 10 m/min after being adhered to the adherend at 23°C and left at

50°C for 24 h; and

a difference between the peel force F and the peel force E, i.e., peel force F minus peel force E, is 4.5 to 8.5 N/20 mm.

[5]. The adhesive sheet according to any one of [1] to [4], wherein the adhesive layer
5 comprises a base polymer and a functional resin;

the content of the functional resin is from 10 to 40 parts by mass based on 100 parts by mass of the base polymer; and

the functional resin is at least one selected from the group consisting of an epoxy resin, a phenol resin, a vinyl resin, and a rosin resin.

10 [6]. The adhesive sheet according to [5], wherein the adhesive layer further comprises at least one selected from the group consisting of a plasticizer, a crosslinking agent, an antistatic agent, and a peeling auxiliary agent.

[7]. The adhesive sheet according to [6], wherein the plasticizer comprises at least one selected from the group consisting of dioctyl phthalate, dioctyl terephthalate, and diisononyl
15 phthalate;

the content of the plasticizer is from 20 to 90 parts by mass with respect to 100 parts by mass of the base polymer.

[8]. The adhesive sheet according to [6], wherein the content of the crosslinking agent is from 0.01 to 15 parts by mass with respect to 100 parts by mass of the base polymer;

20 the crosslinking agent comprises an epoxy-based crosslinking agent and/or an isocyanate-based crosslinking agent;

the content of the epoxy-based crosslinking agent is from 0.01 to 5 parts by mass with respect to 100 parts by mass of the base polymer; and

25 the content of the isocyanate-based crosslinking agent is from 0.1 to 10 parts by mass with respect to 100 parts by mass of the base polymer.

[9]. The adhesive sheet according to [6], wherein the content of the antistatic agent is from 0.1 to 15 parts by mass with respect to 100 parts by mass of the base polymer;

30 the antistatic agent comprises at least one selected from the group consisting of a conductive polymer, a conductive inorganic particle, a metallic particle or fiber, an ionic compound, and an ionic surfactant.

[10]. The adhesive sheet according to [6], wherein the peeling auxiliary agent comprises an ionic surfactant and/or a nonionic surfactant;

the content of the peeling auxiliary agent is from 0.1 to 5 parts by mass with respect to 100 parts by mass of the base polymer.

35 [11]. The adhesive sheet according to any one of [1] to [10], wherein the adhesive sheet

satisfies at least one of the following characteristics (a) to (p):

(a) in a peel test at a peeling speed of 12 m/min, a peeling electrostatic voltage generated by peeling the adhesive sheet off from the release film is 500V or less;

(b) the adhesive sheet has a surface resistivity of 1.0×10^4 to 1.0×10^{11} ohms/sq;

5 (c) after the adhesive sheet is stretched 1 to 1.2 folds in the 360° direction, the substrate layer has a surface resistivity of 1.0×10^5 to 1.0×10^8 ohms/sq, and the adhesive layer of the adhesive sheet has a surface resistivity of 1.0×10^{11} ohms/sq or less;

(d) a logarithmic change rate of the surface resistivity of the adhesive sheet as calculated by the following formula (1) is 100% or less:

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$$\text{logarithmic change rate of surface resistivity (\%)} = [(X2-X1)/X1] \times 100\% \quad (1)$$

wherein X2 represents a logarithmic value of the surface resistivity of the adhesive sheet after stretched 1 to 1.2 folds in the 360° direction, and X1 represents a logarithmic value of the surface resistivity of the adhesive sheet before stretching;

15 (e) the adhesive sheet has a tensile strength of 15 to 60 MPa in the longitudinal direction (MD direction);

(f) the adhesive sheet has a tensile strength of 10 to 50 MPa in the width direction (TD direction);

(g) a ratio of the tensile strength in the longitudinal direction (MD direction) to the tensile strength in the width direction (TD direction) of the adhesive sheet is 1.0 to 1.5;

20 (h) the adhesive sheet has a 50% modulus of 15 to 50 MPa in the longitudinal direction (MD direction);

(i) the adhesive sheet has a 50% modulus of 10 to 45 MPa in the width direction (TD direction);

25 (j) the adhesive sheet has an elongation at break of 100% to 300% in the longitudinal direction (MD direction);

(k) the adhesive sheet has an elongation at break of 80% to 270% in the width direction (TD direction);

(l) a ratio of the elongation at break in the longitudinal direction (MD direction) to the elongation at break in the width direction (TD direction) of the adhesive sheet is 1.0 to 1.5;

30 (m) the adhesive sheet has a heating shrinkage rate at 50°C of 1.0% to 8% in the longitudinal direction (MD direction);

(n) the adhesive sheet has a heating shrinkage rate at 50°C of -6.0% to 3.0% in the width direction (TD direction);

(o) the adhesive sheet has a transmittance of 50% to 90% after the release film is removed;

35 and

(p) the adhesive sheet has a haze of 15% to 55% measured following removal of the release film under an environment of 23°C and 50% relative humidity after being left at 50°C for 72 h.

[12]. The adhesive sheet according to any one of [1] to [11], wherein the substrate layer comprises a polyvinyl chloride resin and at least one selected from the group consisting of a plasticizer, a stabilizer, and a haze regulator;

the content of the plasticizer is from 10 to 60 parts by mass with respect to 100 parts by mass of the polyvinyl chloride resin;

the plasticizer comprises at least one selected from the group consisting of dioctyl phthalate, dioctyl terephthalate, and diisononyl phthalate;

the content of the stabilizer is from 0.1 to 5.0 parts by mass with respect to 100 parts by mass of the polyvinyl chloride resin; and

the content of the haze regulator is from 0.1 to 10 parts by mass with respect to 100 parts by mass of the polyvinyl chloride resin.

[13]. The adhesive sheet according to any one of [1] to [12], wherein the substrate layer has an arithmetic average surface roughness Ra of 1 to 6 μm at 23°C, or the surface of the substrate layer has a surface roughness with a maximum height (Rz) of 6 to 12 μm at 23°C.

[14]. The adhesive sheet according to any one of [1] to [13], wherein the adhesive sheet further comprises an primer layer and/or a back-coating layer,

the back-coating layer is disposed on a side of the substrate layer opposite to the adhesive layer, and

the primer layer is disposed on a side of the substrate layer opposite to the back-coating layer.

[15]. The adhesive sheet according to [14], wherein the back-coating layer has an arithmetic average surface roughness Ra of 0.1 to 5.0 μm at 23°C, or the surface of the back-coating layer has a surface roughness with a maximum height (Rz) of 1 to 10 μm at 23°C;

the back-coating layer arithmetic average surface roughness Ra of 0.1 to 4.0 μm at 50°C, or the surface of the back-coating layer has a surface roughness with a maximum height (Rz) of 2.0 to 8.0 μm at 50°C.

[16]. The adhesive sheet according to any one of [1] to [15], wherein the substrate layer has a thickness of 5 to 300 μm; and the adhesive layer has a thickness of 1 to 40 μm.

[17]. The adhesive sheet according to any one of [1] to [16], wherein a haze change rate of the adhesive sheet as calculated by the following formula (2) is 10% or less:

haze change rate = (haze before storage - haze after storage)/haze before storage × 100%

(2)

wherein the haze before storage is a haze of the adhesive sheet measured after being left for 24 h under an environment of 23°C and 50% relative humidity and removing the release film; and

the haze after storage is a haze of the adhesive sheet measured following removal of the release film under an environment of 23°C and 50% relative humidity after being left at 50°C for 72 h.

[18]. A winding body, wherein the winding body comprises the adhesive sheet according to any one of [1] to [17] in a winding form.

[19]. A stacked body, wherein the stacked body comprises two or more adhesive sheets according to any one of [1] to [17] in a stacked form.

Advantageous Effects of the Invention

The adhesive sheet of the present disclosure has excellent adhesiveness, haze stability over time, antistatic property, adhesion storage, and thermal resistance and is easily peelable after use without causing adhesive residue contamination.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view schematically showing the structure of an adhesive sheet in one embodiment of the present disclosure.

FIG. 2 is a cross-sectional view schematically showing the structure of an adhesive sheet in another embodiment of the present disclosure.

FIG. 3 is a cross-sectional view schematically showing the structure of an adhesive sheet in yet another embodiment of the present disclosure.

FIG. 4 is a schematic diagram schematically showing the structure of a winding body of an adhesive sheet in one embodiment of the present disclosure.

FIG. 5 is a schematic diagram schematically showing the structure of a stacked body of an adhesive sheet in one embodiment of the present disclosure.

Descriptions of Reference Numerals

1, 2, 3: adhesive sheet

10: substrate layer

20: adhesive layer

30: release film

40: back-coating layer

50: primer layer

100: winding body of adhesive sheet

200: stacked body

201: first adhesive sheet

202: second adhesive sheet

DETAILED DESCRIPTION

5 Various exemplary examples, features, and aspects of the present disclosure will be described in detail below. Herein the specific term “exemplary” means “used as an instance, example, or explanatory”. An “exemplary” example given here is not necessarily construed as being superior to or better than other examples.

10 In addition, numerous details are given in the following specific embodiments for the purpose of better explaining the present disclosure. It should be understood by a person skilled in the art that the present disclosure can still be realized even without some of those details. In some of the examples, methods, means, equipment and steps well-known to a person skilled in the art are not described in detail so that the principle of the present disclosure becomes apparent.

15 Unless otherwise stated, the units used in the present specification are all international standard units, and the numerical values and numerical ranges used in the present disclosure should all be construed as including systematic errors inevitable in industrial production.

The meaning of “may” used in the present specification includes both the meaning of performing a certain treatment and the meaning of not performing a certain treatment.

20 The phrases such as “some specific/preferred embodiments”, “other specific/preferred embodiments”, “embodiments” and the like referred to in the present specification mean that particular elements (for example, features, structures, properties and/or characteristics) described in relation to this embodiment are included in at least one of the embodiments described herein, and may or may not exist in other embodiments. Additionally, it should be
25 understood that the elements may be combined in any suitable manner into various embodiments.

The numerical range represented by “numerical value A to numerical value B” used in the present specification refers to the range including the endpoint values A and B.

<Adhesive Sheet>

30 The adhesive sheet of the present disclosure has a substrate layer, an adhesive layer disposed on a side of the substrate layer, and a release film disposed on a side of the adhesive layer opposite to the substrate layer, wherein a side of the release film away from a bonding face of the adhesive layer is a frosted surface, the frosted surface has an arithmetic average surface roughness Ra of 0.25 μm or more, or the surface of the frosted surface has a surface
35 roughness with a maximum height (Rz) of 1.5 μm or more,

The adhesive sheet is present in a winding form or stacked form, the frosted surface of the release film is in contact with the surface of the substrate layer away from the bonding face of the adhesive layer, and the adhesive sheet has a haze of 10% to 80% after removing the release film.

FIG. 1 is a cross-sectional view schematically showing the structure of an adhesive sheet in one embodiment of the present disclosure. As shown in FIG. 1, the adhesive sheet 1 comprises a substrate layer 10, an adhesive layer 20 disposed on a side of the substrate layer 10, and a release film 30 disposed on a side of the adhesive layer 20 opposite to the substrate layer 10. The adhesive layer 20 is preferably disposed on the entire face of the substrate layer 10. The release film 30 is preferably disposed on the entire face of the adhesive layer 20.

As shown in FIG. 1, the substrate layer 10 has a first surface 10A and a second surface 10B. The adhesive layer 20 has a third surface 20A and a fourth surface 20B. The release film 30 has a fifth surface 30A and a sixth surface 30B. The fifth surface 30A of the release film 30 is away from the side of the bonding face (the third surface 20A) of the adhesive layer 20, and the fifth surface 30A of the release film 30 is the frosted surface of the release film.

When the adhesive sheet of the present disclosure is present in a winding form, in the winding body of the adhesive sheet, the adhesive sheet is wound in such a manner that the friction face of the release film abuts against the back face (*i.e.*, the surface of the substrate layer at the opposite side of the adhesive face of the adhesive layer) of this adhesive sheet.

A configuration example of the winding body of the adhesive sheet disclosed herein is shown in FIG. 4. The winding body 100 of the adhesive sheet as shown in FIG. 4 has a configuration in which the adhesive sheet 1 is wound along the longitudinal direction, and the adhesive sheet 1 has a substrate layer 10 having a first surface 10A and a second surface 10B, an adhesive layer 20 having a third surface 20A and a fourth surface 20B disposed on the first surface 10A, and a release film 30 having a fifth surface 30A and a sixth surface 30B disposed on the third surface 20A. In the winding body 100 of the adhesive sheet, the adhesive sheet 1 is wound in such a manner that the fifth surface 30A (frosted surface) of the release film 30 abuts against the second surface 10B of the substrate layer.

When the adhesive sheet of the present disclosure is present in a stacked form, the friction face of the release film of the first adhesive sheet in the stacked body abuts against the surface of the substrate layer of the second adhesive sheet away from the bonding face of the adhesive layer.

A configuration example of the stacked body disclosed herein is shown in FIG. 5. The stacked body 200 as shown in FIG. 5 has a first adhesive sheet 201 and a second adhesive sheet 202. The frosted surface (the fifth surface 30A) of the release film 30 of the first adhesive sheet

201 is in contact with the surface (the second surface 10B) of the substrate layer 10 of the second adhesive sheet 202 away from the bonding face (the fourth surface 20B) of the adhesive layer 20, that is, the fifth surface 30A of the release film of the first adhesive sheet 201 is in contact with the second surface 10B of the substrate layer of the second adhesive sheet 202.

5 FIG. 2 is a cross-sectional view schematically showing the structure of an adhesive sheet in another embodiment of the present disclosure. The adhesive sheet 2 further has a back-coating layer 40. As shown in FIG. 2, the back-coating layer 40 is disposed on the side of the substrate layer 10 opposite to the adhesive layer 20.

10 FIG. 3 is a cross-sectional view schematically showing the structure of an adhesive sheet in yet another embodiment of the present disclosure. The adhesive sheet 3 further has a primer layer 50. As shown in FIG. 3, the primer layer 50 is disposed on the side of the substrate layer 10 opposite to the back-coating layer 40 and between the substrate layer 10 and the adhesive layer 20.

15 The concept of the adhesive sheet described in the present specification may include objects referred to as an adhesive tape, an adhesive label, an adhesive film, etc.

 The adhesive sheet of the present disclosure has the following characteristics:

20 The side of the release film away from the bonding face of the adhesive layer is a frosted surface. The frosted surface has an arithmetic average surface roughness R_a of 0.25 μm or more, preferably 0.35 μm or more, more preferably 0.4 μm or more. In some preferred embodiments, the arithmetic average surface roughness R_a of the frosted surface is preferably 1.5 μm or less, more preferably 1.0 μm or less.

25 The surface of the frosted surface has a surface roughness with the maximum height (R_z) of 1.5 μm or more, preferably 2.0 μm or more, more preferably 2.5 μm or more. In some preferred embodiments, the surface of the frosted surface has a surface roughness with the maximum height (R_z) of preferably 4.0 μm or less, more preferably 3.0 μm or less.

30 When the adhesive sheet of the present disclosure is present in a winding or stacked form, the frosted surface of the release film is in contact with the surface of the substrate layer away from the bonding face of the adhesive layer, and the rough face of the substrate layer cooperates with the frosted surface of the release film, such that the plasticizers or the like which move to the surface of the substrate layer can be uniformly distributed on the surface of the substrate layer, *i.e.*, uniformly distributed along the concavities and convexities of the surface of the substrate layer. As a result, even if the adhesive sheet of the present disclosure is stored for a long time, the haze will not decrease and the desired haze could be well maintained.

35 The haze (haze after storage) of the adhesive sheet of the present disclosure is 10% to

80%, preferably 15% to 55% as measured following removal of the release film under an environment of 23°C and 50% relative humidity after being left at 50°C for 72 h. In some specific embodiments, the haze of the adhesive sheet of the present disclosure is 10%, 20%, 30%, 40%, 50%, 60%, 70%, or 80% after removal of the release film.

5 In the present disclosure, the haze change rate represented by the following formula (2) is preferably 10% or less, more preferably 5% or less:

$$\text{haze change rate} = (\text{haze before storage} - \text{haze after storage}) / \text{haze before storage} \times 100\%$$

(2)

10 wherein the haze before storage represents a haze value (initial value) of the adhesive sheet before storage under high temperature/high humidity environment, *i.e.*, the haze of the adhesive sheet as measured following removal of the release film after being left for 24 h under a standard environment of 23°C and 50% relative humidity; and

the haze after storage is a haze of the adhesive sheet measured following removal of the release film after being left at 50°C for 72 h under an environment of 23°C and 50% relative
15 humidity.

In the present disclosure, the adhesive sheet has a peel force A of 0.3 to 2.0 N/20 mm, preferably 0.3 to 1.5 N/20 mm, more preferably 0.3 to 1.0 N/20 mm when peeled at 23°C in the 180° direction at a tensile speed of 300 mm/min.

20 In the present disclosure, the adhesive sheet has a peel force B of 0.5 to 2.5 N/20 mm, preferably 0.5 to 2.0 N/20 mm, more preferably 0.5 to 1.5 N/20 mm when peeled in the 180° direction at a tensile speed of 300 mm/min after being adhered to an adherend at 23°C and left at 50°C for 24 h.

When the peel force A and the peel force B of the adhesive sheet fall within the above ranges respectively, the adhesive sheet can be endowed with excellent adhesiveness and
25 adhesion storage, and can be easily peeled off after use without causing adhesive residue contamination. However, when the peel forces are not within the above ranges, the above properties of the adhesive sheet may be impaired and adhesive residue contamination occurs easily.

30 The above peel forces can be determined, for example, by the methods described in the examples below, and unless otherwise specified, the speed or peeling speed herein is the speed of the equipment.

In the present disclosure, if the peel force of the adhesive sheet when peeled at 23°C in the 180° direction at a tensile speed of 300 mm/min is set as A and the peel force of the adhesive sheet when peeled in the 180° direction at a tensile speed of 300 mm/min after being adhered
35 to an adherend at 23°C and left at 50°C for 24 h is set as B, the difference between B and A,

i.e., B-A, is 0.1 to 0.8 N/20 mm, preferably 0.1 to 0.6 N/20 mm, more preferably 0.1 to 0.5 N/20 mm. By allowing the difference (B-A) of the above two peel forces to be 0.1 to 0.8 N/20 mm, excellent peel force stability over time could be achieved.

5 In the present disclosure, the adhesive sheet has a peel force C of 1.0 to 5.0 N/20 mm, preferably 1.0 to 4.0 N/20 mm, more preferably 1.0 to 3.0 N/20 mm when peeled at 23°C in the 180° direction at a tensile speed of 10 m/min.

In the present disclosure, the adhesive sheet has a peel force D of 5.0 to 9.0 N/20 mm, preferably 6.0 to 9.0 N/20 mm, more preferably 7.0 to 9.0 N/20 mm when peeled at 23°C in the 20° direction at a tensile speed of 10 m/min.

10 When the peel forces of the adhesive sheet when peeled at 23°C in the 180° and 20° directions at a tensile speed of 10 m/min fall within the above ranges respectively, the adhesive sheet could exhibit excellent chip transfer performance, adhesiveness, and adhesion storage and be easily peelable after use without causing adhesive residue contamination. However, when the peel forces are not within the above ranges, the above properties of the adhesive sheet
15 may be impaired and adhesive residue contamination occurs easily.

In the present disclosure, if the peel force of the adhesive sheet when peeled at 23°C in the 180° direction at a tensile speed of 10 m/min is set as C and the peel force of the adhesive sheet when peeled at 23°C in the 20° direction at a tensile speed of 10 m/min is set as D, the difference between D and C, *i.e.*, D-C, is 4.0 to 8.0 N/20 mm, preferably 5.0 to 8.0 N/20 mm,
20 more preferably 6.0 to 8.0 N/20 mm. By allowing the difference D-C of the above two peel forces to be 4.0 to 8.0 N/20 mm, the adhesive sheet could exhibit excellent chip transfer performance, adhesiveness, and adhesion storage and be easily peelable after use without causing adhesive residue contamination. However, when the peel forces are not within the above ranges, the above properties of the adhesive sheet would be impaired and adhesive
25 residue contamination occurs easily.

In the present disclosure, the adhesive sheet has a peel force E of 1.5 to 5.5 N/20 mm, preferably 1.5 to 4.5 N/20 mm, more preferably 1.5 to 3.5 N/20 mm when peeled in the 180° direction at a tensile speed of 10 m/min after being adhered to the adherend at 23°C and left at 50°C for 24 h.

30 In the present disclosure, the adhesive sheet has a peel force F of 5.5 to 9.5 N/20 mm, preferably 6.5 to 9.5 N/20 mm, more preferably 7.5 to 9.5 N/20 mm when peeled at 23°C in the 20° direction at a tensile speed of 10 m/min after being adhered to the adherend at 23°C and left at 50°C for 24 h.

35 When the peel force E and the peel force F of the adhesive sheet fall within the above ranges respectively, the adhesive sheet could exhibit excellent high-speed peel force stability

over time.

In the present disclosure, if the peel force of the adhesive sheet when peeled in the 180° direction at a tensile speed of 10 m/min after being adhered to the adherend at 23°C and left at 50°C for 24 h is set as E and the peel force of the adhesive sheet when peeled at 23°C in the 20°
5 direction at a tensile speed of 10 m/min after being adhered to the adherend at 23°C and left at 50°C for 24 h is set as F, the difference between F and E, *i.e.*, F-E, is 4.5 to 8.5 N/20 mm, preferably 5.0 to 8.5 N/20 mm, more preferably 6.0 to 8.5 N/20 mm. By allowing the difference F-E of the above two peel forces to be 4.5 to 8.5 N/20 mm, the adhesive sheet could exhibit excellent high-speed peel force stability over time.

10 In the present disclosure, the above-mentioned adherend is an SUS430BA plate.

In the present disclosure, the adhesive sheet satisfies at least one of the following characteristics (a) to (p):

Characteristic (a): in the peel test at a peeling speed of 12 m/min, the peeling electrostatic voltage generated by peeling the adhesive sheet off from the release film is 500V or less,
15 preferably 200V or less, more preferably 100V or less.

When the peeling electrostatic voltage falls within the above range, the peeling static electricity potentially generated at the time of peeling off the adhesive sheet could be suppressed, and the adhesive sheet has excellent antistatic properties (peeling static electricity resistance), which protects the adherend from being damaged at the time of peeling and could
20 effectively avoid problems such as electrostatic breakdown. The above-mentioned peeling electrostatic voltage can be determined, for example, by the method described in the examples below.

Characteristic (b): the adhesive sheet has a surface resistivity of 1.0×10^4 to 1.0×10^{11} ohms/sq, preferably 1.0×10^5 to 1.0×10^{10} ohms/sq, more preferably 1.0×10^6 to 1.0×10^9 ohms/sq.

25 When the surface resistivity of the adhesive sheet is within the above range, the adhesive sheet could satisfy the antistatic function, and is effective in suppressing generation of static electricity when adhering to members such as an electronic component material during production and operations, which could avoid damage to the electronic component material. The surface resistivity is determined under the following conditions: (determined at
30 23°C/50%RH atmosphere by using a concentric ring electrode (probe) with the electrode area of 20 cm², an applied voltage of 100V, and an applied period of 30 s).

Characteristic (c): after the adhesive sheet is stretched 1 to 1.2 folds in the 360° direction, the substrate layer has a surface resistivity of 1.0×10^5 to 1.0×10^8 ohms/sq, preferably 1.0×10^6 to 1.0×10^8 ohms/sq, more preferably 1.0×10^7 to 1.0×10^8 ohms/sq; the adhesive layer of the
35 adhesive sheet has a surface resistivity of 1.0×10^{11} ohms/sq or less, preferably 1.0×10^{10}

ohms/sq or less, more preferably 1.0×10^9 ohms/sq or less; if the surface resistivity is within the above ranges, the antistatic function could be satisfied, and when the adhesive sheet is adhered to members such as an electronic component material, damage to an electronic component material could be avoided.

5 Characteristic (d): the logarithmic change rate of the surface resistivity of the adhesive sheet as calculated by the following formula (1) is 100% or less, preferably 60% or less, more preferably 30% or less:

$$\text{logarithmic change rate of surface resistivity (\%)} = [(X2-X1)/X1] \times 100\% \quad (1)$$

wherein X2 represents a logarithmic value of the surface resistivity of the adhesive sheet
10 after stretched 1 to 1.2 folds in the 360° direction, and X1 represents a logarithmic value of the surface resistivity of the adhesive sheet before stretching;

When the logarithmic change rate of the surface resistivity is set within the above range, the adhesive sheet could achieve excellent antistatic properties and peeling electrostatic voltage stability over time, could satisfy the antistatic function, and could avoid damage to the
15 electronic component material when adhered to members such as an electronic component material.

Characteristic (e): the adhesive sheet has a tensile strength of 15 to 60 MPa, preferably 20 to 60 MPa, more preferably 20 to 50 MPa in the longitudinal direction (MD direction).

Characteristic (f): the adhesive sheet has a tensile strength of 10 to 50 MPa, preferably 20
20 to 50 MPa, more preferably 20 to 40 MPa in the width direction (TD direction).

When the tensile strength in the longitudinal direction or the tensile strength in the width direction falls within the above range, the adhesive sheet has excellent extensibility, and the adhesive sheet is not easily torn at the time of peeling, so the adhesive sheet has excellent re-peelability and could exhibit good conformability to the unevenness stepwise difference of
25 the adherend. If the tensile strength is not within the above range, adequate strength may not be achieved, the extensibility is poor, and there is a tendency that the flexibility of the adhesive sheet decreases and it is difficult to achieve good resilience resistance (causing damage to the substrate). The above tensile strengths can be determined, for example, by the methods described in the examples below.

30 Characteristic (g): the ratio of the tensile strength in the longitudinal direction (MD direction) to the tensile strength in the width direction (TD direction) of the adhesive sheet is 1.0 to 1.5, preferably 1.0 to 1.2. When the tensile strength ratio is within the above range, the adhesive sheet can be endowed with excellent film expandability, adhesiveness, antistatic properties, adhesion storage, thermal resistance, and transparency and easily peelable after use
35 without causing adhesive residue contamination.

Characteristic (h): the adhesive sheet has a 50% modulus of 15 to 50 MPa, preferably 20 to 40 MPa in the longitudinal direction (MD direction).

Characteristic (i): the adhesive sheet has a 50% modulus of 10 to 45 MPa, preferably 20 to 40 MPa in the width direction (TD direction).

5 By setting the 50% moduli of the adhesive sheet in the longitudinal direction (MD direction) and in the width direction (TD direction) within the above ranges, it is possible to avoid too small bending strength of the adhesive sheet, thereby suppressing a decrease in the workability of the adhesive sheet, and to avoid too large rigidity as a sheet, thereby suppressing a failure such as turn-up or exfoliation of the adhesive sheet that could be generated due to the
10 resilience force of the tape in the cases, e.g., when the adhesive sheet is adhered to an adherend. The 50% moduli described above can be determined, for example, by the methods described in the examples below.

Characteristic (j): the adhesive sheet has an elongation at break of 100% to 300%, preferably 150% to 250% in the longitudinal direction (MD direction).

15 Characteristic (k): the adhesive sheet has an elongation at break of 80% to 270%, preferably 100% to 250% in the width direction (TD direction).

When the elongations at break in the longitudinal direction (MD direction) and in the width direction (TD direction) of the adhesive sheet fall within the above ranges, the adhesive sheet of the present disclosure could be endowed with moderate elongation properties, for
20 example, the conformability to the adherend can be improved, and excellent film expandability or extensibility may be achieved, thereby improving the chip transferability. The above elongations at break can be determined, for example, by the methods described in the examples below.

Characteristic (l): the ratio of the elongation at break in the longitudinal direction (MD
25 direction) to the elongation at break in the width direction (TD direction) of the adhesive sheet is 1.0 to 1.5, preferably 1.0 to 1.2.

When the ratio between the elongations at break is within the above range, the adhesive sheet could achieve more excellent unevenness followability, better avoid occurrence of wrinkles or creases, and could provide excellent film expandability (or extensibility) and
30 balance excellent adhesiveness and re-peelability, so that the chip transferability is improved.

Characteristic (m): the adhesive sheet has a heating shrinkage rate at 50°C of 1.0% to 8%, preferably 1.5% to 7% in the longitudinal direction (MD direction).

Characteristic (n): the adhesive sheet has a heating shrinkage rate at 50°C of -6.0% to 3.0%, preferably -5.0% to 2% in the width direction (TD direction).

35 When the shrinkage rates of the adhesive sheet in the longitudinal direction (MD direction)

and in the width direction (TD direction) fall within the above ranges, wrinkles could be suppressed when the adhesive sheet is adhered to an adherend and heated, so that an excellent appearance could be achieved. The above shrinkage rates can be determined, for example, by the methods described in the examples below.

5 Characteristic (o): the adhesive sheet has a transmittance of 50% to 90%, preferably 60% to 85%, more preferably 70% to 80% after removal of the release film. By allowing the transmittance of the adhesive sheet to be within the above range, the adhesive sheet could have good transparency.

[Adhesive Layer]

10 The adhesive layer of the present disclosure comprises a base polymer and a functional resin. The content of the functional resin is from 10 to 40 parts by mass based on 100 parts by mass of the base polymer. The adhesive layer in the technology disclosed herein may be a layer formed of an adhesive composition comprising a base polymer and a functional resin. The form of the adhesive composition is not particularly limited and may be, for example, adhesive
15 compositions in various forms such as a water-dispersible type, a solvent type, a hot-melt type, and an active energy ray-curable type (*e.g.*, photocuring type).

Hereinafter, the components of the adhesive composition of the present disclosure will be described in detail.

(Base Polymer)

20 The adhesive composition of the present disclosure comprises a base polymer. Examples of the base polymer may include, for example, an acrylic polymer, a rubber-based polymer, a polyester-based polymer, a urethane-based polymer, a polyether-based polymer, a silicone-based polymer, a polyamide-based polymer, and a fluorine-based polymer. Preferably, the adhesive composition comprises an acrylic polymer as a base polymer.

25 The content of the base polymer is not particularly limited, and is preferably 70 mass% or more, more preferably 80 mass% or more, further preferably 90 mass% or more with respect to the total content (total mass, 100% by mass) of the adhesive composition from the standpoint of achieving adequate adhesive reliability. By adjusting the content of the base polymer in the adhesive composition to the above range, it is possible to provide an adhesive composition that
30 is more excellent in stress relaxation and durability and excellent in adhesiveness to the adherend.

The base polymer involved in the technology disclosed herein is preferably a polymer of a monomer component comprising a soft monomer (viscous monomer) as a main monomer, a functional monomer (copolymerizable monomer) copolymerizable with the above main
35 monomer, and a hard monomer. Here the main monomer refers to the main component in the

monomer components constituting the base polymer, *i.e.*, more than 50 wt% of the component included in the monomer component.

In a preferred embodiment, the soft monomer (viscous monomer) includes alkyl (meth)acrylate. In the present specification, the term “alkyl (meth)acrylate” refers to alkyl
5 acrylate and/or alkyl methacrylate.

The alkyl (meth)acrylate is preferably alkyl (meth)acrylate having an alkyl group with 4 to 20 carbon atoms. Specific examples of alkyl (meth)acrylate having an alkyl group with 4 to 20 carbon atoms are not particularly limited and may include, for example, n-butyl (meth)acrylate, isobutyl (meth)acrylate, sec-butyl (meth)acrylate, tert-butyl (meth)acrylate,
10 pentyl (meth)acrylate, isopentyl (meth)acrylate, hexyl (meth)acrylate, heptyl (meth)acrylate, octyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, isooctyl (meth)acrylate, nonyl (meth)acrylate, isononyl (meth)acrylate, decyl (meth)acrylate, isodecyl (meth)acrylate, undecyl (meth)acrylate, dodecyl (meth)acrylate, tridecyl (meth)acrylate, tetradecyl (meth)acrylate, pentadecyl (meth)acrylate, hexadecyl (meth)acrylate, heptadecyl
15 (meth)acrylate, octadecyl (meth)acrylate, nonadecyl (meth)acrylate, and eicosyl (meth)acrylate. Of these, n-butyl acrylate (BA) and 2-ethylhexyl acrylate (2EHA) are preferred. Alkyl (meth)acrylate may be used alone or in combination of two or more thereof.

The content of the soft monomer (viscous monomer) is preferably from 60 to 93 parts by mass, more preferably from 60 to 80 parts by mass based on 100 parts by mass of all monomer
20 components of the base polymer. When the content of the soft monomer is within the above range, excellent adhesiveness could be achieved.

As hard monomers, hard monomers that may form hard polymers having a higher glass transition point may be suitably used. The hard monomer is useful for improving the cohesive strength of the adhesive layer. The hard monomer may be used alone or in combination of two
25 or more thereof.

Non-limiting specific examples of the hard monomer may include, for example, N-vinylpyrrolidone (NVP), acrylonitrile (AN), methyl methacrylate (MMA), methyl acrylate (MA), vinyl acetate (VAC), and styrene.

The content of the hard monomer is preferably from 7 to 40 parts by mass, more
30 preferably from 20 to 40 parts by mass based on 100 parts by mass of all monomer components of the base polymer. When the content of the hard monomer is within the above range, the cohesive strength and heat resistance could be further improved.

As a functional monomer (copolymerizable monomer), a monomer having a polar group may be suitably used. The monomer having a polar group is useful for introducing a
35 crosslinking point into the base polymer or improving the cohesive force of the base polymer.

The functional monomer may be used alone or in combination of two or more thereof.

Non-limiting specific examples of the functional monomer may include, for example, hydroxyl-containing monomers (monomers containing a hydroxyl group), carboxyl-containing monomers (monomers containing a carboxyl group), sulfonyl-containing monomers, phosphate group-containing monomers, epoxy group-containing monomers, isocyanate group-containing monomers, amide group-containing monomers, monomers having a succinimide skeleton, maleimide-based monomers, itaconimide-based monomers, aminoalkyl (meth)acrylate-based monomers, alkoxyalkyl (meth)acrylate-monomers, vinyl ether-based monomers, and olefin-based monomers. Among them, at least one selected from the group consisting of hydroxyl-containing monomers and carboxyl-containing monomers is preferred.

The content of the functional monomer is preferably from 1 to 10 parts by mass, more preferably from 1 to 5 parts by mass based on 100 parts by mass of all monomer components of the base polymer. When the content of the functional monomer is within the above range, the cohesive force of the adhesive may be prevented from becoming too high and the adhesiveness could be improved.

The hydroxyl-containing monomer is a monomer having at least one hydroxyl group in its molecule. In the case where the monomer component for constituting the base polymer includes a hydroxyl-containing monomer, that is, the base polymer includes a monomer unit derived from a hydroxyl-containing monomer, a secondary bond such as a hydrogen bond will be formed with an adherend, so the cohesive force of the base polymer (appropriately an acrylic polymer) is improved, which may more efficiently suppress the change in adhesive force over time, and the adhesive residues on the adherend are fewer after peeling and the aggregation is higher. Furthermore, by containing a hydroxyl-containing monomer in the raw material monomer of the base polymer, it may be crosslinked effectively with a crosslinking agent when used, and may fully exhibit the effect as an adhesive. Additionally, breakage of the adherend may also be effectively prevented during the peeling operation. The base polymer in this embodiment may contain one hydroxyl-containing monomer or two or more hydroxyl-containing monomers.

Specific examples of the hydroxyl-containing monomer may include, for example, hydroxyalkyl (meth)acrylates such as 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 2-hydroxybutyl (meth)acrylate, 3-hydroxypropyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate, 6-hydroxyhexyl (meth)acrylate, 8-hydroxyoctyl (meth)acrylate, 10-hydroxydecyl (meth)acrylate, 12-hydroxylauryl (meth)acrylate, and (4-hydroxymethylcyclohexyl)methyl (meth)acrylate.

The content of the hydroxyl-containing monomer is not particularly limited. For example,

the content of the hydroxyl-containing monomer is from 0.5 to 10 parts by mass, preferably from 1 to 9 parts by mass based on 100 parts by mass of all monomer components of the base polymer. When the content of the hydroxyl-containing monomer is within the above range, a secondary bond such as a hydrogen bond will be formed with an adherend, so the cohesive force of the base polymer (appropriately an acrylic polymer) is improved, which may more efficiently suppress the change in adhesive force over time, and the adhesive residues on the adherend are fewer after peeling and the aggregation is higher. When the content of the hydroxyl-containing monomer is less than 0.5 parts by mass, adequate adhesiveness may not be acquired. When the content of the hydroxyl-containing monomer is greater than 10 parts by mass, the adhesive force becomes too large, and there is a concern that adhesion easily occurs. Besides, there is a concern that breakage of the adherend easily occurs during the peeling operation.

The carboxyl-containing monomer is a monomer having at least one carboxyl group in its molecule. By containing a carboxyl-containing monomer in the raw material monomer of the base polymer, a secondary bond such as a hydrogen bond will be formed with an adherend, so the cohesive force of the base polymer (appropriately an acrylic polymer) is improved, which may more efficiently suppress the change in adhesive force over time, and the adhesive residues on the adherend are fewer after peeling and the aggregation is higher. Additionally, by containing a carboxyl-containing monomer in the raw material monomer of the base polymer, it may be crosslinked effectively with a crosslinking agent when used, and may fully exhibit the effect as an adhesive. Furthermore, breakage of the adherend may also be effectively prevented during the peeling operation.

Specific examples of the carboxyl-containing monomer may include, for example, acrylic acid, methacrylic acid, carboxyethyl (meth)acrylate, carboxypentyl (meth)acrylate, crotonic acid, isocrotonic acid, fumaric acid, itaconic acid, maleic acid, citraconic acid, maleic anhydride, and itaconic anhydride. Among them, acrylic acid and methacrylic acid are preferred. The above carboxyl-containing monomers may be used alone or in combination of two or more thereof.

The content of the carboxyl-containing monomer is not particularly limited. For example, the content of the carboxyl-containing monomer is preferably from 0.5 to 10 parts by mass, more preferably from 1 to 6 parts by mass based on 100 parts by mass of all monomer components of the base polymer. When the content of the carboxyl-containing monomer is within the above range, a secondary bond such as a hydrogen bond will be formed with an adherend, so the cohesive force of the base polymer (appropriately an acrylic polymer) is improved, which may more efficiently suppress the change in adhesive force over time, and the

adhesive residues on the adherend are fewer after peeling and the aggregation is higher. When the content of the carboxyl-containing monomer is greater than 10 parts by mass, the adhesive force becomes too large, and there is a concern that adhesion easily occurs. Besides, there is a concern that breakage of the adherend easily occurs during the peeling operation. When the
5 content of the carboxyl-containing monomer is less than 0.5 parts by mass, adequate adhesiveness may not be acquired.

Examples of the sulfonyl-containing monomer may include, for example, styrenesulfonic acid, allylsulfonic acid, sodium vinylsulfonate, 2-(meth)acrylamido-2-methylpropanesulfonic acid, (meth)acrylamidopropanesulfonic acid, sulfopropyl (meth)acrylate, and
10 (meth)acryloyloxynaphthalenesulfonic acid, and the like.

Examples of the epoxy group-containing monomer may include, for example, epoxy group-containing acrylates such as glycidyl (meth)acrylate and 2-ethyl glycidyl (meth)acrylate, allyl glycidyl ethers, and glycidyl (meth)acrylates, and the like.

Examples of the isocyanate group-containing monomer may include, for example,
15 2-isocyanatoethyl (meth)acrylate and the like.

Examples of the amide group-containing monomer may include, for example, (meth)acrylamide; N,N-dialkyl(meth)acrylamides such as N,N-dimethyl(meth)acrylamide, N,N-diethyl(meth)acrylamide, N,N-dipropyl(meth)acrylamide, N,N-diisopropyl(meth)acrylamide, N,N-di(n-butyl)(meth)acrylamide, and
20 N,N-di(tert-butyl)(meth)acrylamide; N-alkyl(meth)acrylamides such as N-ethyl(meth)acrylamide, N-isopropyl(meth)acrylamide, N-butyl(meth)acrylamide, and N-n-butyl(meth)acrylamide; N-vinylcarboxylic amides such as N-vinylacetamide; N,N-dimethylaminopropyl(meth)acrylamide, hydroxyethylacrylamide, N-hydroxymethyl(meth)acrylamide, N-hydroxyethyl(meth)acrylamide,
25 N-hydroxymethylpropane(meth)acrylamide, N-methoxymethyl(meth)acrylamide, N-methoxyethyl(meth)acrylamide, N-butoxymethyl(meth)acrylamide, and N-(meth)acryloylmorpholine, and the like.

Examples of the monomer having a succinimide skeleton may include, for example, N-(meth)acryloyloxymethylene succinimide, N-(meth)acryloyl-6-oxyhexamethylene
30 succinimide, and N-(meth)acryloyl-8-oxyhexamethylene succinimide, and the like.

Examples of the maleimide-based monomers may include, for example, N-cyclohexylmaleimide, N-isopropylmaleimide, N-laurylmaleimide, and N-phenylmaleimide, and the like.

Examples of the itaconimide-based monomers may include, for example,
35 N-methylitaconimide, N-ethylitaconimide, N-butylitaconimide, N-octylitaconimide,

N-2-ethylhexylitaconimine, N-cyclohexylitaconimide, and N-laurylitaconimide, and the like.

Examples of the aminoalkyl (meth)acrylate-based monomers may include, for example, aminoethyl(meth)acrylate, N,N-dimethylaminoethyl(meth)acrylate, N,N-diethylaminoethyl(meth)acrylate, and tert-butylaminoethyl(meth)acrylate, and the like.

5 Examples of the alkoxyalkyl (meth)acrylate-based monomers may include, for example, methoxyethyl(meth)acrylate, ethoxyethyl(meth)acrylate, propoxyethyl(meth)acrylate, butoxyethyl(meth)acrylate, and ethoxypentyl(meth)acrylate, and the like.

Examples of the vinyl ether-based monomers may include, for example, vinyl alkyl ethers such as methyl vinyl ether and ethyl vinyl ether, and the like.

10 Examples of the olefin-based monomers may include, for example, ethylene, butadiene, isoprene, and isobutylene, and the like.

The method for obtaining the base polymer is not particularly limited, and various known polymerization methods such as solution polymerization, emulsion polymerization, bulk polymerization, suspension polymerization, and photopolymerization may be used
15 appropriately. For example, it may be preferable to use solution polymerization. As the method for supplying monomers during solution polymerization, a batch feeding method of supplying all raw material monomers at one time, a continuous feeding (dropping) method, a separate feeding (dropping) method, and the like may be adopted properly. The polymerization temperature for the solution polymerization may be properly selected depending on the types
20 of the monomer and the solvent used, the type of the polymerization initiator, etc. For example, the polymerization temperature may be set to about 20°C to about 170°C (typically about 40°C to about 140°C).

The solvent (polymerization solvent) used in the solution polymerization may be selected appropriately from conventionally known organic solvents. For example, any one solvent or a
25 mixture of two or more solvents selected from the group consisting of aromatic compounds (typically aromatic hydrocarbons) such as toluene; acetates such as ethyl acetate; aliphatic or alicyclic hydrocarbons such as hexane and cyclohexane; halogenated alkanes such as 1,2-dichloroethane; lower alcohols (such as monohydric alcohols with 1 to 4 carbon atoms) such as isopropanol; ethers such as tert-butyl methyl ether; ketones such as methyl ethyl ketone,
30 etc. may be used.

The initiator used for polymerization may be selected appropriately from conventionally known polymerization initiators depending upon the type of polymerization method. For example, it may be preferable to use one or two or more of azo-based polymerization initiators such as 2,2'-azobisisobutyronitrile (AIBN). Other examples of the polymerization initiator may
35 include persulfates such as potassium persulfate; peroxide-based initiators such as benzoyl

peroxide and hydrogen peroxide; substituted ethane initiators such as phenyl-substituted ethane; and aromatic carbonyl compounds, etc. Yet other examples of the polymerization initiator may include redox-based initiators obtained by combining peroxides and reducing agents. Such polymerization initiators may be used alone or in combination of two or more thereof. The amount of the polymerization initiator is the commonly-used amount, for example, it may be selected from the range of from about 0.005 parts by mass to about 1 part by mass (typically from about 0.01 part by mass to about 1 part by mass) with respect to 100 parts by mass of all monomer components.

The weight-average molecular weight (Mw) of the base polymer (appropriately acrylic polymer) in the technology disclosed herein is not particularly limited and may be, for example, 1,000,000 or less, preferably 400,000 or more. Generally, when the weight-average molecular weight Mw exceeds 1,000,000, the cohesion tends to increase due to the effect resulting from entanglement of the polymer and thus the fluidity reduces, and it is sometimes impossible to obtain sufficient adhesive area to fix the adherend.

Here the weight-average molecular weight (Mw) refers to a value obtained by gel permeation chromatography (GPC) in terms of standard polystyrene. The GPC device may be, for example, "HLC-8320GPC" (model name, column: TSKgelGMH-H(S), manufactured by Tosoh Corporation).

(Functional Resin)

The adhesive composition of the present disclosure comprises a functional resin. Examples of the functional resin may include at least one selected from the group consisting of an epoxy resin, a phenol resin, a vinyl resin, and a rosin resin.

The epoxy resin is not particularly limited. For example, various epoxy resins such as triphenylmethane epoxy resin, cresol linear novolac epoxy resin, biphenyl epoxy resin, modified bisphenol A epoxy resin, bisphenol A epoxy resin, bisphenol F epoxy resin, modified bisphenol F epoxy resin, bicyclopentadiene epoxy resin, phenol linear novolac epoxy resin, and phenoxy resin may be used. These epoxy resins may be used alone or in combination of two or more thereof. From the standpoint of ensuring the reactivity of the epoxy resin, an epoxy resin having an epoxy equivalent of 150 to 250 g/eq, a softening point or melting point of 50°C to 130°C, and a solid state at room temperature is preferred. From the standpoint of reliability, triphenylmethane epoxy resin, cresol novolac epoxy resin, and biphenyl epoxy resin are more preferred. In addition, bisphenol F epoxy resin is preferred.

As a phenol resin, phenol novolac resin, xylok resin or phenol biphenylene resin may be used appropriately. These phenol resins may be used alone or in combination of two or more thereof.

The vinyl resin is not particularly limited, and may be a vinyl-containing homopolymer or copolymer, for example, an ethylene-vinyl acetate copolymer, a vinyl chloride-vinyl acetate copolymer, polyvinyl chloride, and polyvinyl alcohol. These vinyl resins may be used alone or in combination of two or more thereof.

5 The rosin resin is not particularly limited, and those known to the public may be used. They may be used alone or in combination of two or more thereof.

The functional resin is preferably a phenol novolac resin, an ethylene-vinyl acetate copolymer, a vinyl chloride-vinyl acetate copolymer, polyvinyl chloride, polyvinyl alcohol, etc.

10 The content of the functional resin is from 10 to 40 parts by mass, preferably from 15 to 30 parts by mass, more preferably from 15 to 20 parts by mass based on 100 parts by mass of the base polymer. By setting the content of the functional resin within the above range, the adhesive sheet could have good adhesiveness, antistatic properties, adhesion storage, and thermal resistance and be easily peelable after use without causing adhesive residue contamination.

15 (Plasticizer)

In the present disclosure, the adhesive layer contains a plasticizer. Examples of the plasticizer may include, for example, plasticizers such as terephthalate-based plasticizers, isophthalate-based plasticizers, phthalate-based plasticizers, trimellitate-based plasticizers, adipate-based plasticizers (such as dioctyl adipate and diisononyl adipate), adipate
20 polyester-based plasticizers, phosphate-based plasticizers (such as tritolyl phosphate), citrate-based plasticizers (such as acetyl tributyl citrate), sebacate-based plasticizers, azelate-based plasticizers, maleate-based plasticizers, benzoate-based plasticizers, polyether-based polyesters, epoxy-based polyesters, and polyesters (such as a low molecular weight polyester formed of carboxylic acid and glycol). At least one of diisononyl phthalate, dioctyl phthalate, dioctyl terephthalate, and bis(2-ethylhexyl) phthalate is preferred. The
25 plasticizer may be used alone or in combination of two or more thereof.

Examples of the terephthalate-based plasticizers may include, for example, dibutyl terephthalate (DBTP), diisobutyl terephthalate (DIBTP), di-n-hexyl terephthalate (DHTP), bis(2-ethylhexyl) terephthalate (DOTP), di-n-octyl terephthalate (DnOTP), diisononyl
30 terephthalate (DINTP), dinonyl terephthalate (DNTP), diisodecyl terephthalate (DIDTP), and bis-butyl benzyl terephthalate (BBTP), and the like.

As the above phthalate-based plasticizers, for example, diesters of phthalic acid and alkyl alcohols having 4 to 16 carbon atoms (preferably 6 to 14, typically 8 to 13) may be used. Suitable examples may include, for example, di-n-octyl phthalate, bis(2-ethylhexyl) phthalate,
35 diisononyl phthalate, and diisodecyl phthalate, and the like.

As the above trimellitate-based plasticizers, for example, triesters of trimellitic acid and alkyl alcohols having 6 to 14 carbon atoms (typically 8 to 12 carbon atoms) may be used. Suitable examples include, for example, tri-n-octyl trimellitate, tris(2-ethylhexyl) trimellitate, triisononyl trimellitate, tri-n-decyl trimellitate, and triisodecyl trimellitate, and the like.

As the above adipate-based plasticizers, for example, diesters of adipic acid and alkyl alcohols having 4 to 16 carbon atoms (preferably 6 to 14, typically 8 to 13 carbon atoms) may be used. Suitable examples may include, for example, di-n-octyl adipate, di(2-ethylhexyl) adipate, and diisononyl adipate, and the like.

As the above polyester-based plasticizers, for example, polyester compounds can be used, which is obtainable from polycarboxylic acids such as succinic acid, adipic acid, suberic acid, azelaic acid, sebacic acid, citric acid, phthalic acid, isophthalic acid, terephthalic acid, and trimellitic acid and polyols such as (poly)ethylene glycol (the “(poly)ethylene glycol” here refers inclusively to ethylene glycol and polyethylene glycol; the same applies hereinafter), (poly)propylene glycol, (poly)butylene glycol, (poly)hexylene glycol, (poly)neopentyl glycol, and polyvinyl alcohol. As the above polycarboxylic acids, aliphatic dicarboxylic acids having 4 to 12 (typically 6 to 10) carbon atoms are preferable. Suitable examples may include, for example, adipic acid and sebacic acid. In particular, adipic acid is desired in terms of availability and cost. As the above polyols, aliphatic diols having 2 to 10 carbon atoms are preferable. Suitable examples may include, for example, ethylene glycol and butylene glycol (such as 1,3-butylene glycol and 1,4-butylene glycol), and the like.

The molecular weight of the plasticizer is not particularly limited. In some preferred embodiments, the molecular weight of the plasticizer is 1000 or less, preferably 800 or less, more preferably 600 or less. The upper limit of the molecular weight of the plasticizer is not particularly limited. From the standpoint of handling ability and the like, the molecular weight of the plasticizer is, for example, 250 or more or may be 400 or more.

The content ratio of the plasticizer is preferably from 20 to 90 parts by mass, more preferably from 25 to 80 parts by mass with respect to 100 parts by mass of the base polymer. If the content ratio is within this range, an adhesive sheet excellent in flexibility and conformability to the adherend could be achieved. If the content ratio exceeds 90 parts by mass, unnecessary dissolution of the plasticizer may occur.

In some specific embodiments, the content ratio of the plasticizer is 20 parts by mass, 30 parts by mass, 40 parts by mass, 50 parts by mass, 60 parts by mass, 70 parts by mass, 80 parts by mass or 90 parts by mass with respect to 100 parts by mass of the base polymer.

(Antistatic Agent)

In the present disclosure, the adhesive composition further preferably comprises an

antistatic agent.

Examples of the antistatic agent contained in the composition for forming the adhesive layer described above may include, for example, a conductive polymer, a conductive inorganic particle, a metallic particle or fiber, an ionic compound, and an ionic surfactant. These antistatic agents may be used alone or in a combination of two or more thereof.

<Conductive Polymer>

Examples of the above conductive polymer may include, for example, polyaniline, polypyrrole, polythiophene, polyquinoxaline, polyacetylene, polyethyleneimine, and allylamine polymers. Among them, polyaniline, polythiophene and the like that are apt to formation of a water-soluble conductive polymer or a water-dispersible conductive polymer are preferably used. These conductive polymers may be used alone or in a combination of two or more thereof.

<Conductive Inorganic Particle>

Examples of the above conductive inorganic particle may include, for example, conductive metal oxide, carbon nanotube, graphene, fullerene, acetylene black, Ketjenblack, natural graphite, artificial graphite, and titanium black, and the like. These conductive inorganic particles may be used alone or in a combination of two or more thereof.

Examples of the conductive metal oxide may include, for example, metal oxides such as tin oxide-based metal oxide, antimony oxide-based metal oxide, indium oxide-based metal oxide, and zinc oxide-based metal oxide. In addition to tin oxide, examples of the tin oxide-based conductive particles may include, for example, antimony-doped tin oxide, indium-doped tin oxide, aluminum-doped tin oxide, tungsten-doped tin oxide, a titanium oxide-cerium oxide-tin oxide composite, and a titanium oxide-tin oxide composite, and the like. The average particle size of the particles is 1 to 100 nm, preferably 2 to 50 nm.

<Metallic Particle or Fiber>

As the above metallic particle or fiber, any suitable polymer may be used as long as it could achieve the effects of the present disclosure. Examples may include, for example, particles, nanowires and the like composed of gold, silver, copper, aluminum, nickel or alloys thereof. These metallic particles or fibers may be used alone or in a combination of two or more thereof.

<Ionic Compound>

Examples of the ionic compound may include, for example, an alkali metal salt and/or an organic cation-anion salt. The “organic cation-anion salt” described in the present disclosure refers to an organic salt whose cationic moiety is composed of an organic substance and whose anionic moiety may be an organic substance or an inorganic substance. The “organic

cation-anion salt” is also referred to as an ionic liquid or an ionic solid. These ionic compounds may be used alone or in a combination of two or more thereof.

The alkali metal salt may be an organic salt and an inorganic salt of an alkali metal.

Examples of the alkali metal ion constituting the cationic moiety of the alkali metal salt may include various ions such as lithium ion, sodium ion, and potassium ion. Among these alkali metal ions, the lithium ion is preferred.

The anionic moiety of the alkali metal salt may be composed of an organic substance or an inorganic substance.

Examples of the anionic moiety constituting the organic salt may include, for example, CH_3COO^- , CF_3COO^- , CH_3SO_3^- , CF_3SO_3^- , $(\text{CF}_3\text{SO}_2)_3\text{C}^-$, $\text{C}_4\text{F}_9\text{SO}_3^-$, $\text{C}_3\text{F}_7\text{COO}^-$, $(\text{CF}_3\text{SO}_2)(\text{CF}_3\text{CO})\text{N}^-$, $(\text{FSO}_2)_2\text{N}^-$, $^-\text{O}_3\text{S}(\text{CF}_2)_3\text{SO}_3^-$, PF_6^- , CO_3^{2-} , and the anions represented by the following general formulae (1) to (4):

(1): $(\text{C}_n\text{F}_{2n+1}\text{SO}_2)_2\text{N}^-$ (wherein n is an integer of 1 to 10),

(2): $\text{CF}_2(\text{C}_m\text{F}_{2m}\text{SO}_2)_2\text{N}^-$ (wherein m is an integer of 1 to 10),

(3): $^-\text{O}_3\text{S}(\text{CF}_2)_l\text{SO}_3^-$ (wherein l is an integer of 1 to 10),

(4): $(\text{C}_p\text{F}_{2p+1}\text{SO}_2)\text{N}^-(\text{C}_q\text{F}_{2q+1}\text{SO}_2)$ (wherein p and q are an integer of 1 to 10). In particular, the anionic moiety containing a fluorine atom is preferably used since such a moiety is able to give an ionic compound having a good ionization property.

As the anionic moiety constituting the inorganic salt, Cl^- , Br^- , I^- , AlCl_4^- , Al_2Cl_7^- , BF_4^- , PF_6^- , ClO_4^- , NO_3^- , AsF_6^- , SbF_6^- , NbF_6^- , TaF_6^- , $(\text{CN})_2\text{N}^-$ and the like may be used.

As the anionic moiety, (perfluoroalkylsulfonyl)imide represented by the above-mentioned general formula (1), such as $(\text{CF}_3\text{SO}_2)_2\text{N}^-$ and $(\text{C}_2\text{F}_5\text{SO}_2)_2\text{N}^-$, are preferable, and trifluoromethanesulfonylimide represented by $(\text{CF}_3\text{SO}_2)_2\text{N}^-$ is particularly preferable.

Specific examples of the organic salt of the alkali metal may include, for example, sodium acetate, sodium alginate, sodium lignin sulfonate, sodium toluene sulfonate, LiCF_3SO_3 , $\text{Li}(\text{CF}_3\text{SO}_2)_2\text{N}$, $\text{Li}(\text{CF}_3\text{SO}_2)_2\text{N}$, $\text{Li}(\text{C}_2\text{F}_5\text{SO}_2)_2\text{N}$, $\text{Li}(\text{C}_4\text{F}_9\text{SO}_2)_2\text{N}$, $\text{Li}(\text{CF}_3\text{SO}_2)_3\text{C}$, $\text{KO}_3\text{S}(\text{CF}_2)_3\text{SO}_3\text{K}$, and $\text{LiO}_3\text{S}(\text{CF}_2)_3\text{SO}_3\text{K}$. Among them, LiCF_3SO_3 , $\text{Li}(\text{CF}_3\text{SO}_2)_2\text{N}$, $\text{Li}(\text{C}_2\text{F}_5\text{SO}_2)_2\text{N}$, $\text{Li}(\text{C}_4\text{F}_9\text{SO}_2)_2\text{N}$, $\text{Li}(\text{CF}_3\text{SO}_2)_3\text{C}$, and the like are preferable., and fluorine-containing lithium imide salts such as $\text{Li}(\text{CF}_3\text{SO}_2)_2\text{N}$, $\text{Li}(\text{C}_2\text{F}_5\text{SO}_2)_2\text{N}$, and $\text{Li}(\text{C}_4\text{F}_9\text{SO}_2)_2\text{N}$, and the like are more preferable, and (perfluoroalkylsulfonyl)imide lithium salt are particularly preferred.

Examples of the inorganic salt of the alkali metal may include, for example, lithium perchlorate and lithium iodide.

The organic cation-anion salt used in the present disclosure is composed of a cationic component and an anionic component. The above cationic component is composed of an

organic substance. Specific examples of the cationic component may include, for example, a pyridinium cation, a piperidinium cation, a pyrrolidinium cation, a cation having a pyrroline skeleton, a cation having a pyrrole skeleton, an imidazolium cation, a tetrahydropyrimidinium cation, a dihydropyrimidinium cation, a pyrazolium cation, a pyrazolinium cation, a tetraalkylammonium cation, a trialkylsulfonium cation, and a tetraalkylphosphonium cation, and the like.

Examples of the anionic component may include, for example, Cl^- , Br^- , I^- , AlCl_4^- , Al_2Cl_7^- , BF_4^- , PF_6^- , ClO_4^- , NO_3^- , CH_3COO^- , CF_3COO^- , CH_3SO_3^- , CF_3SO_3^- , $(\text{CF}_3\text{SO}_2)_3\text{C}^-$, AsF_6^- , SbF_6^- , NbF_6^- , TaF_6^- , $(\text{CN})_2\text{N}^-$, $\text{C}_4\text{F}_9\text{SO}_3^-$, $\text{C}_3\text{F}_7\text{COO}^-$, $(\text{CF}_3\text{SO}_2)(\text{CF}_3\text{CO})\text{N}^-$, $(\text{FSO}_2)_2\text{N}^-$, $^-\text{O}_3\text{S}(\text{CF}_2)_3\text{SO}_3^-$, and anions represented by the following general formulae (1) to (4):

(1): $(\text{C}_n\text{F}_{2n+1}\text{SO}_2)_2\text{N}^-$ (wherein n is an integer of 1 to 10),

(2): $\text{CF}_2(\text{C}_m\text{F}_{2m}\text{SO}_2)_2\text{N}^-$ (wherein m is an integer of 1 to 10),

(3): $^-\text{O}_3\text{S}(\text{CF}_2)_l\text{SO}_3^-$ (wherein l is an integer of 1 to 10),

(4): $(\text{C}_p\text{F}_{2p+1}\text{SO}_2)\text{N}^-(\text{C}_q\text{F}_{2q+1}\text{SO}_2)$, (wherein p and q are an integer of 1 to 10). In particular, the anionic component containing a fluorine atom is preferably used since an ionic compound having a good ionization property can be obtained.

In some preferred embodiments, the organic cation-anion salt is preferably a nitrogen-containing onium salt, a sulfur-containing onium salt or a phosphorus-containing onium salt because they could exhibit excellent antistatic abilities.

Examples of the organic cation-anion salt of the present disclosure may further include, for example, 1-butylpyridinium tetrafluoroborate, 1-butylpyridinium hexafluorophosphate, 1-butyl-3-methylpyridinium tetrafluoroborate, 1-butyl-3-methylpyridinium trifluoromethanesulfonate, 1-butyl-3-methylpyridinium bis(trifluoromethanesulfonyl)imine salt, 1-butyl-3-methylpyridinium bis(pentafluoroethanesulfonyl)imine salt, 1-hexylpyridinium tetrafluoroborate, 1,1-dimethylpyrrolidinium bis(trifluoromethanesulfonyl)imine salt, 1-methyl-1-ethylpyrrolidinium bis(trifluoromethanesulfonyl)imine salt, 1-methyl-1-propylpyrrolidinium bis(trifluoromethanesulfonyl)imine salt, 1-methyl-1-butylpyrrolidinium bis(trifluoromethanesulfonyl)imine salt, 1-methyl-1-pentylpyrrolidinium bis(trifluoromethanesulfonyl)imine salt, 1-methyl-1-hexylpyrrolidinium bis(trifluoromethanesulfonyl)imine salt, 1-methyl-1-heptylpyrrolidinium bis(trifluoromethanesulfonyl)imine salt, 1-ethyl-1-propylpyrrolidinium bis(trifluoromethanesulfonyl)imine salt, 1-ethyl-1-butylpyrrolidinium bis(trifluoromethanesulfonyl)imine salt, 1-ethyl-1-pentylpyrrolidinium bis(trifluoromethanesulfonyl)imine salt, 1-ethyl-1-hexylpyrrolidinium bis(trifluoromethanesulfonyl)imine salt,

	1,1-dipropylpyrrolidinium	bis(trifluoromethanesulfonyl)imine	salt,
	1-propyl-1-butylpyrrolidinium	bis(trifluoromethanesulfonyl)imine	salt,
	1,1-dibutylpyrrolidinium	bis(trifluoromethanesulfonyl)imine	salt, 1-propylpiperidinium
	bis(trifluoromethanesulfonyl)imine	salt,	1-pentylpiperidinium
5	bis(trifluoromethanesulfonyl)imine	salt,	1,1-dimethylpiperidinium
	bis(trifluoromethanesulfonyl)imine	salt,	1-methyl-1-ethylpiperidinium
	bis(trifluoromethanesulfonyl)imine	salt,	1-methyl-1-propylpiperidinium
	bis(trifluoromethanesulfonyl)imine	salt,	1-methyl-1-butylpiperidinium
	bis(trifluoromethanesulfonyl)imine	salt,	1-methyl-1-pentylpiperidinium
10	bis(trifluoromethanesulfonyl)imine	salt,	1-methyl-1-hexylpiperidinium
	bis(trifluoromethanesulfonyl)imine	salt,	1-methyl-1-heptylpiperidinium
	bis(trifluoromethanesulfonyl)imine	salt,	1-ethyl-1-propylpiperidinium
	bis(trifluoromethanesulfonyl)imine	salt,	1-ethyl-1-butylpiperidinium
	bis(trifluoromethanesulfonyl)imine	salt,	1-ethyl-1-pentylpiperidinium
15	bis(trifluoromethanesulfonyl)imine	salt,	1-ethyl-1-hexylpiperidinium
	bis(trifluoromethanesulfonyl)imine	salt,	1-ethyl-1-heptylpiperidinium
	bis(trifluoromethanesulfonyl)imine	salt,	1,1-dipropylpiperidinium
	bis(trifluoromethanesulfonyl)imine	salt,	1-propyl-1-butylpiperidinium
	bis(trifluoromethanesulfonyl)imine	salt,	1,1-dibutylpiperidinium
20	bis(trifluoromethanesulfonyl)imine	salt,	1,1-dimethylpyrrolidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-methyl-1-ethylpyrrolidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-methyl-1-propylpyrrolidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-methyl-1-butylpyrrolidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-methyl-1-pentylpyrrolidinium
25	bis(pentafluoroethanesulfonyl)imine	salt,	1-methyl-1-hexylpyrrolidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-methyl-1-heptylpyrrolidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-ethyl-1-propylpyrrolidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-ethyl-1-butylpyrrolidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-ethyl-1-pentylpyrrolidinium
30	bis(pentafluoroethanesulfonyl)imine	salt,	1-ethyl-1-hexylpyrrolidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-ethyl-1-heptylpyrrolidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1,1-dipropylpyrrolidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-propyl-1-butylpyrrolidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1,1-dibutylpyrrolidinium
35	bis(pentafluoroethanesulfonyl)imine	salt,	1-propylpiperidinium

	bis(pentafluoroethanesulfonyl)imine	salt,	1-pentylpiperidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1,1-dimethylpiperidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-methyl-1-ethylpiperidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-methyl-1-propylpiperidinium
5	bis(pentafluoroethanesulfonyl)imine	salt,	1-methyl-1-butylpiperidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-methyl-1-pentylpiperidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-methyl-1-hexylpiperidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-methyl-1-heptylpiperidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-ethyl-1-propylpiperidinium
10	bis(pentafluoroethanesulfonyl)imine	salt,	1-ethyl-1-butylpiperidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-ethyl-1-pentylpiperidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-ethyl-1-hexylpiperidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1-ethyl-1-heptylpiperidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1,1-dipropylpiperidinium
15	bis(pentafluoroethanesulfonyl)imine	salt,	1-propyl-1-butylpiperidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	1,1-dibutylpiperidinium
	bis(pentafluoroethanesulfonyl)imine	salt,	2-methyl-1-pyrroline tetrafluoroborate,
	1-ethyl-2-phenylindole	tetrafluoroborate,	1,2-dimethylindole tetrafluoroborate,
	1-ethylcarbazole	tetrafluoroborate,	1-ethyl-3-methylimidazolium tetrafluoroborate,
20	1-ethyl-3-methylimidazolium	acetate,	1-ethyl-3-methylimidazolium trifluoroacetate,
	1-ethyl-3-methylimidazolium	heptafluorobutyrate,	1-ethyl-3-methylimidazolium
	trifluoromethane sulfonate,	1-ethyl-3-methylimidazolium	perfluorobutanesulfonate,
	1-ethyl-3-methylimidazolium	dicyandiamide salt,	1-ethyl-3-methylimidazolium
	bis(trifluoromethanesulfonyl)imine	salt,	1-ethyl-3-methylimidazolium
25	bis(pentafluoroethanesulfonyl)imine	salt,	1-ethyl-3-methylimidazolium
	tri(trifluoromethanesulfonyl)	methide,	1-butyl-3-methylimidazolium tetrafluoroborate,
	1-butyl-3-methylimidazolium	hexafluorophosphate,	1-butyl-3-methylimidazolium
	trifluoroacetate,	1-butyl-3-methylimidazolium	heptafluorobutyrate,
	1-butyl-3-methylimidazolium	trifluoromethane sulfonate,	1-butyl-3-methylimidazolium
30	perfluorobutanesulfonate,	1-butyl-3-methylimidazolium	bis(trifluoromethanesulfonyl)imine
	salt,	1-hexyl-3-methylimidazolium	bromide,
	1-hexyl-3-methylimidazolium	chloride,	1-hexyl-3-methylimidazolium
	1-hexyl-3-methylimidazolium	tetrafluoroborate,	1-hexyl-3-methylimidazolium
	hexafluorophosphate,	1-hexyl-3-methylimidazolium	trifluoromethane sulfonate,
	1-octyl-3-methylimidazolium	tetrafluoroborate,	1-octyl-3-methylimidazolium
35	hexafluorophosphate,	1-hexyl-2,3-dimethylimidazolium	tetrafluoroborate,

	1,2-dimethyl-3-propylimidazolium	bis(trifluoromethanesulfonyl)imine	salt,
	1-methylpyrazolium tetrafluoroborate,	3-methylpyrazolium tetrafluoroborate,	
	N,N-dimethyl-N-ethyl-N-propylammonium	bis(trifluoromethanesulfonyl)imine	salt,
	N,N-dimethyl-N-ethyl-N-butylammonium	bis(trifluoromethanesulfonyl)imine	salt,
5	N,N-dimethyl-N-ethyl-N-pentylammonium	bis(trifluoromethanesulfonyl)imine	salt,
	N,N-dimethyl-N-ethyl-N-hexylammonium	bis(trifluoromethanesulfonyl)imine	salt,
	N,N-dimethyl-N-ethyl-N-heptylammonium	bis(trifluoromethanesulfonyl)imine	salt,
	N,N-dimethyl-N-ethyl-N-nonylammonium	bis(trifluoromethanesulfonyl)imine	salt,
	N,N-dimethyl-N,N-dipropylammonium	bis(trifluoromethanesulfonyl)imine	salt,
10	N,N-dimethyl-N-propyl-N-butylammonium	bis(trifluoromethanesulfonyl)imine	salt,
	N,N-dimethyl-N-propyl-N-pentylammonium	bis(trifluoromethanesulfonyl)imine	salt,
	N,N-dimethyl-N-propyl-N-hexylammonium	bis(trifluoromethanesulfonyl)imine	salt,
	N,N-dimethyl-N-propyl-N-heptylammonium	bis(trifluoromethanesulfonyl)imine	salt,
	N,N-dimethyl-N-butyl-N-hexylammonium	bis(trifluoromethanesulfonyl)imine	salt,
15	N,N-dimethyl-N-butyl-N-heptylammonium	bis(trifluoromethanesulfonyl)imine	salt,
	N,N-dimethyl-N-pentyl-N-hexylammonium	bis(trifluoromethanesulfonyl)imine	salt,
	N,N-dimethyl-N,N-dihexylammonium	bis(trifluoromethanesulfonyl)imine	salt,
	trimethylheptylammonium	bis(trifluoromethanesulfonyl)imine	salt,
	N,N-diethyl-N-methyl-N-propylammonium	bis(trifluoromethanesulfonyl)imine	salt,
20	N,N-diethyl-N-methyl-N-pentylammonium	bis(trifluoromethanesulfonyl)imine	salt,
	N,N-diethyl-N-methyl-N-heptylammonium	bis(trifluoromethanesulfonyl)imine	salt,
	N,N-diethyl-N-propyl-N-pentylammonium	bis(trifluoromethanesulfonyl)imine	salt,
	triethylpropylammonium	bis(trifluoromethanesulfonyl)imine	salt, triethylpentylammonium
	bis(trifluoromethanesulfonyl)imine	salt,	triethylheptylammonium
25	bis(trifluoromethanesulfonyl)imine	salt,	N,N-dipropyl-N-methyl-N-ethylammonium
	bis(trifluoromethanesulfonyl)imine	salt,	N,N-dipropyl-N-methyl-N-pentylammonium
	bis(trifluoromethanesulfonyl)imine	salt,	N,N-dipropyl-N-butyl-N-hexylammonium
	bis(trifluoromethanesulfonyl)imine	salt,	N,N-dipropyl-N,N-dihexylammonium
	bis(trifluoromethanesulfonyl)imine	salt,	N,N-dibutyl-N-methyl-N-pentylammonium
30	bis(trifluoromethanesulfonyl)imine	salt,	N,N-dibutyl-N-methyl-N-hexylammonium
	bis(trifluoromethanesulfonyl)imine	salt,	trioctylmethylammonium
	bis(trifluoromethanesulfonyl)imine	salt,	N-methyl-N-ethyl-N-propyl-N-pentylammonium
	bis(trifluoromethanesulfonyl)imine	salt,	1-butylpyridinium (trifluoromethanesulfonyl)
	trifluoroacetamide	salt,	1-butyl-3-methylpyridinium (trifluoromethanesulfonyl)
35	trifluoroacetamide	salt,	1-ethyl-3-methylimidazolium (trifluoromethanesulfonyl)

trifluoroacetamide salt, tetrahexylammonium bis(trifluoromethanesulfonyl)imine salt, diallyldimethylammonium tetrafluoroborate, diallyldimethylammonium trifluoromethane sulfonate, diallyldimethylammonium bis(trifluoromethanesulfonyl)imine salt, diallyldimethylammonium bis(pentafluoroethanesulfonyl)imine salt, N,N-diethyl-N-methyl-N-(2-methoxyethyl)ammonium tetrafluoroborate, N,N-diethyl-N-methyl-N-(2-methoxyethyl)ammonium trifluoromethane sulfonate, N,N-diethyl-N-methyl-N-(2-methoxyethyl)ammonium bis(trifluoromethanesulfonyl)imine salt, N,N-diethyl-N-methyl-N-(2-methoxyethyl)ammonium bis(pentafluoroethanesulfonyl)imine salt, glycidyltrimethylammonium trifluoromethane sulfonate, glycidyltrimethylammonium bis(trifluoromethanesulfonyl)imine salt, glycidyltrimethylammonium bis(pentafluoroethanesulfonyl)imine salt, and diallyldimethyl bis(pentafluoroethanesulfonyl)imine salt, and the like.

The method for synthesizing the organic cation-anion salt is not particularly limited as long as the organic cation-anion salt as a target could be obtained. Generally, the halide method, the hydroxide method, the acid ester method, the complexation method, the neutralization method, etc. described in the literature "Ionic Liquids-the Front and Future of Material Development" [published by the CMC Corporation] may be used. In addition, it is also possible to use commercially available organic cation-anion salts.

<Ionic Surfactant>

Examples of the above ionic surfactant may include, for example, cationic surfactants (e.g., quaternary ammonium salt type, phosphonium salt type, and sulfonium salt type), anionic surfactants (e.g., carboxylic acid type, sulfonate type, sulfate type, phosphate type, and phosphite type), zwitterionic surfactants (e.g., sulfobetaine type, alkyl betaine type, and alkyl imidazolium betaine type), and nonionic surfactants (e.g., polyol derivatives, β -cyclodextrin inclusions, sorbitan fatty acid monoesters/diesters, polyoxyalkylene derivatives, and amine oxides). These ionic surfactants may be used alone or in a combination of two or more thereof.

In some preferred embodiments, the content of the antistatic agent is preferably from 0.1 to 15 parts by mass, more preferably from 0.5 to 10 parts by mass with respect to 100 parts by mass of the base polymer. In some preferred embodiments, the content of the antistatic agent is preferably 0.1 parts by mass, 0.5 parts by mass, 1 part by mass, 5 parts by mass, 10 parts by mass or 15 parts by mass with respect to 100 parts by mass of the base polymer. When the content of the antistatic agent is set within the above range, the sufficient antistatic effect can be achieved to adequately suppress the peeling static electricity generated at the time of peeling, so as to avoid or reduce the damage to the adherend.

The adhesive composition of the present disclosure further preferably comprises a

crosslinking agent.

(Crosslinking Agent)

In the present disclosure, in order to adjust the cohesive force and the like, the adhesive composition preferably comprises a crosslinking agent. The crosslinking agent may be a
5 commonly used crosslinking agent and may include, for example, epoxy-based crosslinking agents, isocyanate-based crosslinking agents, melamine-based crosslinking agents, aziridine-based crosslinking agents, and metal chelate-based crosslinking agents. By using these crosslinking agents, a moderate crosslinking reaction can be generated to fully improve the cohesion and ensure good adhesiveness, and breakage of the adherend may be effectively
10 prevented during the peeling operation. These crosslinking agents may be used alone or in combination of two or more thereof.

As the epoxy-based crosslinking agent, compounds having two or more epoxy groups in one molecule may be used without particular limitations. Epoxy-based crosslinking agents having 3 to 5 epoxy groups in one molecule are preferred. The epoxy-based crosslinking agents
15 may be used alone or in combination of two or more thereof.

Specific examples of the epoxy-based crosslinking agent are not particularly limited and may include, for example, bisphenol A, epichlorohydrin-type epoxy-based resins, ethylene glycidyl
ethers, N,N,N',N'-tetraglycidyl-m-xylylenediamine, 1,3-bis(N,N-diglycidylaminomethyl)cyclohexane, 1,6-hexanediol diglycidyl ethers,
20 polyethylene glycol diglycidyl ethers, and polyglycerol polyglycidyl ethers, and the like. Examples of commercially available products of epoxy-based crosslinking agents may include "TETRAD-C" and "TETRAD-X" (tradenames, manufactured by Mitsubishi Gas Chemical Company, Inc.), "EPICLON CR-5L" (tradename, manufactured by DIC Corporation), "DENACOL EX-512" (tradename, manufactured by Nagase Chemicals, Ltd.), and "TEPIC-G"
25 (tradename, manufactured by Nissan Chemical Industries, Ltd.).

The amount of the epoxy-based crosslinking agent is not particularly limited. For example, it is preferably from 0.01 to 5 parts by mass, more preferably from 0.1 to 5 parts by mass based on 100 parts by mass of the base polymer. In some specific embodiments, the amount of the epoxy-based crosslinking agent is 0.01 parts by mass, 0.5 parts by mass, 1 part by mass, 2 parts
30 by mass, 3 parts by mass, 4 parts by mass or 5 parts by mass based on 100 parts by mass of the base polymer.

In the embodiments involving the epoxy-based crosslinking agent, the epoxy equivalent of the epoxy-based crosslinking agent is preferably 80 to 120 g/eq.

As the isocyanate-based crosslinking agent, it may be preferable to use polyfunctional
35 isocyanate (which refers to a compound having an average of two or more isocyanate groups

per molecule, including compounds having an isocyanurate structure). The isocyanate-based crosslinking agents may be used alone or in combination of two or more thereof.

Examples of the polyfunctional isocyanate may include aliphatic polyisocyanates, alicyclic polyisocyanates, aromatic polyisocyanates, and the like.

5 Specific examples of the aliphatic polyisocyanates may include: 1,2-ethylene diisocyanate; butanediyl isocyanates such as 1,2-butanediyl isocyanate, 1,3-butanediyl isocyanate, and 1,4-butanediyl isocyanate; hexanediyl isocyanates such as 1,2-hexanediyl isocyanate, 1,3-hexanediyl isocyanate, 1,4-hexanediyl isocyanate, 1,5-hexanediyl isocyanate, 1,6-hexanediyl isocyanate, and 2,5-hexanediyl isocyanate; 2-methyl-1,5-pentanediyl isocyanate, 10 3-methyl-1,5-pentanediyl isocyanate, lysine diisocyanate, and the like.

 Specific examples of the alicyclic polyisocyanates may include: isophorone diisocyanate; cyclohexyl diisocyanates such as 1,2-cyclohexyl diisocyanate, 1,3-cyclohexyl diisocyanate, and 1,4-cyclohexyl diisocyanate; cyclopentyl diisocyanates such as 1,2-cyclopentyl diisocyanate and 1,3-cyclopentyl diisocyanate; hydrogenated xylylene diisocyanate, 15 hydrogenated toluene diisocyanate, hydrogenated diphenylmethane diisocyanate, hydrogenated tetramethylxylene diisocyanate, 4,4'-dicyclohexylmethane diisocyanate, and the like.

 Specific examples of the aromatic polyisocyanates may include: 2,4-toluene diisocyanate, 2,6-toluene diisocyanate, 4,4'-diphenylmethane diisocyanate, 2,4'-diphenylmethane diisocyanate, 2,2'-diphenylmethane diisocyanate, 4,4'-diphenyl ether diisocyanate, 20 2-nitrobiphenyl-4,4'-diisocyanate, 2,2'-diphenylpropane-4,4'-diisocyanate, 3,3'-dimethyldiphenylmethane-4,4'-diisocyanate, 4,4'-diphenylpropane diisocyanate, m-phenyl diisocyanate, p-phenyl diisocyanate, naphthalene-1,4-diisocyanate, naphthalene-1,5-diisocyanate, 3,3'-dimethoxybiphenyl-4,4'-diisocyanate, xylylene-1,4-diisocyanate, xylylene-1,3-diisocyanate, and the like.

25 Preferred polyfunctional isocyanates may be, for example, polyfunctional isocyanates having an average of three or more isocyanate groups per molecule. The tri- or more functional isocyanates may be multimers (typically dimers or trimers), derivatives (such as products resulting from the addition reaction of polyols and two or more molecules of polyfunctional isocyanates), polymers, and the like of bifunctional or tri- or more functional isocyanates.

30 Examples of the polyfunctional isocyanate may include polyfunctional isocyanates such as dimers or trimers of diphenylmethane diisocyanates, an isocyanurate form of hexamethylene diisocyanate (a trimer adduct with an isocyanurate structure), a reaction product of trimethylolpropane and toluene diisocyanate, a reaction product of trimethylolpropane and hexamethylene diisocyanate, polymethylene polyphenyl isocyanate, polyether polyisocyanate, 35 and polyester polyisocyanate. The commercially available products of polyfunctional

isocyanates may include, for example, “DURANATE TPA-100” (tradename, manufactured by Asahi Chemical Co., Ltd.), “CORONATE L” (tradename, manufactured by Nippon Polyurethane Industry Co. Ltd.), “CORONATE HL” (tradename, manufactured by Nippon Polyurethane Industry Co. Ltd.), “CORONATE HK” (tradename, manufactured by Nippon Polyurethane Industry Co. Ltd.), “CORONATE HX” (tradename, manufactured by Nippon Polyurethane Industry Co. Ltd.), “CORONATE2096” (tradename, manufactured by Nippon Polyurethane Industry Co. Ltd.), and the like.

In the embodiments involving the isocyanate-based crosslinking agent, the isocyanate group content (NCO content) in the isocyanate-based crosslinking agent is preferably 7% to 15%.

The amount of the isocyanate-based crosslinking agent is not particularly limited. For example, it is preferably from 0.1 to 10 parts by mass, preferably from 0.5 to 5 parts by mass based on 100 parts by mass of the base polymer. In some specific embodiments, the amount of the isocyanate-based crosslinking agent is 0.1 parts by mass, 0.5 parts by mass, 1 part by mass, 2 parts by mass, 3 parts by mass, 4 parts by mass, 5 parts by mass, 6 parts by mass, 7 parts by mass, 8 parts by mass, 9 parts by mass or 10 parts by mass based on 100 parts by mass of the base polymer.

Examples of the melamine-based crosslinking agents may include: hexamethylolmelamine, butylated melamine resins (such as “SUPER BECKAMINE J-820-60N” (tradename, available from the DIC Corporation)), and the like.

The amount of the melamine-based crosslinking agent is not particularly limited. For example, it is preferably from 0.5 to 12 parts by mass, preferably from 1 to 8 parts by mass based on 100 parts by mass of the base polymer.

Examples of the aziridine-based crosslinking agents may include: trimethylolpropane tris[3-(1-aziridiny)propionate] and trimethylolpropane tris[3-(1-(2-methyl)aziridiny)propionate]. As aziridine-based crosslinking agents, commercially available products may be used. For example, the Chemitite series such as Chemitite PZ-33 and Chemitite DZ-22E (manufactured by Nippon Shokubai Co., Ltd.) and the like may be used.

Examples of the metal chelate-based crosslinking agents may include, for example, aluminum chelate compounds, titanium chelate compounds, zinc chelate compounds, zirconium chelate compounds, iron chelate compounds, cobalt chelate compounds, nickel chelate compounds, tin chelate compounds, manganese chelate compounds, and chromium chelate compounds.

The amount of the crosslinking agent is preferably from 0.01 to 15 parts by mass with respect to 100 parts by mass of the base polymer. By setting the amount of the crosslinking

agent within the above range, it is possible to increase the cohesive force of the adhesive, avoid production of adhesive residues on the adherend, and also provide moderate fluidity, which tends to achieve good wettability on the adherend and thus achieve close adhesion. In some embodiments, from the standpoint of avoiding a decrease in viscosity caused by unduly increased cohesive force, the amount of the crosslinking agent is more preferably 1 part by mass or more, further preferably 3 parts by mass or more, and more preferably 10 parts by mass or less, further preferably 8 parts by mass or less with respect to 100 parts by mass of the base polymer.

In order to carry out the above crosslinking reaction more efficiently, a crosslinking catalyst may also be used. As a crosslinking catalyst, it may be preferable to use, for example, tin-based catalysts (such as dioctyldilauryltin). The amount of the crosslinking catalyst is not particularly limited, and is preferably from 0.0001 to 1 part by mass with respect to 100 parts by mass of the base polymer, for example.

(Peeling auxiliary agent)

The peeling auxiliary agent contained in the adhesive layer is transferred to the surface of the adhesive layer over time, suppresses ascent of the adhesive force, and improves the re-peelability. By using the peeling auxiliary agent, it is possible to balance the adhesiveness to the adherend during protection and the light peelability when removing the protective sheet. The peeling auxiliary agent disclosed herein is typically a compound having a hydrophobic group and a hydrophilic group, and its preferable examples include various surfactants such as ionic surfactants and nonionic surfactants. The peeling auxiliary agents may be used alone or in a combination of two or more thereof. The peeling auxiliary agent disclosed herein may typically be a hydrophilic polar group. Because the peeling auxiliary agent moves between the surface of the adhesive layer and the surface of the adherend (especially when the adherend is a metal plate), excellent light peelability is thus achieved.

The ionic surfactant includes anionic surfactants. Examples of the anionic surfactants usable as peeling auxiliary agents may include, for example, alkyl sulfates such as dodecyl sulfates, fatty acids and fatty acid salts (such as lauric acid, myristic acid, palmitic acid, stearic acid, and laurate), alkyl phosphates, alkylbenzene sulfonates (such as nonylbenzene sulfonates), naphthalene sulfonates (such as dodecynaphthalene sulfonates), alkyl diphenyl ether disulfonates, polyoxyethylene alkyl ether sulfates such as polyoxyethylene octadecyl ether sulfates and polyoxyethylene dodecyl ether sulfates, polyoxyethylene alkyl phenyl ether sulfates such as polyoxyethylene lauryl phenyl ether sulfates, polyoxyethylene phenyl ether sulfates, and sulfosuccinates such as lauryl sulfosuccinates.

Examples of the nonionic surfactants may include, for example, polyoxyethylene alkyl

ethers such as polyoxyethylene lauryl ethers, polyoxyethylene alkyl phenyl ethers such as polyoxyethylene nonylphenyl ethers, sorbitan fatty acid esters such as sorbitan monolaurate dilaurates, and polyoxyethylene glyceryl fatty acid esters.

The content of the peeling auxiliary agent is preferably from 0.1 to 5 parts by mass, preferably from 0.5 to 4 parts by mass with respect to 100 parts by mass of the base polymer. By setting the content of the peeling auxiliary agent at 0.1 parts by mass or more, there is a tendency to improve the re-peelability. Furthermore, since the content of the peeling auxiliary agent is 5 parts by mass or less, the adhesive layer has good adhesiveness to the adherend, and there is also a tendency to prevent contamination of the adherend.

In addition to the above-mentioned components, the adhesive composition of the present disclosure may contain various additives commonly used in the adhesive field, such as photoinitiators, softeners, anti-aging agents, and antioxidants as needed within the scope that does not impair the effects of the present disclosure. As to such various additives, conventionally known additives may be used by conventional methods.

In a preferred embodiment, the gel rate of the adhesive layer is preferably 45% or more, more preferably 50% or more, further preferably 55% or more. The upper limit of the gel rate is preferably 98% or less, more preferably 95% or less, further preferably 90% or less. When the gel rate is within the above range, excellent adhesive properties could be achieved. The gel rate can be adjusted, for example, according to the composition and molecular weight of the base polymer, the presence or absence of the crosslinking agent and the selection of its type and amount, etc.

The gel rate may be calculated, for example, by the following method:

Approximate 0.1 g of an adhesive sample (weight: Wg1) formed from the adhesive composition was wrapped into a drawstring-bag shape with a porous polytetrafluoroethylene film (weight: Wg2) having an average pore diameter of 0.2 μm , and the mouth was fastened tightly with a kite string (weight: Wg3). The bag was dipped in 50 mL of ethyl acetate and kept at room temperature (typically 23°C) for 7 days. Thereafter, the above bag was taken out and the ethyl acetate attached to the outer surface of the bag was wiped off. The bag was dried at 130°C for 2 h. The weight (Wg4) of the bag was measured. The gel rate was determined by substituting each of the values into the equation below.

$$\text{Gel rate (\%)} = [(Wg4 - Wg2 - Wg3) / Wg1] \times 100$$

(Formation of Adhesive Layer)

The adhesive layer disclosed herein may be formed by a conventionally known method. For example, a method for forming an adhesive layer by directly applying (typically coating) the adhesive composition to the substrate layer and drying the same (direct method) may be

adopted. In addition, a method for forming an adhesive layer on a surface with releasability (release surface) by applying the adhesive composition to this surface and drying the same, and transferring this adhesive layer onto the substrate layer (transfer method) may also be adopted. From the standpoint of productivity, the transfer method is preferred. As the above release
5 surface, the surface of the release liner or the rear surface of the substrate layer that has been subjected to the peeling treatment or the like may be used. Of note, the adhesive layer disclosed herein is typically formed continuously, but it is not limited to such a form and it may also be an adhesive layer formed in a regular or irregular pattern such as a dot or strip shape.

The adhesive composition may be coated with a conventionally known coater such as a
10 gravure roll coater, a die coater, or a bar coater. Alternatively, the adhesive composition may be coated by infiltration or curtain coating or the like.

From the standpoints of promoting the crosslinking reaction, improving the production efficiency and the like, the adhesive composition is preferably dried under heating. The drying temperature may be set, for example, at about 40°C to about 150°C, and is preferably set at
15 about 60°C to about 130°C in general. After the adhesive composition is dried, it may be further aged for the purposes of regulating the migration of the components within the adhesive layer, carrying out the crosslinking reaction, relaxing the strain possibly existing in the substrate film or adhesive layer, etc.

The thickness of the adhesive layer is not particularly limited. Considering the balance
20 between the adhesiveness to the adherend and the cohesiveness, the thickness of the adhesive layer is preferably from 1 to 40 μm , more preferably from 3 to 35 μm . By setting the thickness of the adhesive layer within the above range, good adhesiveness may be achieved.

[Substrate Layer]

As the material constituting the substrate layer, any suitable material may be used. As the
25 substrate, it is preferable to use a plastic film.

The plastic film may include any suitable resin material. Examples of such a resin material may include, for example, polyvinyl chloride, polyolefin, ethylene-vinyl acetate copolymer, polyester, polyimide, and polyamide. Of these, the resin material is preferably polyvinyl chloride, polyolefin or ethylene-vinyl acetate copolymer, more preferably polyvinyl
30 chloride. The polyvinyl chloride is excellent in stress relaxation, and thus could moderately relax the impact of the needle when pushing upward, and could suppress displacement and exfoliation of the adherend that has been diminished into small pieces.

The content ratio of the above-mentioned resin material in the plastic film is, for example, from 50 parts by mass to 100 parts by mass, preferably from 60 parts by mass to 100 parts by
35 mass, further preferably from 70 parts by mass to 100 parts by mass with respect to 100 parts

by mass of the plastic film.

The plastic film may include a plasticizer. The content ratio of the plasticizer in the plastic film is preferably from 10 to 60 parts by mass, more preferably from 15 to 55 parts by mass with respect to 100 parts by mass of the above-mentioned resin material (e.g., polyvinyl chloride resin) in the plastic film. By including the plasticizer in the plastic film at the above content ratio, an adhesive sheet having excellent conformability to deformation such as stretching and good picking-up property could be obtained, and even if the adhesive sheet is stored for a long time, the haze does not decrease and the haze stability over time is excellent.

In some specific embodiments, the content ratio of the plasticizer in the plastic film is 10 parts by mass, 20 parts by mass, 30 parts by mass, 40 parts by mass, 50 parts by mass or 60 parts by mass with respect to 100 parts by mass of the above-mentioned resin material (e.g., polyvinyl chloride resin) in the plastic film.

As the above plasticizer, a plasticizer of the same system as the plasticizer contained in the adhesive layer may be used. Examples of such kind of plasticizer may include, for example, dioctyl phthalate, dioctyl terephthalate, and diisononyl phthalate. If the adhesive layer contains the plasticizer of the same system as the plasticizer contained in the substrate layer, the modification of the substrate layer and the adhesive layer over time can still be suppressed even when the plasticizer migrates from the substrate layer to the adhesive layer.

The plastic film may include a stabilizer. As the stabilizer, for example, phosphite (phosphite compound) or calcium, zinc, or barium salt stabilizers of stearic acid or lauric acid may be used. Examples of the phosphite stabilizer include alkylaryl phosphites such as monoalkyl-diaryl phosphites and dialkyl-monoaryl phosphites.

The content of the stabilizer is preferably from 0.1 to 5 parts by mass, more preferably from 0.2 to 4.5 parts by mass with respect to 100 parts by mass of the above-mentioned resin material (e.g., polyvinyl chloride resin) in the plastic film. By including the stabilizer in the plastic film at the above content ratio, deterioration of the adhesive strength could be prevented, and the adhesive sheet is excellent in long-term storage stability.

The plastic film may include a haze regulator. The haze regulator may include at least one selected from the group consisting of a filler material and a colorant.

Examples of the colorant may include, for example, known colorants such as inorganic pigments, organic pigments, and organic dyes.

Examples of the organic pigments and organic dyes may include, for example, aminium-based coloring matters, cyanine-based coloring matters, merocyanine-based coloring matters, croconium-based coloring matters, squarylium-based coloring matters, azulenium-based coloring matters, polymethine-based coloring matters, naphthoquinone-based

coloring matters, pyrylium-based coloring matters, phthalocyanine-based coloring matters, naphthocyanine-based coloring matters, naphtholactam-based coloring matters, azo-based coloring matters, condensed azo-based coloring matters, indigo-based coloring matters, perinone-based coloring matters, perylene-based coloring matters, dioxazine-based coloring matters, quinacridone-based coloring matters, isoindolinone-based coloring matters, quinphthalone-based coloring matters, pyrrole-based coloring matters, thioindigo-based coloring matters, metal complex-based coloring matters (metal complex salt dyes), dithiol metal complex-based coloring matters, indoxyl-based coloring matters, triarylmethane-based coloring matters, anthraquinone-based coloring matters, dioxazine-based coloring matters, naphthol-based coloring matters, azomethine-based coloring matters, benzimidazolone-based coloring matters, pyranthrone-based coloring matters, and threne-based coloring matters.

Examples of the inorganic pigments may include, for example, carbon black, cobalt-based coloring matters, iron-based coloring matters, chromium-based coloring matters, titanium-based coloring matters, vanadium-based coloring matters, zirconium-based coloring matters, molybdenum-based coloring matters, ruthenium-based coloring matters, platinum-based coloring matters, ITO (indium tin oxide)-based coloring matters, and ATO (antimony tin oxide)-based coloring matters.

Examples of the filler material may include, for example, known filler materials such as organic filler materials and inorganic filler materials.

Examples of the organic filler material may include, for example, rubber particles such as styrene-type particles, butadiene-type particles, and acrylic particles, and silicone composite particles such as silicone resin particles and silicone rubber particles.

Examples of the inorganic filler material may include, for example, powders such as silica, alumina, talc, calcium carbonate, titanium white, red ferric oxide, silicon carbide, and boron nitride; beads made by sphericalizing these inorganic filler materials; surface-modified products of these inorganic filler materials; monocrystal fibers of these inorganic filler materials; and glass fibers.

The content of the haze regulator is preferably from 0.1 to 10 parts by mass, more preferably from 0.2 to 9 parts by mass with respect to 100 parts by mass of the above-mentioned resin material (e.g., polyvinyl chloride resin) in the plastic film.

The plastic film may include any appropriate additional component within the scope that does not impair the effects of the present disclosure.

The surface of the substrate layer of the present disclosure may be subjected to any surface treatment in order to improve close adhesion and retention with adjacent layers, etc.

Examples of the above surface treatment may include, for example, chemical or physical

treatments such as chromic acid treatment, ozone exposure, flame exposure, high voltage electric shock exposure, and ionizing radiation treatment, and coating treatment.

The thickness of the substrate layer of the present disclosure may be set at any appropriate thickness depending upon the desired strength or flexibility and intended use, etc. The
5 thickness of the substrate layer is preferably from 5 to 300 μm , more preferably from 30 to 200 μm , further preferably from 50 to 150 μm .

In some preferred embodiments, the substrate layer has an arithmetic average surface roughness R_a at 23°C of 1 to 6 μm , preferably 3 to 5 μm .

In some preferred embodiments, the surface of the substrate layer has a surface roughness
10 with the maximum height (R_z) at 23°C of 6 to 12 μm , 6 to 9 μm .

In some preferred embodiments, the substrate layer has an arithmetic average surface roughness R_a at 50°C of 1 to 4 μm , preferably 1 to 3 μm .

In some preferred embodiments, the surface of the substrate layer has a surface roughness with the maximum height (R_z) at 50°C of 6 to 10 μm , 6 to 9 μm .

15 By allowing the surface roughness R_a or R_z at 23°C or 50°C of the substrate layer to be within the above range, the haze does not decrease and the haze stability over time is excellent even if the adhesive sheet is stored for a long time.

[Release Film]

The release film includes a single-layer structure or a multi-layer structure and is formed
20 of materials commonly used in this technical field. For example, release paper may be used. The release film may be a sheet comprising a substrate film and a release treatment agent layer formed on one side thereof.

The substrate film of the release film may be composed of any suitable material(s), and for example, may be selected from the group consisting of a poly(ether ether ketone) film, a
25 polyetherimide film, a polyarylate film, a polyethylene naphthalate film, a polyethylene film, a polypropylene film, a polybutene film, a polybutadiene film, a polymethylpentene film, a polyvinyl chloride film, a polyvinyl chloride copolymer film, a polyethylene terephthalate film, a polybutylene terephthalate film, a polyurethane film, an ethylene-vinyl acetate copolymer film, an ionomer resin film, an ethylene-(meth)acrylic acid copolymer film, an
30 ethylene-(meth)acrylate copolymer film, a polystyrene film, and a polycarbonate film.

The release treatment agent layer may be formed by subjecting the above substrate film to surface treatment with various release treatment agents such as silicone-based release treatment agents, long-chain alkyl-based release treatment agents, fluorine-based release treatment agents, and molybdenum sulfide-based release treatment agents.

35 In the present disclosure, the side of the release film away from the bonding face of the

adhesive layer is the frosted surface. This frosted surface is obtained by indentation with an abrasive roller or by sandblasting.

The thickness of the release film is not particularly limited, and the thickness is preferably from 20 to 70 μm .

5 [Back-coating Layer]

As shown in FIG. 2, the adhesive sheet of the present disclosure further comprises a back-coating layer 40 disposed at the side of the substrate layer 10 opposite to the adhesive layer 20.

10 The material for forming the back-coating layer is not particularly limited. One or two or more of polyurethane-based resins, epoxy-based resins, polyester-based resins, acrylic resins, polyamide-based resins, melamine-based resins, olefin-based resins, polystyrene-based resins, phenol-based resins, isocyanurate-based resins, polyvinyl acetate-based resins and the like may be used. When an acrylic adhesive layer or the like is provided on the substrate layer of the resin film, polyurethane-based, epoxy-based, polyester-based, and acrylic primer layers are
15 preferred.

In some preferred embodiments, the back-coating layer preferably includes at least one selected from the group consisting of thermosetting acrylic, polyurethane-based, and epoxy-based resins.

In some preferred embodiments, the back-coating layer preferably includes an antistatic
20 agent. In this way, the antistatic properties of the adhesive sheet are improved, and the peeling electrostatic voltage can be sufficiently suppressed. The back-coating layer may be a monolayer structure or may be a multilayer structure of two or more layers. Among the methods for configuring an primer layer having a multilayer structure, it is preferable to design at least one of the layers (typically at least one layer including the layer in contact with the
25 substrate layer) as a back-coating layer containing an antistatic agent.

As the antistatic agent, for example, the antistatic agents described in the above-mentioned adhesive layer and the like may be used. For example, it is possible to use conductive polymers such as polythiophene, polyaniline, polypyrrole, polyethyleneimine, and allylamine polymers; conductive inorganic particles such as conductive metal oxide, carbon
30 nanotube, graphene, fullerene, acetylene black, Ketjenblack, natural graphite, artificial graphite, and titanium black; metallic particles or fibers and the like may be used. They may be used alone or in combination with two or more thereof.

Among the methods for configuring the back-coating layer, examples of the conductive polymer that may be included in the back-coating layer may include polythiophene and
35 polyaniline. As polythiophene, Mw is preferably 40×10^4 or less, more preferably 30×10^4 or

less in terms of polystyrene. As polyaniline, Mw is preferably 50×10^4 or less, more preferably 30×10^4 or less. Additionally, Mw of these conductive polymers is generally preferably 0.1×10^4 or more, more preferably 0.5×10^4 or more. It should be noted that in the present specification, polythiophene refers to an unsubstituted or thiophene-substituted polymer. A suitable example
5 of a thiophene-substituted polymer in the technology disclosed herein may be poly(3,4-ethylenedioxythiophene).

In some preferred embodiments, the back-coating layer may include polystyrene sulfonate (PSS) as a dopant (e.g., a dopant of a thiophene-based polymer). In some embodiments, the back-coating layer is formed by a back-coating layer-forming composition containing an
10 aqueous solution of PSS-containing polythiophene (which may be in such a form that PSS is added to polythiophene as a dopant). The aqueous solution may contain polythiophene : PSS at a weight ratio of 1:1 to 1: 10. The total content of polythiophene and PSS in the above aqueous solution may be, for example, about 1 to 5% by weight.

From the viewpoint of improving the antistatic properties, the amount of the conductive
15 polymer may be set to about 10 parts by mass or more, typically appropriately 25 parts by mass or more, preferably 40 parts by mass or more with respect to 100 parts by mass of the resin included in the back-coating layer. Considering the compatibility of the conductive polymer in the back-coating layer, it is appropriate to set the amount of the conductive polymer to 200 parts by mass or less (e.g., 150 parts by mass or less), preferably 120 parts by mass or less (e.g.,
20 100 parts by mass or less) with respect to 100 parts by mass of the resin. The amount of the conductive polymer may also be set to 80 parts by mass or less (e.g., 60 parts by mass or less) with respect to 100 parts by mass of the resin.

The total amount of the antistatic agent (a total amount of all antistatic agents including the conductive polymer, the conductive inorganic particles and the like) in the back-coating
25 layer may be set to about 5% by weight (e.g., about 10% by weight or more), and appropriately to about 30% by weight or more, e.g., it may also exceed 50% by weight. The upper limit of the total amount of the antistatic agent in the primer layer is not particularly limited, and is appropriately about 90% by weight or less (e.g., 80% by weight or less), or may also be about 40% by weight or less (e.g., about 30% by weight or less) in consideration of its close adhesion
30 to the substrate layer, etc.

The back-coating layer may further include a binder in addition to the above-mentioned conductive agent. As the binder that may be included in the back-coating layer, the above-mentioned materials for forming the back-coating layer may be used without particular limitations. Of these, thermosetting polyurethane- and/or epoxy-based resins are preferably
35 used. The proportion of the binder in the entire back-coating layer may be set to, e.g., about 30%

by weight or more, and appropriately about 40% by weight or more (e.g., about 50% by weight or more). Furthermore, it is appropriate to set the above proportion of the binder to less than 90% by weight (less than 80% by weight) in consideration of the antistatic properties, etc.

Additionally, in some embodiments, the back-coating layer contains a crosslinking agent. As the crosslinking agent, it is suitable to use crosslinking agents such as melamine-based, isocyanate-based, and epoxy-based crosslinking agents commonly used to crosslink resins. This may thus allow for preferable balance of the anchoring properties to the substrate layer.

The back-coating layer may contain additives such as an antioxidant, a colorant, a fluidity modifier, a film-forming aid, a surfactant, and an anticorrosive agent as necessary.

In some preferred embodiments, the back-coating layer is preferably formed by a back face treatment agent. The back face treatment agent usable for forming the back-coating layer is not particularly limited, and known or conventionally-used treatment agents such as silicone-based back face treatment agents, fluorine-based back face treatment agents, and long-chain alkyl-based back face treatment agents may be used depending upon the purposes or applications. The back face treatment agents may be used alone or in combination of two or more thereof.

The back-coating layer may be suitably formed by the following method: a liquid composition (coating material for forming an primer layer) formed by dispersing or dissolving the above-mentioned resin component and additives used as appropriate into a suitable solvent is applied to the substrate layer with a known or conventionally-used coater such as a gravure roll coater or a reverse roll coater, and drying or curing treatment is included if necessary, thereby forming the back-coating layer. From the viewpoint of forming a thin and uniform layer, the NV (non-volatile component) of the above-mentioned coating material may be set, for example, at 5% by weight or less (typically 0.05 to 5% by weight). As the solvent that may constitute the coating material, any one of an organic solvent, water, or a mixed solvent thereof may be used, and water or a mixed solvent comprising water as the main component (for example, a mixed solvent of water and ethanol) is preferred.

The thickness of the back-coating layer in the technology disclosed herein is not particularly limited and is typically 0.01 μm or more. From the viewpoint of appropriately exhibiting the functions of the primer layer, it is appropriate to set at 0.05 μm or more, and it may also be preferably 0.1 μm or more (e.g., 0.2 μm or more). The upper limit of the thickness of the primer layer may be set at 50 μm or less (e.g., 10 μm or less), and it is appropriate to set at 3 μm or less, preferably 1 μm or less (e.g., 0.6 μm or less) from the viewpoint of transparency, etc.

In some preferred embodiments, the back-coating layer has an arithmetic average surface

roughness Ra at 23°C of 0.1 to 5.0 μm , preferably 0.5 to 3.0 μm .

In some preferred embodiments, the surface of the back-coating layer has a surface roughness with the maximum height (Rz) at 23°C of 1 to 10 μm , 1.5 to 9.0 μm .

In some preferred embodiments, the back-coating layer has an arithmetic average surface roughness Ra at 50°C of 0.1 to 4.0 μm , preferably 0.5 to 3.0 μm .

In some preferred embodiments, the surface of the back-coating layer has a surface roughness with the maximum height (Rz) at 50°C of 2.0 to 8.0 μm , 2.0 to 7.0 μm .

By allowing the surface roughness Ra or Rz at 23°C or 50°C of the back-coating layer to be within the above range, the haze does not decrease and the haze stability over time is excellent even if the adhesive sheet is stored for a long time.

[Primer Layer]

As shown in FIG. 3, the adhesive sheet of the present disclosure may further comprise an primer layer 50 disposed on the side of the substrate layer 10 opposite to the back-coating layer 40 and between the substrate layer 10 and the adhesive layer 20.

The material for forming the primer layer is not particularly limited. One or two or more of polyurethane-based resins, epoxy-based resins, polyester-based resins, acrylic resins, polyamide-based resins, melamine-based resins, olefin-based resins, polystyrene-based resins, phenol resins, isocyanurate-based resins, polyvinyl acetate-based resins, and the like may be used. When an acrylic adhesive layer or the like is provided on the substrate layer of the resin film, polyurethane-based, epoxy-based, polyester-based, and acrylic primer layers are preferred.

In some preferred embodiments, the primer layer preferably includes at least one selected from the group consisting of thermosetting acrylic, polyurethane-based, and epoxy-based resins.

In some preferred embodiments, the primer layer further preferably includes an antistatic agent. Therefore, the antistatic properties of the adhesive sheet are improved, and the peeling electrostatic voltage can be sufficiently suppressed. The primer layer may be a monolayer structure or may be a multilayer structure of two or more layers. Among the methods for configuring an primer layer having a multilayer structure, it is preferable to design at least one of the layers (typically at least one layer including the layer in contact with the primer layer) as a back-coating layer containing an antistatic agent.

As the antistatic agent, for example, the antistatic agents described in the above-mentioned adhesive layer and the like may be used. For example, conductive polymers; conductive inorganic particles; metallic particles or fibers and so forth may be used. They may be used alone or in combination of two or more thereof.

The primer layer may include the same conductive polymer, dopant, binder and the like as those in the back-coating layer, and their contents are the same as those in the back-coating layer.

The primer layer may further contain any suitable additives. Examples of such additives may include, for example, ultraviolet absorbers, anti-aging agents, light stabilizers such as hindered amine-based light stabilizers, surface lubricants, leveling agents, plasticizers, low molecular weight polymers, preservatives, polymerization inhibitors, silane coupling agents, inorganic and organic fillers (such as calcium oxide, magnesium oxide, silicon oxide, zinc oxide, and titanium oxide), metal powders, colorants, pigments, heat-resistant stabilizers, anti-buildup agents, lubricants, and anti-blocking agents.

In some preferred embodiments, the primer layer is preferably formed by a primer. The primer treatment agent usable for forming the primer layer is not particularly limited, and known or conventionally used treatment agents such as silicone-based back face treatment agents, fluorine-based back face treatment agents, and long-chain alkyl-based back face treatment agents may be used depending upon the purposes or applications. The back face treatment agents may be used alone or in combination of two or more thereof.

The thickness of the primer layer is not particularly limited, and is preferably from 0.05 to 2 μm , more preferably from 0.1 to 1.5 μm . By setting the thickness of the primer layer within the above range, the effects of the present disclosure can be better achieved.

(Production Method for Adhesive Sheet)

The adhesive sheet of the present disclosure may be produced by any suitable method. For example, the following methods may be used: a method for coating an adhesive composition on a substrate layer, or a method for transferring a coating layer formed by coating an adhesive composition on any suitable substrate onto a substrate layer, etc., and then providing the release film on the adhesive layer in such a manner that the frosted surface of the release film is away from the bonding face of the adhesive layer.

As the coating method for the above adhesive composition, any suitable coating method may be used. For example, the layers may be formed by drying after coating. Examples of the coating method may be, for example, coating with a multi-coater, a die-coater, a gravure-coater, an applicator or a rod coater, or may be air knife coating, reverse roller coating, lip coating, dip coating, offset printing, flexographic printing, screen printing or the like. Examples of the drying method may include, for example, natural drying and heat drying. The heating temperature in the case of heat drying may be set at any appropriate temperature depending on the characteristics of the substance to be dried.

(Use)

The adhesive sheets disclosed herein may be, for example, adhered to various members or devices for use in applications such as protection as well as packaging and fixing of semiconductor elements.

Examples

5 The embodiments of the present disclosure will be described in detail below with reference to the examples. However, a person skilled in the art shall appreciate that the following examples are merely intended to illustrate the present disclosure and should not be considered to limit the scope of the present disclosure. Where the specific conditions are not indicated in the examples, conventional conditions or the conditions recommended by the
10 manufacturers will be followed. Where the manufacturers are not indicated for the reagents or instruments used herein, all of them are commercially-available conventional products.

(Preparation of Acrylic Polymer A1)

To a reaction vessel equipped with a stirrer, a thermometer, a nitrogen inlet tube, and a reflux condenser, 70 parts of n-butyl acrylate (BA) (manufactured by Zhejiang Weixing Co.,
15 Ltd.), 25 parts of N-vinylpyrrolidone (NVP), 5 parts of 2-hydroxyethyl acrylate (HEA), and 200 to 300 parts of toluene as a polymerization solvent were charged and stirred at 65°C for 1.5 h under a nitrogen atmosphere, and then 0.1 parts of 2,2'-azobisisobutyronitrile (AIBN) was charged as a thermal polymerization initiator and reacted at 65°C for 3 h to 4 h to obtain a solution of the acrylic polymer A1.

(Production Example 1): Production of Substrate Layer 1

100 parts by mass of polyvinyl chloride, 20 parts by mass of DOTP as a plasticizer, 1 part
by mass of zinc stearate (OW-5000LTS) as a stabilizer, and 5 parts by mass of talc powder as a
haze regulator were mixed and prepared into a substrate film by a calendering method. The
thickness of this substrate film was 75 μm . Furthermore, the freshly prepared substrate film had
25 an arithmetic average surface roughness R_a at 23°C of 3.5 μm , and the surface of the freshly prepared substrate film had a surface roughness with the maximum height (R_z) at 23°C of 10 μm .

(Production Example 2): Production of Substrate Layer 2

100 parts by mass of polyvinyl chloride, 30 parts by mass of DOTP as a plasticizer, 1 part
30 by mass of zinc stearate (OW-5000LTS) as a stabilizer, and 5 parts by mass of talc powder as a
haze regulator were mixed and prepared into a substrate film by a calendering method. The
thickness of this substrate film was 75 μm . Furthermore, the freshly prepared substrate film had
an arithmetic average surface roughness R_a at 23°C of 3.5 μm , and the surface of the freshly prepared substrate film had a surface roughness with the maximum height (R_z) at 23°C of 10
35 μm .

(Production Example 3): Production of Substrate Layer 3

100 parts by mass of polyvinyl chloride, 70 parts by mass of DOTP as a plasticizer, 1 part by mass of zinc stearate (OW-5000LTS) as a stabilizer, and 5 parts by mass of talc powder as a haze regulator were mixed and prepared into a substrate film by a calendering method. The thickness of this substrate film was 75 μm . Furthermore, the freshly prepared substrate film had an arithmetic average surface roughness R_a at 23°C of 3.5 μm , and the surface of the freshly prepared substrate film had a surface roughness with the maximum height (R_z) at 23°C of 10 μm .

<Preparation of Adhesive Sheet>

10 Example 1

To the solution of acrylic polymer A1 described above, with respect to 100 parts of the acrylic polymer A1 contained in this solution, 1 part of LiTFsl (organolithium salt) as an antistatic agent, 10 parts of ethylene-vinyl acetate copolymer as a functional resin, 3 parts of isocyanate-based crosslinking agent (tradename: CORONATE L, manufactured by Nippon Polyurethane Industry Co. Ltd.), 0.1 parts of epoxy-based crosslinking agent (tradename: TETRAD C, manufactured by Mitsubishi Gas Chemical Company Inc.), and 30 parts of DOTP as a plasticizer were added and mixed homogeneously to prepare an adhesive composition C1.

The adhesive composition C1 was coated on one side of the substrate layer 1 prepared in Production Example 1 described above, and then dried to form an adhesive layer having a thickness of 10 μm . The drying conditions were heating at 130°C for 2 min.

Anti-static back-coating solution E1 (polythiophene dispersion solution, manufactured by OE Chemicals, brand: Polyelec OE-001) was coated on the other side of the aforementioned substrate layer 1, and then dried in a suspension oven at 80°C for 1 min to form a back-coating layer having a thickness of 1 μm .

25 The PET release film (manufactured by Yaoyang Technology Co., Ltd.) was placed on the adhesive layer in such a manner that the frosted surface of the release film was away from the bonding face of the adhesive layer. The arithmetic average surface roughness R_a of the frosted surface was 0.3 μm , and the surface of the frosted surface had a surface roughness with the maximum height (R_z) of 1.5 μm .

30 The adhesive sheet was thereby obtained. The evaluation results were shown in Table 1.

Examples 2 to 5

The adhesive sheets were obtained in the same manner as in Example 1, with the exception of changing the type of the substrate layer, the amount of the functional resin, the amount of the plasticizer, and the type of the release film as shown in Table 1. The evaluation results were shown in Table 1.

Comparative Examples 1 to 3

The adhesive sheets were obtained in the same manner as in Example 1, with the exception of changing the type of the substrate layer, the amount of the plasticizer, and the type of the release film as shown in Table 2. The evaluation results were shown in Table 2.

5 In the following table:

Li salt: LiTFsl, CAS No.: 90076-65-6, manufactured by Moiear (Shanghai) Technology Co., Ltd.

isocyanate-based crosslinking agent: tradename: CORONATE L, manufactured by Nippon Polyurethane Industry Co. Ltd.

10 epoxy-based crosslinking agent: tradename: TETRAD C, manufactured by Mitsubishi Gas Chemical Company Inc.

ethylene-vinyl acetate copolymer: (an ethylene-vinyl acetate copolymer having a vinyl acetate content of 15% or more)

15 “1 μm ” for polythiophene (dry film thickness, μm) was the dry film thickness obtained by evenly coating the prepared anti-static back-coating solution on the substrate surface using a micro-gravure coater, followed by drying and rolling up; speed $V = 10$ to 100 M/min, mesh number: 100 to 300 meshes, drying temperature: 60°C to 120°C , which matched appropriate speed.

Table 1

		Example 1	Example 2	Example 3	Example 4	Example 5
Substrate layer	Types	Substrate Layer 1	Substrate Layer 1	Substrate Layer 2	Substrate Layer 1	Substrate Layer 1
	Thickness (μm)	75	75	75	75	75
Adhesive layer	Acrylic Polymer (parts)		A1 (100)	A1 (100)	A1 (100)	A1 (100)
	Antistatic agent	Li salt (parts)	1	1	1	1
	Crosslinking agent	Isocyanate-based crosslinking agent (parts)	3	3	3	3
		Epoxy-based crosslinking agent (parts)	0.1	0.1	0.1	0.1
	Functional resin	Vinyl resin (parts)	10	20	20	10
	Plasticizer (parts)		30	30	40	10
	Adhesive layer thickness (μm)		10	10	10	10
Back-coating layer	Antistatic agent	Polythiophene (dry film thickness, μm)	1	0.8	1	1
						1.2

Release film (frosted surface)	Ra (μm)	0.3	0.3	0.3	0.45	0.25
	Rz (μm)	1.5	1.5	1.5	2.5	1.5
Physical properties	Ra of back-coating layer of adhesive sheet (μm)	0.4	0.6	0.4	0.4	0.25
	Rz of back-coating layer of adhesive sheet (μm)	2	2.5	2	2	1.4
	Peel force A (N/20mm)	0.48	0.55	0.7	0.3	0.48
	Peel force B (N/20mm)	0.60	0.75	0.9	0.5	0.6
	Difference of peel force B minus peel force A	0.12	0.2	0.2	0.2	0.12
	Peel force C (N/20mm)	2.55	1.8	2.3	2	2.55
	Peel force D (N/20mm)	7.12	8	8.5	7	7.12
	Difference of peel force D minus peel force C (N/20mm)	4.57	6.2	6.2	5	4.57
	Peel force E (N/20mm)	3	3.4	4	2.5	3
	Peel force F (N/20mm)	9	9.5	11	8.5	9
	Difference of peel force F minus peel force E (N/20mm)	6	6.1	7	6	6
	50% Modulus (MD, MPa)	25	23	20	25	25
	50% Modulus (TD, MPa)	23	20	18	23	23
	Tensile strength of adhesive sheet (MD, MPa)	30	25	24	30	30
	Tensile strength of adhesive sheet (TD, MPa)	32	26	25	32	32
	Elongation at break of adhesive sheet (MD, %)	180	200	210	180	180
	Elongation at break of adhesive sheet (TD, %)	200	220	230	200	200
	Surface resistivity of adhesive face (before film expansion, ohms/sq)	8.0×10^9	8.0×10^9	8.0×10^9	8.0×10^9	8×10^9
	Surface resistivity of back face (before film expansion, ohms/sq)	4.3×10^6	4.3×10^6	4.3×10^6	4.3×10^6	4.3×10^6
	Surface resistivity of adhesive face (1.2 folds after film expansion, ohms/sq)	4×10^{10}	4×10^{10}	4×10^{10}	4×10^{10}	4×10^{10}
	Surface resistivity of back face (1.2 folds after film expansion, ohms/sq)	6×10^7	6×10^7	6×10^7	6×10^7	6×10^7
	Logarithmic change rate of surface resistivity of adhesive face (%)	11	11	11	11	11

	Logarithmic change rate of surface resistivity of back face (%)	16	16	16	16	16
	Peeling electrostatic voltage (peeled from the release film surface; V, 12 m/min)	30	30	30	30	30
	Heating shrinkage rate at 50°C (% , MD)	0.5	0.8	1	0.5	0.5
	Heating shrinkage rate at 50°C (% , TD)	0.3	0.5	0.7	0.3	0.3
	Stain on adhesive face	○	○	△	○	○
	Adhesive residue	○	○	△	○	○
	Film expandability (MD)	○	○	○	○	○
	Film expandability (TD)	○	○	○	○	○
	Chip arrangement regularity after film expansion (chip space: edge, center)	○	○	○	○	○
	Transfer rate (%)	98	99	99	98	99
	Sunken crystal	○	○	△	○	○
	Transmittance (%)	77	77	79	77	80
	Initial haze (%)	30	35	30	30	25
	Haze after storage (%)	29	34	28	30	23
	Haze change rate (%)	3.0	2.8	6.6	0	8
	Haze stability	○	○	△	○	△
	Comprehensive evaluation	○	○	△	○	△

Table 2

			Comp. Ex. 1	Comp. Ex. 2	Comp. Ex. 3
Substrate layer	Type		Substrate layer 3	Substrate layer 1	Substrate layer 1
	Thickness (μm)		75	75	75
Adhesive layer	Acrylic Polymer (parts)		A1 (100)	A1 (100)	A1 (100)
	Antistatic agent	Li salt (parts)	1	1	1
	Crosslinking agent	Isocyanate-based crosslinking agent (parts)	3	3	3
		Epoxy-based crosslinking agent (parts)	0.1	0.1	0.1
	Functional resin	Vinyl resin (parts)	10	10	10
	Plasticizer (parts)		30	30	30
Adhesive layer thickness (μm)			10	10	10
Back-coating layer	Antistatic agent	Polythiophene (dry film thickness, μm)	1	1	1.4

Release paper (frosted surface)	Ra (μm)	0.15	0.2	0.2
	Rz (μm)	1.0	1.3	1.3
Physical properties	Ra of back-coating layer of adhesive sheet (μm)	0.4	0.4	0.09
	Rz of back-coating layer of adhesive sheet (μm)	2	2	1.0
	Peel force A (N/20mm)	0.5	0.48	0.48
	Peel force B (N/20mm)	0.7	0.60	0.60
	Difference of peel force B minus peel force A	0.2	0.12	0.12
	Peel force C (N/20mm)	3	2.55	2.55
	Peel force D (N/20mm)	7.5	7.12	7.12
	Difference of peel force D minus peel force C (N/20mm)	4.5	4.57	4.57
	Peel force E (N/20mm)	4	3	3
	Peel force F (N/20mm)	9.5	9	9
	Difference of peel force F minus peel force E (N/20mm)	5.5	6	6
	50% Modulus (MD, MPa)	20	25	25
	50% Modulus (TD, MPa)	18	23	23
	Tensile strength of adhesive sheet (MD, MPa)	22	30	30
	Tensile strength of adhesive sheet (TD, MPa)	20	32	32
	Elongation at break of adhesive sheet (MD, %)	250	180	180
	Elongation at break of adhesive sheet (TD, %)	270	200	200
	Surface resistivity of adhesive face (before film expansion, ohms/sq)	8.0×10^9	8.0×10^9	8.0×10^9
	Surface resistivity of back face (before film expansion, ohms/sq)	4.3×10^6	4.3×10^6	4.3×10^6
	Surface resistivity of adhesive face (1.2 fold after film expansion, ohms/sq)	4×10^{10}	4×10^{10}	4×10^{10}
	Surface resistivity of back face (1.2 fold after film expansion, ohms/sq)	6×10^7	6×10^7	6×10^7
	Logarithmic change rate of surface resistivity of adhesive face (%)	11	11	11
	Logarithmic change rate of surface resistivity of back face (%)	16	16	16
	Peeling electrostatic voltage (peeled from release film surface; V, 12	30	30	30

	m/min)			
	Heating shrinkage rate at 50°C (%, MD)	8	0.5	0.5
	Heating shrinkage rate at 50°C (%, TD)	5	0.3	0.3
	Stain on adhesive face	△	○	○
	Adhesive residue	△	○	○
	Film expandability (MD)	○	○	○
	Film expandability (TD)	○	○	○
	Chip arrangement regularity after film expansion (chip space: edge, center)	△	○	○
	Transfer rate (%)	95	99	99
	Sunken crystal	△	○	○
	Transmittance (%)	85	80	85
	Initial haze (%)	25	28	14
	Haze after storage (%)	9	8	5
	Haze change rate(%)	64	71	64
	Haze stability	×	×	×
	Comprehensive evaluation	×	×	×

<Evaluation of Tests>

(1) Ra and Rz of Frosted surface of Release Film

The arithmetic surface roughness Ra and the maximum height Rz of the frosted surface of the release film were determined using an optical surface roughness meter (manufactured by
5 Veeco Metrogy Group, tradename: “Wyko NT9100”) in accordance with JIS B 0601.

(2) Ra and Rz of Back-coating Layer of Adhesive Sheet

The arithmetic surface roughness Ra and the maximum height Rz of the surface of the back-coating layer of the adhesive sheet were determined using an optical surface roughness meter (manufactured by Veeco Metrogy Group, tradename: “Wyko NT9100”) in accordance
10 with JIS B 0601.

(3) Peel Force A

The adhesive sheets prepared in all of the Examples and Comparative Examples were cut into a size of 20 mm wide by 150 mm long as test pieces. An SUS plate (SUS430BA plate) cleaned with toluene was used as an adherend. Under the standard environment of 23°C and
15 50%RH, the release liner covering the adhesive face of each of the test pieces was peeled off, and the exposed adhesive face was press-bonded onto the adherend by reciprocating a 2-kg roller once. After being left under the above standard environment for 30 min, the test pieces thereby press-bonded onto the adherends were peeled off at a tensile speed of 300 mm/min and a peel angle of 180° by using a universal testing machine (manufactured by the Shimadzu

Corporation, product name: “AG-X plus electronic universal testing machine”) in accordance with JIS Z 0237, and the forces (N/20mm) required for such peeling were determined.

(4) Peel Force B

The adhesive sheets prepared in all of the Examples and Comparative Examples were cut into a size of 20 mm wide by 150 mm long as test pieces. An SUS plate (SUS430BA plate) cleaned with toluene was used as an adherend. Under the standard environment of 23°C and 50%RH, the release liner covering the adhesive face of each of the test pieces was peeled off, and after the exposed adhesive face was press-bonded onto the adherend by reciprocating a 2-kg roller once, the test pieces were left at 50°C for 24 h. After being left under the above standard environment for 30 min, the test pieces thereby press-bonded onto the adherends were peeled off at a tensile speed of 300 mm/min and a peel angle of 180° by using a universal testing machine (manufactured by the Shimadzu Corporation, product name: “AG-X plus electronic universal testing machine”) in accordance with JIS Z 0237, and the forces (N/20mm) required for such peeling were determined.

(5) Peel Force C

The steps for evaluation of test (3) described above were repeated, with the exception of peeling at a peel angle of 180° and a tensile speed of 10 m/min, and the forces (N/20mm) required for such peeling were determined.

(6) Peel Force D

The steps for evaluation of test (3) described above were repeated, with the exception of peeling at a peel angle of 20° and a tensile speed of 10 m/min, and the forces (N/20mm) required for such peeling were determined.

(7) Peel Force E

The steps for evaluation of test (4) described above were repeated, with the exception of peeling at a peel angle of 180° and a tensile speed of 10 m/min, and the forces (N/20mm) required for such peeling were determined.

(8) Peel Force F

The steps for evaluation of test (4) described above were repeated, with the exception of peeling at a peel angle of 20° and a tensile speed of 10 m/min, and the forces (N/20mm) required for such peeling were determined.

(9) 50% Modulus (MD, TD)

The adhesive sheets prepared in all of the Examples and Comparative Examples were cut into a size of 20 mm wide and 150 mm long to prepare test pieces. Subsequently, the test pieces were set at 100 mm in length and 20 mm in width, and stretched to 150 mm in the longitudinal direction or width direction at a tensile speed of 300 mm/min by using a universal testing

machine (manufactured by the Shimadzu Corporation, product name: “AG-X plus electronic universal testing machine”) under the measurement environment of 23°C and 50% relative humidity. The load (MPa) at this time served as the 50% modulus in the MD or TD direction.

(10) Tensile Strength (MD, TD)

5 The adhesive sheets prepared in all of the Examples and Comparative Examples were cut into a size of 20 mm wide and 150 mm long to prepare test pieces. Subsequently, the test pieces were set at 50 mm in length, and subjected to the tensile test at a tensile speed of 300 mm/min by using a universal testing machine (manufactured by the Shimadzu Corporation, product name: “AG-X plus electronic universal testing machine”) under the measurement environment
10 of 23°C and 50% relative humidity. The test pieces were stretched in the longitudinal or width direction until they were broken. The load (MPa) at this time served as the tensile strength in the MD or TD direction.

(11) Elongation at Break (MD, TD)

15 The adhesive sheets prepared in all of the Examples and Comparative Examples were cut into a size of 20 mm wide and 150 mm long to prepare test pieces. Subsequently, the test pieces were set at 50 mm in length, and subjected to the tensile test at a tensile speed of 300 mm/min by using a universal testing machine (manufactured by the Shimadzu Corporation, product name: “AG-X plus electronic universal testing machine”) under the measurement environment of 23°C and 50% relative humidity. The test pieces were stretched in the longitudinal or width
20 direction until they were broken. The elongation at break in the MD or TD direction was thereby measured.

(12) Surface Resistivity (before and after film expansion)

25 The resistivity of the surface of the adhesive layer and the resistivity of the back face (the back face or back-coating face of the adhesive sheet) in each of the Examples and Comparative Examples were determined by using a resistivity meter (manufactured by ACL Staticide, “ACL MODEL 800”) at an atmosphere of 23°C and 50%RH under the conditions of an applied voltage of 100V and application time of 30s.

30 After the film was expanded by stretching 1.2 folds in the 360° direction, the resistivity of the surface of the adhesive layer and the resistivity of the back face (the back face or back-coating face of the adhesive sheet) in each of the Examples and Comparative Examples were determined by using a resistivity meter (manufactured by Mitsubishi Chemical Analytech Co., Ltd., “HIRESTA-UP MCP-HT450”) at an atmosphere of 23°C and 50%RH under the conditions of an applied voltage of 100V and application time of 30s.

35 The surface resistivity of the adhesive face represented the resistivity of the surface of the adhesive layer. When measuring the surface resistivity of the adhesive face, the probe was in

contact with the surface of the adhesive layer.

The surface resistivity of the back face represented the surface resistivity of the back face of the substrate layer. When measuring the surface resistivity of the back face, the probe was in contact with the back face of the substrate layer, i.e., the surface of the substrate layer opposite to the adhesive layer.

(13) Logarithmic Change Rate of Surface Resistivity of Adhesive face

The logarithmic change rate of the surface resistivity of the adhesive face of the adhesive sheet was calculated by the following formula:

$$\text{logarithmic change rate of surface resistivity of adhesive face (\%)} = [(X2-X1) / X1] \times 100\%$$

(1)

wherein X2 represented a logarithmic value of the surface resistivity after the adhesive sheet was stretched by 1 to 1.2 folds in the 360° direction (i.e., “surface resistivity of adhesive face, 1.2 folds after film expansion” as listed in the above table), and

X1 represented a logarithmic value of the surface resistivity before the adhesive sheet was stretched (i.e., “surface resistivity of adhesive face, before film expansion” as listed in the above table).

(14) Logarithmic Change Rate of Surface Resistivity of Back Face

The logarithmic change rate of the surface resistivity of the back face of the adhesive sheet was calculated by the following formula:

$$\text{logarithmic change rate of surface resistivity of back face (\%)} = [(X4-X3) / X3] \times 100\%$$

(1)

wherein X4 represented a logarithmic value of the surface resistivity after the adhesive sheet was stretched by 1 to 1.2 folds in the 360° direction (i.e., “surface resistivity of back face, 1.2 folds after film expansion” as listed in the above table), and

X3 represented a logarithmic value of the surface resistivity before the adhesive sheet was stretched (i.e., “surface resistivity of back face, before film expansion” as listed in the above table).

(15) Peeling Electrostatic Voltage

The silicone-treated surface of the release film (PET film surface-treated with silicone, manufactured by Toray Industries, Inc., tradename: “Cerapeel”, thickness: 38 μm) subjected to static electricity removal was adhered to the adhesive face of the adhesive sheet (70 mm wide × 130 mm long) to prepare a sample for evaluation. At this time, the end portion of the release film in the longitudinal direction protruded 30 mm from the adhesive sheet. In addition, the adhesive sheet and the release film were bonded together by using a hand roller under the conditions specified by JIS Z 0237 (2000) (temperature: 23°C, humidity: 50% RH).

After the sample for evaluation was left for one day under the environment of 23°C and 50%RH, the protruding portion of the release film was grasped to peel off the release film along the longitudinal direction at a peel angle of 150° and a peeling speed of 12 mm/min. The voltage on the surface of the adhesive layer generated at the time of peeling was measured at the position 100 mm away from the location where the release film and the adhesive sheet are separated from each other in a direction perpendicular to the adhesive face, and the maximum value was taken as the peeling voltage. It should be noted that the measuring instrument was a potentiometer (manufactured by Kasuga Denki, Inc., tradename: “KSD-0103”). In addition, the measurement environment was set at 23°C and 50%RH.

(16) Heating Shrinkage Rate at 50°C (MD, TD)

After the adhesive sheet in each of the Examples and Comparative Examples was heated at 50°C for 10 min and then cooled at room temperature (23°C), the shrinkage rates in the MD and TD directions were determined.

Specifically, the adhesive sheet prepared in each of the Examples and Comparative Examples was cut into a top-view substantially square shape of 100 mm in the MD direction × 100 mm in the TD direction, and cross-patterned scratches were created at its four corners to prepare a sample for measurement. The distance (length) between the scratches (the centers of the cross patterns) in the MD direction and the distance (length) between the scratches (the centers of the cross patterns) in the TD direction of the sample for measurement before heating (25°C) were measured using a CNC three-dimensional measuring machine (manufactured by Mitutoyo Corporation, “LEGEX774”). In this way, the lengths before heating were obtained in the MD direction and the TD direction, respectively.

Next, the test piece was placed on the horizontal stand of the oven, heated at 50°C for 10 min, and then naturally cooled at room temperature (23°C) for 10 min. Thereafter, the distance between the scratches in the MD direction and the distance between the scratches in the TD direction were measured using a CNC three-dimensional measuring machine. In this way, the lengths after heating were obtained in the MD direction and the TD direction, respectively. Subsequently, the shrinkage rates in the MD and TD directions were calculated by the following formula respectively:

shrinkage rate (%) = [length before heating (mm) - length after heating (mm)] / length before heating (mm) × 100

(17) Stain on Adhesive face

The adhesive sheets prepared in all of the Examples and Comparative Examples were cut into a size of 400 mm wide by 150 mm long as test pieces. The adhesive sheet samples were adhered, so that the exposed adhesive face was press-bonded onto the bright surface of the

silicon wafer by reciprocating a 2-kg roller once. The test pieces thereby press-bonded onto the adherends were left for 3 days under the above standard environment of 23°C and 50%RH and peeled off at 300 mm/min, and then the surface of the silicon wafer was visually inspected for oily stains. If no oily stains were visually inspected, this property was regarded as “○”; and if slight oily stains were visually inspected, this property was regarded as “△”.

(18) Adhesive Residue

The adhesive sheets prepared in all of the Examples and Comparative Examples were cut into a size of 400 mm wide by 150 mm long as test pieces. The adhesive sheet samples were adhered, so that the exposed adhesive face was press-bonded onto the 125-μm PET film having a surface dyne value of greater than 38 dyn (mN/m) by reciprocating a 2-kg roller once. The test pieces thereby press-bonded onto the adherends were left for 3 days under the standard environment of 23°C and 50%RH and peeled off at 1000 mm/min, and then the surface of the 125-μm PET film was visually inspected for adhesive residues. If no adhesive residues were visually inspected, this property was regarded as “○”, and if slight adhesive residues were visually inspected, this property was regarded as “△”.

(19) Film Expandability (MD/TD)

The adhesive sheets prepared in all of the Examples and Comparative Examples were cut into a size of 200 mm wide by 200 mm long as test pieces, and the release films were peeled off. The films were expanded by stretching with film-expansion equipment WE-4U (Beautrong Precision Mechtronics Co., Ltd.) under the following test conditions: 1.2 folds in the 360° direction, rising speed: 5 mm/s; rising height: 56 mm; heating the upper plate at 50°C; heating the lower plate at 170°C. If there was no damage to the appearances after film expansion, this property was regarded as “○”.

(20) Chip Arrangement Regularity after Film Expansion

The adhesive sheets prepared in all of the Examples and Comparative Examples were cut into a size of 200 mm wide by 200 mm long as test pieces, and the release films were peeled off. The chips were arranged on the adhesive face of the adhesive sheet at the same space in the horizontal and vertical directions. The films were expanded by stretching with film-expansion equipment WE-4U (Beautrong Precision Mechtronics Co., Ltd.) under the following test conditions: 1.2 folds in the 360° direction, rising speed: 5 mm/s; rising height: 56 mm; heating the upper plate at 50°C; heating the lower plate at 170°C.

The space change rates of the chips in the horizontal and vertical directions were measured. If the ratio of the MD/TD change rates was between 0.8 and 1.2, this property was regarded as “○”, and if the ratio of the MD/TD change rates was 0.7 or greater and less than 0.8 or greater than 1.2 and 1.3 or less, this property was regarded as “△”.

(21) Transfer Rate

The chips were arranged on the adhesive face of the first adhesive sheet at the same space in the horizontal and vertical directions. Afterwards, the pasting surface of the first adhesive sheet with the chips was placed upwards and the pasting surface of the second adhesive sheet without chips was placed downwards, and they were adhered and press-bonded by reciprocating a 5-Kg roller three times under the standard environment of 23°C and 50%RH. Thereafter, the well-bonded composite adhesive sheet was reversed and bonded. The first adhesive sheet was peeled off from the top at an angle of 90° and at a speed of 600 mm/min.

Chips with the transfer rate of 85% or more were considered to be qualified.

(22) Sunken Crystal

After a 200 mm × 200 mm adhesive sheet with chips was adhered to the PET#125 protective film, a 3-kg weight was put on the chip section, and the adhesive sheet was observed under a microscope three days later. If the chips were not significantly subsided and sunken into the adhesive or the sunken depth was less than 1/3 of the chip thickness, the property was regarded as “○”; and if the chips were slightly subsided and sunken into the adhesive or the sunken depth was 1/3 or more of the chip thickness, the property was regarded as “△”.

(23) Transmittance / Haze

The adhesive sheets prepared in all of the Examples and Comparative Examples were cut into a size of 100 mm wide by 100 mm long as test pieces. Three of the test pieces were selected and laminated, and left for 24 h under the standard environment of 23°C and 50%RH. Thereafter, the middle test piece was taken out and the release film was removed to determine the initial haze and the initial transmittance.

The adhesive sheets prepared in all of the Examples and Comparative Examples were cut into a size of 100 mm wide by 100 mm long as test pieces. Three of the test pieces were selected and laminated, and left at 50°C for 72 h. Thereafter, the middle test piece was taken out, and under the standard environment of 23°C and 50%RH, the haze and transmittance after storage from the moment when the test piece was just taken out were determined after removal of the release film.

The specific methods for determining the haze and transmittance were as follows: the above test piece was adhered to the inspection hole of the equipment with its adhesive face back to the light source. Under the standard environment of 23°C and 50%RH, a WGT-S light transmittance/haze tester (manufactured by Shanghai Jingke Scientific Instrument Co., Ltd.) was used for determination by pressing “TEST”, and the value was read after 1 min.

(24) Haze Change Rate

Haze change rate = (haze before storage-haze after storage) / haze before storage × 100%

wherein the haze before storage was the initial haze as determined above, and the haze after storage was the haze over time from the immediate removal of the test piece as determined above.

5 Evaluation on haze stability: if the haze change rate was greater than 10%, the haze stability was regarded as “×”; if the haze change rate was 5% to 10%, the haze stability was regarded as “△”; and if the haze change rate was less than 5%, the haze stability was regarded as “○”.

(25) Comprehensive Evaluation

10 If the above determined values were all excellent and the evaluation results were all “○”, the adhesive sheet was regarded as “○”; if the above determined values were good or at least one of the evaluation results was “△”, the adhesive sheet was regarded as “△”; and if the above determined values were poor or at least one of the evaluation results was “×”, the adhesive sheet was regarded as “×”.

15 As shown in Tables 1 and 2 above, Examples 1 to 5 were excellent in all of the haze stability over time, film expandability (or extensibility), adhesiveness, re-peelability, antistatic properties, adhesion storage, thermal resistance, transparency, and transferability, and their adhesive sheets were easily peeled off after use without producing adhesive residue contamination. In contrast, Comparative Examples 1 to 3 could not exhibit excellent haze
20 stability over time, film expandability (or extensibility), adhesiveness, re-peelability, antistatic properties, adhesion storage, thermal resistance, transparency, and transferability at the same time.

It should be noted that, although the technical solution of the present disclosure has been introduced with specific examples, a person skilled in the art shall appreciate that the present
25 disclosure should not be limited thereto.

The foregoing has described the examples of the present disclosure. The above descriptions are merely exemplary, but not exhaustive; and the disclosed examples are not limiting. A number of variations and modifications may be obvious to a person skilled in the art without departing from the scopes and spirits of the described examples. The terms in the
30 present disclosure are selected to provide the best explanation on the principles and practical applications of the embodiments and the technical improvements to the arts on market, or to make the examples described herein understandable to a person skilled in the art.

CLAIMS

1. An adhesive sheet, comprising a substrate layer, an adhesive layer disposed on a side of the substrate layer, and a release film disposed on a side of the adhesive layer opposite to the substrate layer, wherein a side of the release film away from a bonding face of the adhesive layer is a frosted surface, the frosted surface has an arithmetic average surface roughness Ra of 0.25 μm or more, or the surface of the frosted surface has a surface roughness with a maximum height (Rz) of 1.5 μm or more,

the adhesive sheet is present in a winding form or stacked form, the frosted surface of the release film is in contact with the surface of the substrate layer away from the bonding face of the adhesive layer, the adhesive sheet has a haze of 10% to 80% measured following removal of the release film under an environment of 23°C and 50% relative humidity after being left at 50°C for 72 h.

2. The adhesive sheet according to claim 1, wherein the adhesive sheet has a peel force A of 0.3 to 2.0 N/20 mm when peeled at 23°C in the 180° direction at a tensile speed of 300 mm/min;

the adhesive sheet has a peel force B of 0.5 to 2.5 N/20 mm when peeled in the 180° direction at a tensile speed of 300 mm/min after being adhered to an adherend at 23°C and left at 50°C for 24 h; and

a difference between the peel force B and the peel force A, i.e., peel force B minus peel force A, is 0.1 to 0.8 N/20 mm.

3. The adhesive sheet according to claim 1, wherein the adhesive sheet has a peel force C of 1.0 to 5.0 N/20 mm when peeled at 23°C in the 180° direction at a tensile speed of 10 m/min;

the adhesive sheet has a peel force D of 5.0 to 9.0 N/20 mm when peeled at 23°C in the 20° direction at a tensile speed of 10 m/min; and

a difference between the peel force D and the peel force C, i.e., peel force D minus peel force C, is 4.0 to 8.0 N/20 mm.

4. The adhesive sheet according to claim 1, wherein the adhesive sheet has a peel force E of 1.5 to 5.5 N/20 mm when peeled in the 180° direction at a tensile speed of 10 m/min after being adhered to the adherend at 23°C and left at 50°C for 24 h;

the adhesive sheet has a peel force F of 5.5 to 9.5 N/20 mm when peeled at 23°C in the 20° direction at a tensile speed of 10 m/min after being adhered to the adherend at 23°C and left at 50°C for 24 h; and

a difference between the peel force F and the peel force E, i.e., peel force F minus peel

force E, is 4.5 to 8.5 N/20 mm.

5. The adhesive sheet according to any one of claims 1 to 4, wherein the adhesive layer comprises a base polymer and a functional resin;

the content of the functional resin is from 10 to 40 parts by mass based on 100 parts by mass of the base polymer; and

the functional resin is at least one selected from the group consisting of an epoxy resin, a phenol resin, a vinyl resin, and a rosin resin.

6. The adhesive sheet according to claim 5, wherein the adhesive layer further comprises at least one selected from the group consisting of a plasticizer, a crosslinking agent, an antistatic agent, and a peeling auxiliary agent.

7. The adhesive sheet according to claim 6, wherein the plasticizer comprises at least one selected from the group consisting of dioctyl phthalate, dioctyl terephthalate, and diisononyl phthalate;

the content of the plasticizer is from 20 to 90 parts by mass with respect to 100 parts by mass of the base polymer.

8. The adhesive sheet according to claim 6, wherein the content of the crosslinking agent is from 0.01 to 15 parts by mass with respect to 100 parts by mass of the base polymer;

the crosslinking agent comprises an epoxy-based crosslinking agent and/or an isocyanate-based crosslinking agent;

the content of the epoxy-based crosslinking agent is from 0.01 to 5 parts by mass with respect to 100 parts by mass of the base polymer; and

the content of the isocyanate-based crosslinking agent is from 0.1 to 10 parts by mass with respect to 100 parts by mass of the base polymer.

9. The adhesive sheet according to claim 6, wherein the content of the antistatic agent is from 0.1 to 15 parts by mass with respect to 100 parts by mass of the base polymer;

the antistatic agent comprises at least one selected from the group consisting of a conductive polymer, a conductive inorganic particle, a metallic particle or fiber, an ionic compound, and an ionic surfactant.

10. The adhesive sheet according to claim 6, wherein the peeling auxiliary agent comprises an ionic surfactant and/or a nonionic surfactant;

the content of the peeling auxiliary agent is from 0.1 to 5 parts by mass with respect to 100 parts by mass of the base polymer.

11. The adhesive sheet according to any one of claims 1 to 10, wherein the adhesive sheet satisfies at least one of the following characteristics (a) to (p):

(a) in a peel test at a peeling speed of 12 m/min, a peeling electrostatic voltage generated

by peeling the adhesive sheet off from the release film is 500V or less;

(b) the adhesive sheet has a surface resistivity of 1.0×10^4 to 1.0×10^{11} ohms/sq;

(c) after the adhesive sheet is stretched 1 to 1.2 folds in the 360° direction, the substrate layer has a surface resistivity of 1.0×10^5 to 1.0×10^8 ohms/sq, and the adhesive layer of the adhesive sheet has a surface resistivity of 1.0×10^{11} ohms/sq or less;

(d) a logarithmic change rate of the surface resistivity of the adhesive sheet as calculated by the following formula (1) is 100% or less:

$$\text{logarithmic change rate of surface resistivity (\%)} = [(X2-X1)/X1] \times 100\% \quad (1)$$

wherein X2 represents a logarithmic value of the surface resistivity of the adhesive sheet after stretched 1 to 1.2 folds in the 360° direction, and X1 represents a logarithmic value of the surface resistivity of the adhesive sheet before stretching;

(e) the adhesive sheet has a tensile strength of 15 to 60 MPa in the longitudinal direction (MD direction);

(f) the adhesive sheet has a tensile strength of 10 to 50 MPa in the width direction (TD direction);

(g) a ratio of the tensile strength in the longitudinal direction (MD direction) to the tensile strength in the width direction (TD direction) of the adhesive sheet is 1.0 to 1.5;

(h) the adhesive sheet has a 50% modulus of 15 to 50 MPa in the longitudinal direction (MD direction);

(i) the adhesive sheet has a 50% modulus of 10 to 45 MPa in the width direction (TD direction);

(j) the adhesive sheet has an elongation at break of 100% to 300% in the longitudinal direction (MD direction);

(k) the adhesive sheet has an elongation at break of 80% to 270% in the width direction (TD direction);

(l) a ratio of the elongation at break in the longitudinal direction (MD direction) to the elongation at break in the width direction (TD direction) of the adhesive sheet is 1.0 to 1.5;

(m) the adhesive sheet has a heating shrinkage rate at 50°C of 1.0% to 8% in the longitudinal direction (MD direction);

(n) the adhesive sheet has a heating shrinkage rate at 50°C of -6.0% to 3.0% in the width direction (TD direction);

(o) the adhesive sheet has a transmittance of 50% to 90% after the release film is removed; and

(p) the adhesive sheet has a haze of 15% to 55% measured following removal of the release film under an environment of 23°C and 50% relative humidity after being left at 50°C

for 72 h.

12. The adhesive sheet according to any one of claims 1 to 11, wherein the substrate layer comprises a polyvinyl chloride resin and at least one selected from the group consisting of a plasticizer, a stabilizer, and a haze regulator;

5 the content of the plasticizer is from 10 to 60 parts by mass with respect to 100 parts by mass of the polyvinyl chloride resin;

 the plasticizer comprises at least one selected from the group consisting of dioctyl phthalate, dioctyl terephthalate, and diisononyl phthalate;

10 the content of the stabilizer is from 0.1 to 5.0 parts by mass with respect to 100 parts by mass of the polyvinyl chloride resin; and

 the content of the haze regulator is from 0.1 to 10 parts by mass with respect to 100 parts by mass of the polyvinyl chloride resin.

13. The adhesive sheet according to any one of claims 1 to 12, wherein the substrate layer has an arithmetic average surface roughness Ra of 1 to 6 μm at 23°C, or the surface of the substrate layer has a surface roughness with a maximum height (Rz) of 6 to 12 μm at 23°C.

14. The adhesive sheet according to any one of claims 1 to 13, wherein the adhesive sheet further comprises an primer layer and/or a back-coating layer,

 the back-coating layer is disposed on a side of the substrate layer opposite to the adhesive layer, and

20 the primer layer is disposed on a side of the substrate layer opposite to the back-coating layer.

15. The adhesive sheet according to claim 14, wherein the back-coating layer has an arithmetic average surface roughness Ra of 0.1 to 5.0 μm at 23°C, or the surface of the back-coating layer has a surface roughness with a maximum height (Rz) of 1 to 10 μm at 23°C; and

25 the back-coating layer has an arithmetic average surface roughness Ra of 0.1 to 4.0 μm at 50°C, or the surface of the back-coating layer has a surface roughness with a maximum height (Rz) of 2.0 to 8.0 μm at 50°C.

16. The adhesive sheet according to any one of claims 1 to 15, wherein the substrate layer has a thickness of 5 to 300 μm; and the adhesive layer has a thickness of 1 to 40 μm.

17. The adhesive sheet according to any one of claims 1 to 16, wherein a haze change rate of the adhesive sheet as calculated by the following formula (2) is 10% or less:

 haze change rate = (haze before storage - haze after storage)/haze before storage × 100%
(2)

35 wherein the haze before storage is a haze of the adhesive sheet measured after being left

for 24 h under an standard environment of 23°C and 50% relative humidity and removing the release film; and

the haze after storage is a haze of the adhesive sheet measured following removal of the release film under an environment of 23°C and 50% relative humidity after being left at 50°C
5 for 72 h.

18. A winding body, wherein the winding body comprises the adhesive sheet according to any one of claims 1 to 17 in a winding form.

19. A stacked body, wherein the stacked body comprises two or more adhesive sheets according to any one of claims 1 to 17 in a stacked form.

10