



(51) International Patent Classification:

C08F 220/10 (2006.01) C09J 11/06 (2006.01)
 C08F 220/26 (2006.01) C09J 4/00 (2006.01)
 C08F 220/30 (2006.01) C09J 4/06 (2006.01)
 C08F 220/18 (2006.01) C09J 7/38 (2018.01)
 C09J 133/14 (2006.01) G02F 1/00 (2006.01)
 G06F 3/041 (2006.01)

(21) International Application Number:

PCT/IB2019/056338

(22) International Filing Date:

24 July 2019 (24.07.2019)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

10-2018-0088021 27 July 2018 (27.07.2018) KR

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))
- in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE

(54) Title: ADHESIVE COMPOSITION, ADHESIVE FILM, LAMINATE AND PREPARATION METHOD THEREOF

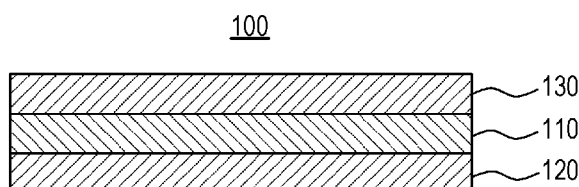


Fig. 4

(57) Abstract: An adhesive film according to the present invention can be initially attached to a substrate with a low adhesive force to easily remove an unnecessary portion, and thereafter, the adhesive film may be strongly attached to the substrate by easily increasing the adhesive force of the remaining portion of the film. Particularly, the adhesive film of the present invention has a sufficiently low initial adhesive force, but has a sufficiently high final adhesive force, so that variability in the adhesive force is very excellent. Therefore, the adhesive film of the present invention and the adhesive composition for preparing the same may be usefully applied to a process requiring the variability in the adhesive force, such as manufacturing of an OLED display panel.

ADHESIVE COMPOSITION, ADHESIVE FILM, LAMINATE AND PREPARATION METHOD THEREOF

Technical Field

5 The present invention relates to an adhesive composition, an adhesive film, a laminate, and a preparation method thereof. More particularly, the present invention relates to an adhesive film having variability in adhesive force, a preparation method thereof, a composition for preparing the same, and a laminate and apparatus including the same.

Background Art

10 A substrate used in a display panel and the like generally requires a tape for protecting a surface from being damaged by external impact or bonding with other components. For example, in an organic light emitting diode (OLED) panel, a tape for bonding components with a polyimide substrate is used.

15 Meanwhile, on the display panel, there is a region where the absence of the tape is preferred for functional reasons, and for example, it is preferred that there are no tapes in regions connected with other terminals. Particularly, in a process of manufacturing a bending display panel which has recently attracted attention, since a tape should not be present in a region where the panel is bent, a precise taping process is required (see US Patent
20 Publication No. 2011-0210937).

 In such a process, initially, the tape can be attached to the substrate with a low adhesive force to easily remove an unnecessary portion, and thereafter, a tape having variability in adhesive force which may be strongly attached to the substrate is required by

increasing easily the adhesive force of the remaining portion of the tape.

Patent Document

(Patent Document 1) US Patent Publication No. 2011-0210937

Technical Problem

5 Currently, adhesive films have been developed to implement variability of the adhesive force by mixing various additives with an adhesive, but these films in the related art have problem in that the compatibility between the adhesive and the additives is not good, the initial adhesive force is not sufficiently low, or the final adhesive force is not sufficiently high.

 Therefore, an object of the present invention is to provide an adhesive film having
10 variability in adhesive force capable of exhibiting high performance by solving the problems in the related art, a preparation method thereof, a composition for preparing the same, and a laminate and an apparatus including the same.

Technical Solution

 According to an aspect of the present invention, there is provided an adhesive
15 composition including a base polymer; a crosslinking agent reacting with the base polymer; a first monomer polymerized after the reaction of the base polymer and the crosslinking agent; and an initiator polymerizing the first monomer. The adhesive composition has a first adhesive force before the polymerization of the first monomer and a second adhesive force after the polymerization of the first monomer after the reaction of the base polymer and the
20 crosslinking agent, and the second adhesive force is higher than the first adhesive force.

 According to another aspect of the present invention, there is provided an adhesive film including a reaction product of a base polymer and a crosslinking agent, in which the adhesive film contains a first monomer and an initiator, the first monomer is polymerizable by

the initiator, the adhesive film has a first adhesive force before the polymerization of the first monomer and a second adhesive force after the polymerization of the first monomer, and the second adhesive force is higher than the first adhesive force.

According to yet another aspect of the present invention, there is provided a laminate
5 including a substrate and the adhesive film.

According to still another aspect of the present invention, there is provided an apparatus including the laminate.

According to still yet another aspect of the present invention, there is provided a display device including a display panel; and a laminate attached onto the display panel.

10

Advantageous Effects

According to the present invention, the adhesive film can be initially attached to the substrate with a low adhesive force to be repositioned, an unnecessary portion may be easily removed, and then, the film may be strongly attached to the substrate by easily increasing the adhesive force of the remaining portion of the film.

15

Particularly, the adhesive film of the present invention is excellent in compatibility between components and much excellent in variability of the adhesive force because a final adhesive force is sufficiently high, while the initial adhesive force is sufficiently low.

20

Therefore, the adhesive film of the present invention and the adhesive composition for preparing the same may be usefully applied to a process requiring the variability in the adhesive force, such as manufacturing of a display panel such as an OLED.

Description of Drawings

FIG 1 is a graph illustrating a change in adhesive force according to polymerization of a first monomer of an adhesive composition according to an embodiment.

FIG 2 is a graph illustrating a change in adhesive force according to addition of a second monomer of an adhesive composition according to an embodiment.

FIG 3 is a graph illustrating a change in storage modulus when crosslinking a base polymer of an adhesive composition according to an embodiment.

5 FIG 4 illustrates a cross-sectional view of an adhesive tape including an adhesive film according to an embodiment.

FIG 5 illustrates an example of a preparation method of a laminate according to an embodiment.

10 FIGS. 6A and 6B illustrate adhesive forces before and after UV curing with respect to adhesive compositions 3A to 3F prepared in Example 3, respectively.

Detailed Description of the Invention

Advantages and features of the present invention, and methods for accomplishing the same will be more clearly understood from embodiments described in detail below with reference to the accompanying drawings. However, the present invention is not limited to
15 embodiments disclosed below, but may be embodied in various different forms. That is, the embodiments are provided to make the disclosure of the present invention be complete and completely announce the scope of the present invention to those skilled in the art to which the present invention belongs and the present invention is just defined by the scope of the claims.

20 The shapes, sizes, ratios, angles, numbers, and the like illustrated in the drawings for describing the present invention are merely examples, and the present invention is not limited thereto. Throughout the specification, the same reference numerals denote the same components. Further, in describing the present invention, when it is determined that a detailed explanation of known related technologies may unnecessarily obscure the subject

matter of the present invention, the detailed description thereof will be omitted.

The terms such as “including,” “having,” and “comprising” used in this specification are generally intended to allow components other than the details described to be added unless the terms are used with “only”. When a component is expressed as singular form, any
5 references to the singular form may include plural form unless expressly stated otherwise.

Components are interpreted to include an ordinary error range even if not expressly stated.

When the position relation between two parts is described using the terms such as “on”, “above”, “below”, and “next”, one or more other parts may be positioned between the
10 two parts unless the terms are used with the term “immediately” or “directly”.

Respective features of embodiments of the present invention can be partially or entirely connected or combined with each other, and can be technically interlocked or driven variously.

Hereinafter, embodiments of the present invention will be described in detail with
15 reference to drawings. The following embodiments are provided as examples so that the spirit of the present invention can be fully transferred to those skilled in the art. Therefore, the present invention is not limited to embodiments to be described below and may also be embodied in different forms.

Adhesive composition

20 According to an aspect of the present invention, there is provided an adhesive composition including a base polymer, a crosslinking agent, a first monomer, and an initiator.

The base polymer may react with the crosslinking agent before the first monomer is polymerized by the initiator. For example, the base polymer can react with the crosslinking

agent while the first monomer and the initiator are preserved. The adhesive force of the adhesive composition after the reaction may be further improved after polymerization of the first monomer.

An adhesive composition according to one embodiment may include a base polymer; a crosslinking agent reacting with the base polymer; a first monomer polymerized after the reaction of the base polymer and the crosslinking agent; and an initiator polymerizing the first monomer. The adhesive composition has a first adhesive force before the polymerization of the first monomer and a second adhesive force after the polymerization of the first monomer, after the reaction of the base polymer and the crosslinking agent, and the second adhesive force is higher than the first adhesive force.

The first monomer may be polymerized by a photoinitiator or a thermal initiator. Specifically, when the photoinitiator is included in the adhesive composition, the first monomer may be polymerized by the photoinitiator after UV irradiation, and when the thermal initiator is included in the adhesive composition, the first monomer may be polymerized by the thermal initiator after heating.

Characteristics of Adhesive Composition

Hereinafter, the characteristics of the adhesive composition will be described with reference to the drawings.

The adhesive composition according to the embodiment includes a first monomer and has a structure different from that before polymerization at the time of the polymerization of the first monomer.

FIG 1 is a graph illustrating a change in adhesive force according to polymerization of the first monomer of the adhesive composition according to one embodiment.

As illustrated in FIG 1, the adhesive composition has a low adhesive force (e.g., 30 gf/in or less) when the first monomer is added and thereafter, the adhesive force is rapidly increased while the first monomer is polymerized (e.g., 1 kgf/in or more).

Accordingly, the adhesive composition has a first adhesive force before the polymerization of the first monomer and the base polymer and a second adhesive force after the polymerization of the first monomer, and the second adhesive force is higher than the first adhesive force.

Further, the adhesive composition may additionally include a second monomer different from the first monomer, and the complexity of the base polymer chain is increased due to the action of the second monomer, so that the adhesive force of the adhesive composition may be further improved.

FIG 2 is a graph illustrating a change in adhesive force according to addition of the second monomer in the adhesive composition according to an embodiment.

As illustrated in FIG 2, as compared to a case of adding only the first monomer, in the case of adding the second monomer together, the adhesive force after the monomer polymerization is further increased.

Meanwhile, before the monomer polymerization, as compared to the case of adding only the first monomer, in the case of adding the second monomer together, the adhesive composition has a lower adhesive force, so that the adhesive force may be improved more rapidly by the second monomer.

Adhesive force at the time of crosslinking of base polymer

In the adhesive composition, the base polymer reacts (that is, is crosslinked) with the crosslinking agent to form a film and the like, and the film formed above has characteristics

different from the related art in terms of physical properties such as an adhesive force.

Accordingly, hereinafter, the characteristics of the adhesive composition while the first monomer and the initiator are preserved after the crosslinking agent reacts with the base polymer will be mainly described.

5 The adhesive composition has a first adhesive force before polymerization of the first monomer (i.e., while the first monomer and the initiator are preserved).

The first adhesive force may be 200 gf/in or less, 150 gf/in or less, 100 gf/in or less, 50 gf/in or less, or 30 gf/in or less.

Specifically, the first adhesive force may be in a range of 1 gf/in to 200 gf/in, 1 gf/in to
10 100 gf/in, or 1 gf/in to 30 gf/in.

In this specification, the adhesive forces (the first adhesive force, the second adhesive force, etc.) may be measured by ASTM D3330 which is a general measuring method in the art, and for example, the adhesive force may be an adhesive force measured for polyimide. A more detailed example of the measuring method has been specifically described in the
15 following embodiment.

Further, the adhesive composition has a second adhesive force after the polymerization of the first monomer.

The second adhesive force may be 350 gf/in or more, 400 gf/in or more, 500 gf/in or more, or 1,000 gf/in or more.

20 Specifically, the second adhesive force may be in a range of 350 gf/in to 3,000 gf/in, or 500 gf/in to 2,000 gf/in.

As an example, the first adhesive force may be 200 gf/in or less and the second adhesive force may be 350 gf/in or more.

As another example, the first adhesive force may be 150 gf/in or less and the second adhesive force may be 400 gf/in or more.

As yet another example, the first adhesive force may be in a range of 1 gf/in to 30 gf/in, and the second adhesive force may be in a range of 500 gf/in to 2,000 gf/in.

5 In the adhesive composition, the second adhesive force is higher than the first adhesive force.

For example, the second adhesive force may be higher than the first adhesive force as 150 gf/in or more, 200 gf/in or more, 500 gf/in or more, or 1,000 gf/in or more.

10 Further, a ratio of the second adhesive force to the first adhesive force may be 20 or more, 30 or more, 50 or more, 70 or more, or 100 or more.

In addition, the ratio of the first adhesive force to the second adhesive force may be 0.06 or less, 0.03 or less, 0.02 or less, or 0.01 or less.

Further, the base polymer may have an adhesive force between the first adhesive force and the second adhesive force.

15 When the adhesive composition further includes the second monomer, the second adhesive force may be further improved.

That is, as compared to the case of adding only the first monomer, in the case of adding the second monomer together, the second adhesive force is further increased.

20 On the other hand, before the monomer polymerization, as compared to the case of adding only the first monomer, in the case of adding the second monomer together, the first adhesive force may be further decreased.

Accordingly, a difference between the first adhesive force and the second adhesive force may be further increased by the second monomer.

That is, the first adhesive force and the second adhesive force may be adjusted by adjusting the addition amounts of the first monomer and the second monomer.

Characteristics at the time of crosslinking of base polymer

FIG. 3 illustrates a change in storage modulus at the time of crosslinking of the base polymer in the adhesive composition according to the embodiment. At this time, for comparison, a change in storage modulus of a general acrylic adhesive was shown together.

As illustrated in FIG. 3, as the crosslinking of the base polymer is performed by increasing the temperature, the storage modulus is decreased, and even in a high-temperature region of 100 °C or more, the storage modulus of 10^6 dyne/cm² or more is maintained, so that the adhesive composition according to the embodiment may be advantageous for a high temperature process such as a chip on plastic (COP) bonding process.

Meanwhile, in the case of the general acrylic adhesive, as the crosslinking is performed by increasing the temperature, the storage modulus is very lowered, and even in a high-temperature region of 100 °C or more, the storage modulus of 10^5 dyne/cm² to 10^6 dyne/cm² is shown. In this case, the initial adhesion of the adhesive is improved, but high-temperature durability is deteriorated and the flowability of the adhesive is increased, so that the general acrylic adhesive may not be suitable for the process of passing through the high temperature region.

The adhesive composition may satisfy the requirement as an optically transparent adhesive after the polymerization of the first monomer.

For example, the adhesive composition may have a haze after polymerization of the first monomer of 5% or less, 2% or less, or 1% or less.

In addition, the adhesive composition may have a light transmittance after

polymerization of the first monomer of 80% or more, 90% or more, or 95% or more.

The adhesive composition may satisfy the requirement as an optically transparent adhesive even after the second monomer is additionally included and polymerized.

For example, when the adhesive composition includes the first monomer and the
5 second monomer, the haze after polymerization may be 5% or less or 2% or less.

When the adhesive composition includes the first monomer and the second monomer, the light transmittance after polymerization may be 80% or more or 90% or more.

Components of adhesive composition

The adhesive composition according to the embodiment includes a base polymer, a
10 crosslinking agent, a first monomer, and an initiator.

In addition, the adhesive composition according to the embodiment may further include a second monomer different from the first monomer.

In addition, the adhesive composition according to the embodiment may further include a solvent and other additives.

15 Hereinafter, each component of the adhesive composition will be described in detail.

Base Polymer

The adhesive composition according to the embodiment includes a base polymer.

The base polymer exhibits an adhesive property as a main component of the adhesive composition. In addition, the base polymer reacts (that is, is crosslinked) with the
20 crosslinking agent to form a film and the like.

The base polymer may be included in a range of 35 wt% to 95 wt% based on the weight of the adhesive composition. Specifically, the base polymer may be included in a range of 40 wt% to 90 wt%, 45 wt% to 85 wt%, or 50 wt% to 80 wt% based on the weight of

the adhesive composition. At this time, the content of the base polymer and the weight of the adhesive composition may be based on the solid content.

The base polymer may contain a functional group reactive with the crosslinking agent. For example, the base polymer may have at least one functional group selected from the group consisting of a carboxyl group, a hydroxyl group, an acryl group, a methacryl group, an acetate group, and a vinyl group.

As an example, the base polymer may be an acrylic resin.

Specifically, the base polymer may be an acrylic copolymer resin.

For example, the acrylic copolymer resin may be a resin copolymerized with at least two monomers selected from the group consisting of 2-ethylhexyl acrylate (2-EHA), butyl acrylate (BA), methyl acrylate (MA), vinyl acetate (VAc), acrylic acid (AA), and 2-hydroxyethyl acrylate (2-HEA).

As a specific example, the combination of at least two monomers constituting the acrylic copolymer resin may include 2-EHA/MA, BA/MA, AA/2-HEA, MA/2-HEA, BA/2-HEA, MA/AA/2-HEA, and the like.

The base polymer may be a thermocurable resin or a photocurable resin.

For example, the base polymer may be a thermocurable resin.

In addition, the base polymer may be a pressure sensitive adhesive (PSA) resin.

The weight average molecular weight (Mw) of the base polymer may be 10,000 to 2,000,000. Alternatively, the weight average molecular weight of the base polymer may be 100,000 to 2,000,000.

First Monomer

The adhesive composition according to the embodiment includes a first monomer.

The first monomer is to be polymerized after the reaction of the base polymer and the crosslinking agent. That is, the first monomer may exist in an unpolymerized state even after the reaction of the base polymer and the crosslinking agent.

5 The first monomer in the unpolymerized state may lower the adhesive force of the reaction product of the base polymer and the crosslinking agent. However, after the reaction of the base polymer and the crosslinking agent, the first monomer is polymerized as necessary, so that the adhesive force of the reaction product may be rapidly improved.

10 The content of the first monomer in the composition may be 10 parts by weight to 120 parts by weight based on 100 parts by weight of the base polymer. Specifically, the content of the first monomer in the composition may be 20 parts by weight to 110 parts by weight, 30 parts by weight to 100 parts by weight, or 40 parts by weight to 90 parts by weight based on 100 parts by weight of the base polymer. At this time, the contents of the base polymer and the first monomer may be based on the solid content.

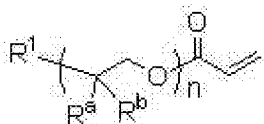
15 The molecular weight of the first monomer may be in a range of 50 to 2,000, or 100 to 1,000.

As an example, the first monomer may be monofunctional or bifunctional or more compounds, for example, monofunctional to trifunctional compounds. The first monomer may have at least one functional group selected from the group consisting of an acryl group, a methacryl group, an ethyleneoxy group, a vinyl group, and a carboxyl group.

20 The first monomer may have compatibility with the base polymer. In addition, the first monomer may be polymerized by a photoinitiator or a thermal initiator.

As an example, the first monomer may be at least one compound represented by the following Chemical Formula 1.

[Chemical Formula 1]



In Chemical Formula 1, n is an integer of 1 to 5;

R¹ is linear C₁₋₁₂ alkyl, or C₆₋₁₀ aryloxy substituted or unsubstituted with phenyl; and

5 R^a and R^b are each independently hydrogen or acryloyloxymethyl.

According to an embodiment of Chemical Formula 1, n is an integer of 1 to 3.

According to another embodiment of Chemical Formula 1, n is an integer of 3 to 5.

According to yet another embodiment of Chemical Formula 1, R¹ is linear C₁₋₃ alkyl.

According to still another embodiment of Chemical Formula 1, R¹ is linear C₆₋₁₂ alkyl.

10 According to still yet another embodiment of Chemical Formula 1, R¹ is phenyloxy.

According to still yet another embodiment of Chemical Formula 1, R¹ is phenyloxy substituted with phenyl.

According to still yet another embodiment of Chemical Formula 1, R^a and R^b are hydrogen, respectively.

15 According to still yet another embodiment of Chemical Formula 1, R^a is hydrogen and R^b is acryloyloxymethyl.

According to still yet another embodiment of Chemical Formula 1, R^a and R^b are acryloyloxymethyl, respectively.

20 According to still yet another embodiment of Chemical Formula 1, R¹ is linear C₁₋₃ alkyl; and R^a and R^b are acryloyloxymethyl, respectively.

According to still yet another embodiment of Chemical Formula 1, R¹ is linear C₆₋₁₂ alkyl; and R^a and R^b are hydrogen, respectively.

According to still yet another embodiment of Chemical Formula 1, R¹ is phenyloxy; and R^a and R^b are hydrogen, respectively.

According to still yet another embodiment of Chemical Formula 1, R¹ is phenyloxy substituted with phenyl; and R^a and R^b are hydrogen, respectively.

5 As a more detailed example of Chemical Formula 1 above, trimethylolpropane triacrylate (TMPTA), lauryl acrylate, phenyl (EO)₂ acrylate, o-phenylphenol EO acrylate, and the like may be included.

Initiator

The adhesive composition according to the embodiment includes an initiator.

10 The initiator is to polymerize the first monomer.

The initiator may be a photoinitiator or a thermal initiator.

The content of the initiator in the composition may be 0.1 part by weight to 10 parts by weight based on 100 parts by weight of the base polymer. Specifically, the content of the initiator in the composition may be 0.1 part by weight to 5 parts by weight based on 100 parts
15 by weight of the base polymer. At this time, the contents of the initiator and the base polymer may be based on the solid content.

As the initiator, a general photoinitiator may be used, and for example, as the photoinitiator, at least one selected from the group consisting of ketones (benzophenone, acetophenone, etc.), benzoin, benzoin ethers, benzyls, and benzyl ketals may be used.

20 As an example, the photoinitiator may be benzoin ethers (e.g., benzoin methyl ether or benzoin isopropyl ether) or substituted benzoin ethers.

As another example, the photoinitiator may be substituted acetophenone, for example, 2,2-diethoxyacetophenone or 2,2-dimethoxy-2-phenylacetophenone.

As yet another example, the photoinitiator may be substituted alpha-ketones (e.g., 2-methyl-2-hydroxypropiophenone), aromatic sulfonyl chlorides (e.g., 2-naphthalenesulfonyl chloride), or photoactive oximes (e.g., 1-phenyl-1,2-propanedione-2-(0-ethoxycarbonyl) oxime).

5 As still another example, the photoinitiator may be 1-hydroxycyclohexyl phenyl ketone, bis (2,4,6-trimethylbenzoyl) phenylphosphine oxide, 1-[4-(2-hydroxyethoxy)phenyl]-2-hydroxy-2-methyl-1-propane-1-one, 2-benzyl-2-dimethylamino-1-4-morpholinophenyl)butanone, 2-methyl-1-[4-(methylthio) phenyl]-2-morpholinopropane-1-one, 2-hydroxy-2-methyl-1-phenylpropan-1-one, and the like.

10 Examples of commercially available photoinitiators may include Ciba IRGACURE series from Ciba Specialty Chemicals Co., Ltd., Esacure KIP series from IGM Resins Co., Ltd., and the like.

As the thermal initiator, according to a polymerization method to be used, a water-soluble or water-insoluble (i.e., oil-soluble) thermal initiator may be selectively used.

15 As the water-soluble initiator, persulfates such as potassium persulfate, ammonium persulfate, sodium persulfate, and mixtures thereof; oxidation-reduction initiators such as a reaction product of a reducing agent such as metabisulfite (e.g., sodium metabisulfite) or bisulfate (e.g., sodium bisulfate) and persulfate; or 4,4'-azobis (4-cyanopentanoic acid) and its soluble salts (e.g., sodium salt, potassium salt), or the like may be used.

20 As the oil-soluble initiator, azos such as 2,2'-azobis (2-methylbutanenitrile), 2,2'-azobis (isobutyronitrile), and 2,2'-azobis (2,4-dimethylpentanenitrile); or peroxides such as benzoyl peroxide, cyclohexane peroxide, and lauroyl peroxide may be used.

Crosslinking agent

The adhesive composition according to the embodiment includes a crosslinking agent.

The crosslinking agent reacts with the base polymer to form a film and the like.

The content of the crosslinking agent in the composition may be 0.1 part by weight to 20 parts by weight based on 100 parts by weight of the base polymer. Specifically, the content of the crosslinking agent in the composition may be 0.1 part by weight to 10 parts by weight or 0.1 part by weight to 5 parts by weight based on 100 parts by weight of the base polymer. At this time, the contents of the crosslinking agent and the base polymer may be based on the solid content.

The crosslinking agent may contain a functional group which is reactive with the functional group of the base polymer.

For example, the crosslinking agent may have one or at least two functional groups selected from the group consisting of an epoxy group, an isocyanate group, a carboxyl group, a hydroxyl group, an acryl group, a methacryl group, an acetate group, and a vinyl group.

As a specific example, the crosslinking agent may have an epoxy group or an isocyanate group.

The crosslinking agent may be a photo-crosslinking agent, a thermal crosslinking agent, or a combination thereof.

As the photo-crosslinking agent, a general multifunctional acrylic compound can be used.

For example, the photo-crosslinking agent may be at least one selected from the group consisting of diacrylate and triacrylate. Specific examples of the photo-crosslinking agent may include 1,4-butanediol diacrylate, 1,6-hexanediol diacrylate (HDDA), 1,9-nonanediol

diacrylate, tripropylene glycol diacrylate, tetraethylene glycol diacrylate, trimethylolpropane triacrylate, and pentaerythritol triacrylate.

The thermal crosslinking agent may be isocyanate-based, epoxy-based, or metal chelate-based compounds.

5 The isocyanate-based compound may be a multifunctional aromatic or aliphatic isocyanate compound. For example, the isocyanate-based compound may be trimerized isocyanate such as a toluene diisocyanate-trimethylol propane (TDI-TMP) adduct.

The epoxy-based compound may have one or at least two epoxy groups, and may have a functional group reactive with the base polymer.

10 The metal chelate-based compound may be a chelate-based compound having a metal such as Zn, Ni, Mn, Fe, Co, Cr, Al, Ti or Zr.

An example of a commercially available thermal crosslinking agent may include Saivinol hardener series from Saiden Chemical Industry Co., Ltd.

Second Monomer

15 The adhesive composition according to the embodiment may further include a second monomer different from the first monomer.

The second monomer may form an additional bond when the base polymer reacts with the crosslinking agent. As such, when the base polymer reacts with the crosslinking agent, the second monomer reacts together to increase the curing density, thereby helping to reduce
20 the first adhesive force.

The content of the second monomer in the composition may be 10 parts by weight to 120 parts by weight based on 100 parts by weight of the base polymer. Specifically, the content of the second monomer in the composition may be 20 parts by weight to 110 parts by

weight, 30 parts by weight to 100 parts by weight, or 40 parts by weight to 90 parts by weight based on 100 parts by weight of the base polymer.

At this time, the contents of the base polymer and the second monomer may be based on the solid content.

5 The total content of the first monomer and the second monomer in the composition may be 60 parts by weight or more based on 100 parts by weight of the base polymer. Specifically, the total content of the first monomer and the second monomer in the composition may be 60 parts by weight to 200 parts by weight, or 60 parts by weight to 150 parts by weight based on 100 parts by weight of the base polymer.

10 At this time, the contents of the base polymer, the first monomer, and the second monomer may be based on the solid content.

When the base polymer reacts with the crosslinking agent, the second monomer may react together to increase the curing density.

Specifically, the second monomer may lower the adhesive force of the reaction
15 product of the base polymer and the crosslinking agent, before the polymerization.

Particularly, as compared with the case where only the first monomer exists, in the case where both the first monomer and the second monomer exist, the adhesive force of the reaction product of the base polymer and the crosslinking agent is lower before the polymerization of the first monomer, but higher after the polymerization, thereby exhibiting a
20 rapid increase in the adhesive force.

The molecular weight of the second monomer may be in a range of 50 to 1000, or 100 to 500.

The second monomer may be monofunctional or bifunctional or more compounds, for

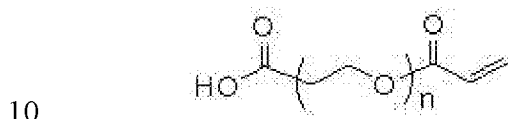
example, monofunctional to trifunctional compounds.

In addition, the second monomer may have at least one functional group selected from the group consisting of a carboxyl group, a hydroxyl group, an acryl group, a methacryl group, an acetate group, and a vinyl group.

5 As a specific example, the second monomer may have each functional group at each of both ends.

As an example, the second monomer may be at least one compound represented by the following Chemical Formula 2.

[Chemical Formula 2]



In Chemical Formula 2, n is an integer of 1 to 5.

Specifically, the second monomer may be 2-carboxyethyl acrylate, 2-carboxy (EO) ethyl acrylate, 2-carboxy (EO)₂ ethyl acrylate, 2-carboxy (EO)₃ ethyl acrylate, or carboxy (EO)₄ ethyl acrylate.

15 Solvent

The adhesive composition according to the embodiment may further include a solvent.

The solvent may serve to adjust the viscosity of the adhesive composition.

The type of the solvent is not particularly limited, and may be, for example, at least one selected from the group consisting of toluene, a mixture of hexane/methyl ethyl ketone, 20 xylene, and isopropyl acetate.

The mixing amount of the solvent is not particularly limited, but for example, the solid content of the adhesive composition may be mixed to be in a range of 40 wt% to 90 wt%, or

50 wt% to 80 wt%.

Additives

The adhesive composition according to the embodiment may further include other additives as necessary.

5 Specific examples of the additives include tackifiers (e.g., rosin ester, terpene, phenol, and aliphatic synthetic hydrocarbon resin, aromatic synthetic hydrocarbon resin, or a mixture of aliphatic synthetic hydrocarbon resin and aromatic synthetic hydrocarbon resin), surfactants, plasticizers (other than a physical foaming agent), nucleating agents (e.g., talc, silica, or TiO₂), fillers (e. g., inorganic fillers and organic fillers), fiber, aging inhibitors, 10 antioxidants, UV-absorbers, antistatic agents, lubricants, pigments, dyes, reinforcing agents, hydrophobic or hydrophilic silica, calcium carbonate, toughening agents, flame retardants, finely grinded polymeric particles (e.g., polyester, nylon, or polypropylene), stabilizers (e.g., UV stabilizer), and combinations thereof.

 The content of the additives is not particularly limited as an appropriate amount to 15 obtain desired properties of the composition, but may be, for example, 0.1 wt% to 10 wt% or 0.1 wt% to 5 w% based on the weight of the adhesive composition.

Specific Composition Example

The adhesive composition according to the embodiment may be configured so that various components exemplified above have specific contents.

20 According to one embodiment, the adhesive composition may include 100 parts by weight of the base polymer, 0.1 to 20 parts by weight of the crosslinking agent, 10 to 120 parts by weight of the first monomer, and 0.1 to 10 parts by weight of the photopolymerization initiator.

According to another embodiment, the adhesive composition may include 100 parts by weight of the base polymer, 0.1 to 20 parts by weight of the crosslinking agent, 10 to 120 parts by weight of the first monomer, 10 to 120 parts by weight of the second monomer, and 0.1 to 10 parts by weight of the initiator.

5 According to yet another embodiment, the adhesive composition may include 100 parts by weight of the pressure sensitive adhesive (PSA) as the base polymer, 0.1 to 20 parts by weight of the thermal crosslinking agent as the crosslinking agent, 10 to 120 parts by weight of the compound of Chemical Formula 1 as the first monomer, and 0.1 to 10 parts by weight of the photoinitiator as the initiator.

10 According to still another embodiment, the adhesive composition may include 100 parts by weight of the pressure sensitive adhesive (PSA) as the base polymer, 0.1 to 20 parts by weight of the thermal crosslinking agent as the crosslinking agent, 10 to 120 parts by weight of the compound of Chemical Formula 1 as the first monomer, 10 to 120 parts by weight of the compound of Chemical Formula 2 as the second monomer, and 0.1 to 10 parts
15 by weight of the photoinitiator as the initiator.

At this time, the contents of the components in the adhesive composition may be based on the solid content.

Preparation Method of Adhesive Composition

20 The adhesive composition according to the embodiment may be prepared by mixing a base polymer, a first monomer, a crosslinking agent, and an initiator and further mixing a solvent and other additives as necessary.

The base polymer may be prepared by a general method such as solution polymerization.

The order and conditions for mixing the base polymer, the first monomer, the crosslinking agent, and the initiator in the preparation of the adhesive composition are not particularly limited, and the process may be suitably modified as necessary.

In addition, the viscosity may be adjusted by using a solvent in each mixing step.

5 However, the preparation method of the adhesive composition is not particularly limited, and the process conditions may be appropriately modified as necessary.

The adhesive composition according to the embodiment may be used to form an adhesive film having a variable adhesive force, and thus may be usefully applied to a process requiring variability in the adhesive force, such as manufacturing of an OLED display panel.

10

Adhesive Film

According to another aspect of the present invention, there is provided an adhesive film formed from the adhesive composition.

The adhesive film has a more improved adhesive force after polymerization than the adhesive force before polymerization of the first monomer.

15

An adhesive film according to one embodiment is an adhesive film including a reaction product of a base polymer and a crosslinking agent, in which the adhesive film contains a first monomer and an initiator, the first monomer is polymerizable by the initiator, the adhesive film has a first adhesive force before the polymerization of the first monomer and a second adhesive force after the polymerization of the first monomer, and the second
20 adhesive force is higher than the first adhesive force.

Components of Adhesive Film

The adhesive film according to the embodiment includes a reaction product of a base polymer and a crosslinking agent. That is, the adhesive film includes a crosslinked base

polymer.

Further, the adhesive film including the reaction product of the base polymer and the crosslinking agent contains a first monomer and an initiator.

For example, the first monomer and the initiator are dispersed in the reaction product
5 of the base polymer and the crosslinking agent.

The first monomer may have compatibility with the reaction product of the base polymer and the crosslinking agent.

Referring back to FIG 1, polymerization of the first monomer may be initiated by the action of the initiator as necessary to improve the adhesive force of the adhesive film.

10 The specific types and contents of the base polymer, the crosslinking agent, the first monomer, and the initiator included in the adhesive film are as described above in the adhesive composition.

Further, the adhesive film according to the embodiment may further include a second monomer different from the first monomer, and the second monomer may form an additional
15 bond in the reaction product of the base polymer and the crosslinking agent.

The specific type and the content of the second monomer are as described in the second monomer included in the adhesive composition.

Further, the adhesive film according to the embodiment may further include other additives, and the specific types and contents thereof are as described in the additives included
20 in the adhesive composition.

Characteristics of Adhesive Film

Adhesive force - before and after polymerization of first monomer

The adhesive film according to the embodiment has a first adhesive force before the

polymerization of the first monomer.

The first adhesive force is preferably equal to or lower than a specific level to remove unnecessary portions after attaching the adhesive film to the substrate.

For example, the first adhesive force may be 200 gf/in or less, 150 gf/in or less, 100
5 gf/in or less, 50 gf/in or less, or 30 gf/in or less.

Specifically, the first adhesive force may be in a range of 1 gf/in to 200 gf/in, 1 gf/in to 100 gf/in, or 1 gf/in to 30 gf/in.

In this specification, the adhesive forces (the first adhesive force, the second adhesive force, etc.) may be measured by ASTM D3330 which is a general measuring method in the art,
10 and for example, the adhesive force may be an adhesive force measured for polyimide. A more detailed example of the measuring method has been specifically described in the following embodiment.

The adhesive film according to the embodiment has a second adhesive force after the polymerization of the first monomer.

15 The second adhesive force may be higher than a specific level to fix the remaining portion of the adhesive film to the substrate after removing the unnecessary portions of the adhesive film.

For example, the second adhesive force may be 350 gf/in or more, 400 gf/in or more, 500 gf/in or more, or 1,000 gf/in or more.

20 Specifically, the second adhesive force may be in a range of 350 gf/in to 10,000 gf/in, or 500 gf/in to 5,000 gf/in.

The second adhesive force is higher than the first adhesive force.

For example, the second adhesive force may be higher than the first adhesive force as

150 gf/in or more, 200 gf/in or more, 500 gf/in or more, or 1,000 gf/in or more.

Further, a ratio of the second adhesive force to the first adhesive force may be 3 or more, 5 or more, 10 or more, 12 or more, or 15 or more.

In addition, the ratio of the first adhesive force to the second adhesive force may be
5 0.06 or less, 0.03 or less, 0.02 or less, or 0.01 or less.

As an example, the first adhesive force may be 200 gf/in or less and the second adhesive force may be 350 gf/in or more.

As another example, the first adhesive force may be 150 gf/in or less and the second adhesive force may be 400 gf/in or more.

10 As yet another example, the first adhesive force may be in a range of 1 gf/in to 30 gf/in, and the second adhesive force may be in a range of 500 gf/in to 5,000 gf/in.

Further, the adhesive film formed by crosslinking the base polymer without the first monomer may have an adhesive force between the first adhesive force and the second adhesive force.

15 Haze and light transmittance after monomer polymerization

The adhesive film may satisfy a requirement as an optically transparent adhesive film.

For example, the adhesive film may have a haze after polymerization of the first monomer of 5% or less, 2% or less, or 1% or less.

In addition, the adhesive film may have a light transmittance after polymerization of
20 the first monomer of 80% or more, 90% or more, or 95% or more.

The adhesive film may satisfy a requirement as an optically transparent adhesive film even when the second monomer is additionally included.

For example, when the adhesive film includes the first monomer and the second

monomer, the haze after polymerization may be 5% or less or 2% or less.

In addition, when the adhesive film includes the first monomer and the second monomer, the light transmittance after polymerization may be 80% or more or 90% or more.

Thickness of Film

5 The thickness of the adhesive film may be in a range of 5 μm to 1000 μm or 10 μm to 100 μm when prepared as a thin film.

Alternatively, the thickness of the adhesive film may be in a range of 0.1 mm to 5 mm or 1 mm to 3 mm when prepared as a thick film.

Preparation method of adhesive film

10 The adhesive film may be prepared by preparing an adhesive composition to be formed as a film.

A preparation method of the adhesive film according to one embodiment includes mixing a base polymer, a first monomer, an initiator, and a crosslinking agent; reacting the crosslinking agent with the base polymer to form a film-like polymer; and preserving the first
15 monomer and the initiator in the film-like polymer to obtain an adhesive film.

The preparing of the adhesive composition may be performed according to the conditions and procedures as described above. The reaction of the base polymer and the crosslinking agent may be performed by a general thermal curing process. For example, a thermal curing temperature may be in a range of 40 $^{\circ}\text{C}$ to 150 $^{\circ}\text{C}$, 60 $^{\circ}\text{C}$ to 150 $^{\circ}\text{C}$, 60 $^{\circ}\text{C}$ to
20 120 $^{\circ}\text{C}$, or 100 $^{\circ}\text{C}$ to 120 $^{\circ}\text{C}$, and a thermal curing time may be 1 minute to 10 minutes, or 2 minutes to 5 minutes, but these thermal curing conditions may be adjusted according to the length and the number of the curing oven. Further, after the thermal curing, aging (e.g., aging at about 50 $^{\circ}\text{C}$ for 3 days) may be further performed.

The thermal curing process may be performed when the adhesive composition is coated on a base film. Specifically, the adhesive composition may be coated on the base film with an appropriate thickness, and the thermal curing may be performed in this process. The coating may be performed by a method such as notch bar, comma, gravure, or die coating.

5 In addition, a coating rate may be in a range of about 1 m/min to 40 m/min or 5 m/min to 30 m/min, but the conditions may be adjusted according to the length of the curing oven.

In addition, the preserving of the first monomer and the initiator in the film-like polymer may be performed by suppressing an environment in which the initiator may act in the coated (and thermally cured) film-like polymer (for example, preventing UV light
10 exposure).

Application to adhesive tape

The adhesive film according to the embodiment may be applied as an adhesive tape.

FIG 4 illustrates a cross-sectional view of an adhesive tape including an adhesive film according to an embodiment.

15 Referring to FIG 4, an adhesive film 110 according to the embodiment may be formed on one surface of a base film 120 to provide a base type adhesive tape 100.

Further, in the adhesive tape, a release film 130 may be laminated on one surface of the adhesive film 110.

Base Film

20 The base film may include at least one resin selected from the group consisting of a polyester resin, a polyurethane resin, and a polyolefin (e.g., polyethylene, etc.) resin. Alternatively, the base film may be constituted by paper, a plastic film, cloth, or a metal foil.

In some embodiments, materials suitable for the base film may include, for example,

paper including both flat or smooth paper and textured paper such as crepe paper, natural or synthetic polymer films, natural and/or synthetic fibers and nonwoven fabric made from combinations thereof, fiber reinforced polymer films, fiber or yarn reinforced polymer films or nonwoven fabric, and a multi-layer laminated structure.

5 Further, the base film may have a thickness in a range of 5 μm to 100 μm or a thickness in a range of 10 μm to 100 μm . As an example, the base film may include polyethylene terephthalate and have a thickness of 10 μm to 100 μm .

Such an adhesive tape may be prepared by a method including applying the adhesive composition on at least one surface of the base film to form an adhesive film.

10 In this case, after the application of the adhesive composition, it is necessary to prevent the first monomer in the adhesive film from being polymerized until the adhesive tape is used.

Alternatively, the adhesive film according to the embodiment may be provided as a base-free type adhesive tape itself, without the base film.

15 Adhesive Film

In the adhesive tape, the adhesive film 110 may be an adhesive film according to the embodiment described above.

Accordingly, the adhesive tape may include an adhesive film having the above-described composition and characteristics.

20 Release Film

The type of the release film used for the adhesive tape is not particularly limited, but may be, for example, at least one selected from the group consisting of a polyester (PET) film, a polyethylene (PE) film, a polypropylene (PP) film, and paper.

Further, the release film may include a silicone coating layer on a surface in contact with the adhesive film.

The thickness of the release film may be 5 μm to 100 μm , but may be thinner or thicker as necessary.

5

Laminate

According to yet another aspect of the present invention, there is provided a laminate including a substrate and the adhesive film according to the embodiment.

Components of laminate

10

The substrate in the laminate may be made of a material such as metal, glass, polymer, or the like.

Specifically, the material of the substrate may be stainless steel, glass, polyolefin, polyimide, or the like.

More specifically, the substrate may include polyimide.

The substrate may be entirely attached with the adhesive film on its surface.

15

Unlike this, the adhesive film may be partially attached to the substrate, and the laminate may have an adhesive film application area and an adhesive film non-application area.

20

In the laminate, at least one adhesive film application area and at least one adhesive film non-application area may each be included, and the adhesive film application area and the adhesive film non-application area may form specific patterns.

The adhesive film in the laminate may be the adhesive film according to the embodiment described above. Accordingly, the laminate structure may include the adhesive film having the above-described composition and characteristics.

Preparation method of laminate

FIG. 5 illustrates an example of a preparation method of the laminate.

Referring to FIG. 5, the preparation method of the laminate may include applying the adhesive film 110 according to the embodiment to a substrate 200; forming an adhesive film application area and an adhesive film non-application area on the substrate 200 by removing a part of the adhesive film 110; and polymerizing a first monomer contained in the adhesive film 111 in the adhesive film application area by an initiator to improve an adhesive force of the adhesive film 111 in the adhesive film application area.

Further, the preparation method of the laminate may include preparing the adhesive composition according to the embodiment; reacting the base polymer with the crosslinking agent to form an adhesive film preserved with the first monomer and the initiator; applying the adhesive film to the substrate; forming an adhesive film application area and an adhesive film non-application area on the substrate by removing a part of the adhesive film; and polymerizing a first monomer contained in the adhesive film in the adhesive film application area by an initiator to improve an adhesive force of the adhesive film in the adhesive film application area.

As a result, the adhesive film after the polymerization of the first monomer may have an improved adhesive force as compared with the adhesive film before the polymerization of the first monomer.

In the preparation method of the laminate, the preparing of the adhesive composition and the preparing of the adhesive film may be performed under the conditions described above.

Further, the forming of the adhesive film application area and the adhesive film non-

application area on the substrate by removing a part of the adhesive film may be performed so that the adhesive film on the adhesive film application area obtained has a shape such as lines, figures, and patterns.

As an example, a cutting line is formed on the surface of the adhesive film applied to the substrate in the form of dashed lines along the periphery of a desired area. Thereafter, an adhesive tape or the like may be attached to the area to be removed of the adhesive film and slowly lifted to remove a part of the adhesive film along the cutting line.

Further, the polymerizing of the first monomer may be performed by a general photocuring or thermal curing process.

Referring to FIG 5, the polymerizing of the first monomer may be performed by irradiating UV light 300 to the adhesive film 111 on the adhesive film application area. The irradiation of the UV light may be performed at an energy condition of 500 mJ/cm² to 3,000 mJ/cm² in a wavelength range of 250 nm to 420 nm.

Apparatus

According to still another aspect of the present invention, there is provided an apparatus including the laminate.

A specific type of the apparatus is not particularly limited, but may be, for example, a display device.

A display device according to an embodiment includes a display panel; and the laminate according to the embodiment attached onto the display panel.

The display panel may be an organic light emitting diode (OLED) display panel or a liquid crystal display (LCD) panel.

[Examples]

Hereinafter, the present invention will be described in more detail with reference to Examples. However, these Examples are just to exemplify the present invention and the present invention is not limited thereto.

5 Preparation Example 1: Preparation of base polymer

Each base polymer (adhesive) was prepared by solution polymerization using components in the following Table.

[Table 1]

Classification		Adhesive A	Adhesive B	Adhesive C	Adhesive D	Adhesive E
Adhesive composition (part by weight)	2-EHA	70		70		
	BA		50		74	73
	MA	30	45	30	26	25
	VAc		5			
	AA	2	2	2		
	2-HEA	0.3	0.3	0.3	1.9	2
	EA/toluene/acetone	153.5	240	153.5	237.7	240
Solid content (wt%)		40	30	40	30	30

- 2-EHA: 2-ethylhexyl acrylate

10 - BA: Butyl acrylate

- MA: Methyl acrylate

- VAc: Vinyl acetate

- AA: Acrylic acid

- 2-HEA: 2-hydroxyethyl acrylate

15 - EA: Ethyl acetate

Example 1: Preparation of adhesive composition

The base polymer (adhesive A or B) obtained in Preparation Example 1 was mixed with a UV monomer, added with a solvent (EA) for adjusting viscosity and other additives as necessary, and then stirred for 30 minutes to 1 hour to prepare a first solution. The solvent (EA) was added to a photoinitiator at a weight ratio of 1:2 to prepare a second solution. The first solution, the second solution, and the crosslinking agent were mixed, added with the solvent (EA) for adjusting viscosity as necessary, and then stirred for 30 minutes to 1 hour to prepare an adhesive composition.

At this time, the components and the contents of the respective materials in the final composition are shown in the following Table.

[Table 2]

Adhesive composition (unit: part by weight)		1E	1F	1G	1H	1I
Adhesive	B	100	100	100	100	100
Crosslinking agent	Isocyanate-based	2.0	2.0	2.0	2.0	2.0
	Metal (Al) chelate-based	1.0	1.0	1.0	1.0	1.0
UV monomer	Lauryl acrylate	5 (17)	10 (33)	15 (50)	18 (60)	25 (83)
Photoinitiator	IRGACURE 651	1.8	1.8	1.8	2.5	1.8

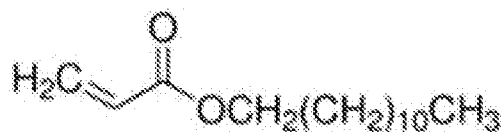
* In Table above, the numerical values in parentheses are parts by weight converted based on 100 parts by weight of the adhesive solid.

- Isocyanate-based crosslinking agent: Solid content 45%, Saivinol hardener AL, Saiden Chemical Industry Co., Ltd.

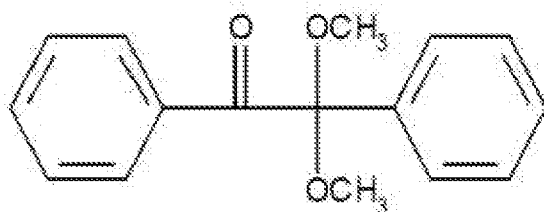
- Metal (Al) chelate-based crosslinking agent: Solid content 5%, Saivinol hardener M-

2, Saiden Chemical Industry Co., Ltd.

- Lauryl acrylate



- Ciba™ IRGACURE 651



5

Test Example 1-1: Measurement of adhesive force to polyimide

(1) Preparation of sample

The adhesive composition to be tested was coated on a polyethylene terephthalate (PET) film with a thickness of 75 μm at a rate of 1.0 m/min. The coated film was dried in a total 6 m oven having three drying zones (at temperatures of 40 °C, 80 °C, and 120 °C, respectively) having lengths of 2 m. As a result, an adhesive film having a thickness of 13 μm was formed on the PET film and cut into a size of 1 inch x 12 mm to obtain a single-sided tape sample.

(2) Measurement of adhesive force before/after UV curing

A polyimide film (manufacturer: SKC Kolon PI) was attached onto a rigid acrylic plate or a glass plate using a PET double-sided tape. The surface of the polyimide film was washed with isopropanol/heptane, and the above-prepared single-sided tape sample was laminated to obtain a laminate. The preparation of the laminate described above was completed within 1 hour in order to minimize the effect of light in an operating process.

15

The laminate was cured in a UV curing machine (metal halide lamp, wavelength range of 250 to 420 nm, main wavelength of 365 nm, energy of 1,000 mJ/cm²). At this time, for each of before and after UV curing, the 180° peeling strength between the polyimide films of the single-sided tape in the laminate was measured. The peeling strength (adhesive force) was measured using a universal tester (UTM, TA Instrument Co., Ltd.) according to ASTM D3330 at a peeling rate of 305 mm/min and a load of 2 kgf. The results were shown in the following Table.

Further, for comparison, a single-sided tape sample was prepared using only an adhesive (base polymer), and the adhesive force to the polyimide film was measured under the same conditions and shown in the following Table.

[Table 3]

Adhesive composition	Adhesive force (gf/in) to polyimide film		
	Only adhesive	Adhesive composition - before UV curing	Adhesive composition - after UV curing
1E	1,150	800	1,200
1F	1,150	200	1,200
1G	1,150	100	1,300
1H	1,150	30	1,400
1I	1,150	30	1,400

As shown in Table above, it could be seen that the adhesive compositions according to Examples had an increased adhesive force after UV curing compared to before UV curing and had a lower adhesive force before UV curing than the adhesive force of only the adhesive (base polymer) and a higher adhesive force before the UV curing. Particularly, it could be seen that when the weight of the first monomer was 60 parts by weight or more based on 100 parts by weight of the solid content of the base polymer, a difference in the adhesive force

before and after UV curing was significantly increased.

Test Example 1-2: Measurement of adhesive forces to various substrates

The same procedure as in Test Example 1-1 was repeated and adhesive forces before and after UV curing of the single-sided tape sample to stainless steel and glass instead of the polyimide film were measured, and the results were shown in the following Table.

Further, for comparison, a single-sided tape sample was prepared using only the adhesive (base polymer), and the adhesive forces to stainless steel and glass were measured, and the results were shown in the following Table.

[Table 4]

Adhesive composition	Adhesive force (gf/in) before UV curing	
	Stainless steel	Glass
1E	980	920
1F	350	300
1G	150	100
1H	50	30
1I	50	30

10 [Table 5]

Adhesive composition	Adhesive force (gf/in) after UV curing	
	Stainless steel	Glass
1E	1400	1,350
1F	1450	1,300
1G	1350	1,250
1H	1450	1,300
1I	1400	1,300

[Table 6]

Adhesive	Adhesive force (gf/in)	
	Stainless steel	Glass
A	730	650
B	1,130	850

As shown in Tables above, it could be seen that the adhesive compositions according to Examples had an increased adhesive force after UV curing compared to before UV curing with respect to various substrates and particularly, had a lower adhesive force before UV curing than the adhesive force of only the adhesive (base polymer) and a higher adhesive force before the UV curing.

Test Example 1-3: Evaluation of Static Shear

A single-sided tape sample with a size of 1 inch x 1 inch was prepared in the same manner as in Test Example 1-1 and its static shear was evaluated. At this time, the evaluation of the static shear was performed by measuring a period required for detachment of the adhesion to stainless steel under conditions of 500 g load and 60 °C/90%RH. The results were shown in the following Table.

[Table 7]

Adhesive composition	Evaluation of Static Shear (unit: day)				
	1E	1F	1G	1H	1I
Only adhesive	7↑	7↑	7↑	7↑	7↑
After UV curing	7↑	7↑	7↑	7↑	7↑

As shown in Table above, the adhesive compositions according to Examples had various static shears after UV curing which were equal to or higher than those of conventional adhesives.

Example 2: Preparation of adhesive composition

Under the same conditions as in Example 1, the adhesive, the crosslinking agent, the UV monomer, and the photoinitiator were mixed with components and contents shown in the following Table to prepare respective adhesive compositions.

5 [Table 8]

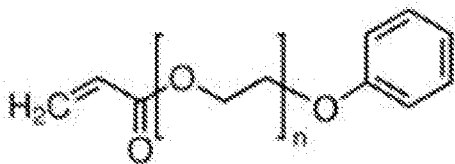
Adhesive composition (unit: part by weight)		2A	2B	2C	2D	2E	2F	2G	2H
Adhesive	C	100	100	100	100				
	D					100	100	100	100
Crosslinking agent	Isocyanate-based	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	Epoxy-based	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UV monomer	Phenyl (EO) _n acrylate	10 (25)	15 (38)	18 (45)	25 (63)	18 (60)	12 (40)	9 (30)	
	o-phenylphenol EO acrylate						6 (20)	9 (30)	18 (60)
Photoinitiator	IRGACURE 651	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

* In Table above, the numerical values in parentheses are parts by weight converted based on 100 parts by weight of the adhesive solid.

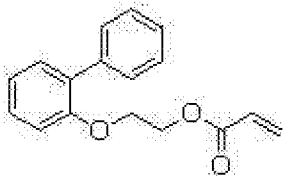
- Isocyanate-based crosslinking agent: Solid content 45%, Saivinol hardener AL, Saiten Chemical Industry Co., Ltd.

10 - Epoxy-based crosslinking agent: Solid content 5%, NA-30, Cosmo Tech Co., Ltd.

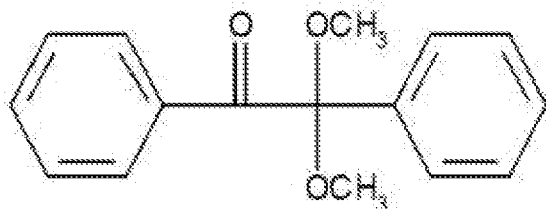
- Phenyl (EO)_n acrylate (n=2)



- o-phenylphenol EO acrylate



- Ciba™ IRGACURE 651



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Test Example 2: Measurement of adhesive force to polyimide

Single-sided tape samples were prepared in the same manner as in Test Example 1-1 using the respective adhesive compositions 2A to 2H prepared in Example 2, adhesive forces before and after UV curing to the polyimide film were measured, and the results were shown in the following Table. Further, for comparison, a single-sided tape sample was prepared using only an adhesive (base polymer), and the adhesive force to the polyimide film was measured under the same conditions and shown in the following Table.

10

[Table 9]

Adhesive composition	Adhesive force (gf/in) to polyimide film		
	Only adhesive	Adhesive composition before UV curing	Adhesive composition after UV curing
2A	830	170	900
2B	830	90	1,000
2C	830	30	1,200
2D	830	40	1,200
2E	250	20	1,200
2F	250	30	2,100
2G	250	30	2,200
2H	250	30	2,300

As shown in Tables above, it could be seen that the adhesive compositions according to Examples had a significantly increased adhesive force after UV curing compared to before UV curing with respect to various substrates, and had a lower adhesive force before UV curing than the adhesive force of only the adhesive (base polymer) and a higher adhesive force before the UV curing. Particularly, it could be seen that when the weight of the first monomer was 60 parts by weight or more based on 100 parts by weight of the solid content of the base polymer, a difference in the adhesive force before and after UV curing was significantly increased.

10 Example 3: Preparation of adhesive composition

Under the same conditions as in Example 1, the adhesive, the crosslinking agent, the UV monomer, and the photoinitiator were mixed with components and contents shown in the following Table to prepare respective adhesive compositions.

[Table 10]

Adhesive composition (unit: part by weight)		3A	3B	3C	3D	3E	3F	3G	3H
Adhesive	E	100	100	100	100	100	100	100	100
Crosslinking agent	Isocyanate-based	4	4	4	4	4	6	4	4
	Epoxy-based	2	2	2	2	2	2	2	2
UV monomer	Phenyl (EO) _n acrylate	9 (30)	9 (30)	9 (30)	9 (30)	9 (30)	9 (30)	18 (60)	12 (40)
	2-carboxyethyl acrylate	9 (30)	14 (47)	20 (67)	25 (83)	33 (110)	14 (47)		
Photoinitiator	IRGACURE 651	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

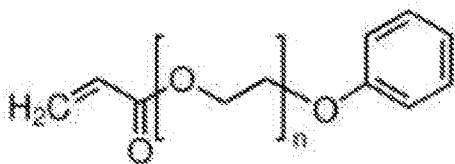
* In Table above, the numerical values in parentheses are parts by weight converted based on 100 parts by weight of the adhesive solid.

- Isocyanate-based crosslinking agent: Solid content 45%, Saivinol hardener AL,

5 Sainen Chemical Industry Co., Ltd.

- Epoxy-based crosslinking agent: Solid content 5%, NA-30, Cosmo Tech Co., Ltd.

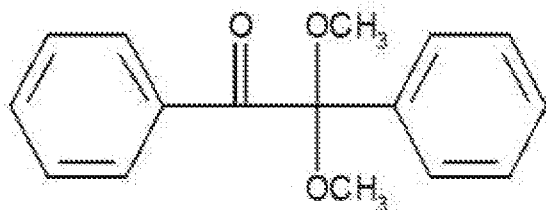
- Phenyl (EO)_n acrylate (CAS No. 56641-05-5) (n=2)



- 2-carboxyethyl acrylate (CAS No. 56641-05-5)



- Ciba™ IRGACURE 651



Test Example 3: Measurement of adhesive force to polyimide

Single-sided tape samples were prepared in the same manner as in Test Example 1-1 using the respective adhesive compositions 3A to 3H prepared in Example 3, adhesive forces before and after UV curing to the polyimide film were measured, and the results were shown in the following Table. Further, depending on the content (parts by weight) of 2-carboxyethyl acrylate as an additional UV monomer, changes in adhesive force before and after UV curing were illustrated in FIGS. 6A and 6B, respectively.

[Table 11]

Adhesive composition	Adhesive force (gf/in) to polyimide film	
	Before UV curing	After UV curing
3A	20	1030
3B	11	1740
3C	9	1980
3D	2	2120
3E	0	2170
3F	9	840
3G	18	780
3H	25	500

As shown in Table above and FIGS. 6A and 6B, in the adhesive compositions according to Example, even with respect to various substrates, the adhesive force after UV curing was significantly increased as compared with that before UV curing. Particularly, as the content of 2-carboxyethyl acrylate as an additional UV monomer was increased, the

adhesive force was decreased before UV curing, while the adhesive force was increased after UV curing.

Example 4: Preparation of adhesive composition

Under the same conditions as in Example 1, the adhesive, the crosslinking agent, the UV monomer, and the photoinitiator were mixed with components and contents shown in the following Table to prepare respective adhesive compositions.

[Table 12]

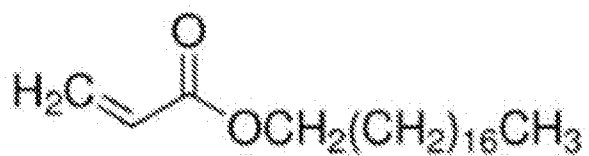
Adhesive composition (unit: part by weight)		4A	4B	4C	4D	4E
Adhesive	E	100	100	100	100	100
Crosslinking agent	Isocyanate-based	4	4	4	4	4
	Epoxy-based	2	2	2	2	2
UV monomer	SA	9 (30)				
	HDDA		9 (30)			
	BA			9 (30)		
	IBOA				9 (30)	
	2-EHA					9 (30)
	2-carboxyethyl acrylate	14 (47)	14 (47)	14 (47)	14 (47)	14 (47)
Photoinitiator	IRGACURE 651	0.9	0.9	0.9	0.9	0.9

* In Table above, the numerical values in parentheses are parts by weight converted based on 100 parts by weight of the adhesive solid.

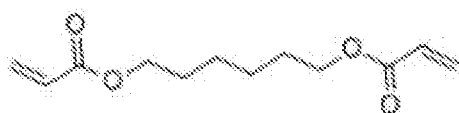
- Isocyanate-based crosslinking agent: Solid content 45%, Saivinol hardener AL, Sainen Chemical Industry Co., Ltd.

- Epoxy-based crosslinking agent: Solid content 5%, NA-30, Cosmo Tech Co., Ltd.

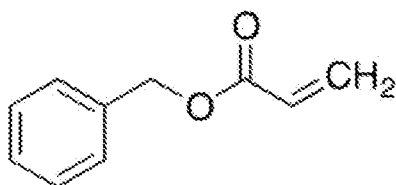
- SA: Stearyl acrylate



- HDDA: 1,6-hexanediol diacrylate

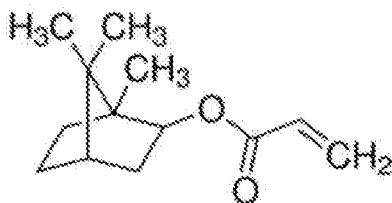


- BA: Benzyl acrylate

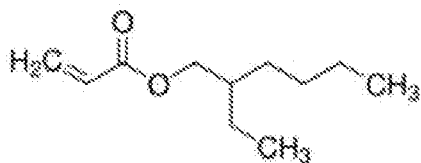


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- IBOA: Isobornyl acrylate



- 2-EHA: 2-ethylhexyl acrylate

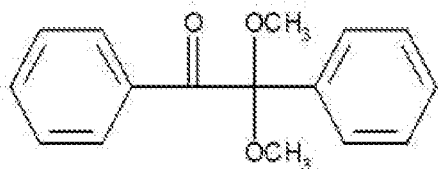


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- 2-carboxyethyl acrylate



- CibaTM IRGACURE 651



Test Example 4: Measurement of adhesive force to PI film

Single-sided tape samples were prepared in the same manner as in Test Example 1-1 using the respective adhesive compositions 4A to 4E prepared in Example 4, adhesive forces before and after UV curing to the polyimide film were measured, and the results were shown in the following Table.

Further, the compatibility of the UV monomer with the adhesive in each adhesive composition was evaluated and shown in the following Table.

Further, for comparison, results of evaluating physical properties for the adhesive compositions prepared in Examples 2 and 3 were shown in the following Table.

[Table 13]

Adhesive composition	Compatibility	Adhesive force (gf/in) to polyimide film		Note
		Adhesive composition before UV curing	Adhesive composition after UV curing	
4A	Good	30	700	
4B	Normal	40	500	
4C	Good	30	700	
4D	Good	100	700	
4E	Bad	150	400	
2E	Good	20	1200	Prepared in Example 2
3B	Good	11	1740	Prepared in Example 3

[Explanation of Reference Numerals and symbols]

100: Adhesive tape 110: Adhesive film according to an embodiment

111: Adhesive film on adhesive film application area

120: Base Film 130: Release Film

5 200: Substrate 300: UV light

What is claimed is:

1. An adhesive composition comprising:

a base polymer;

a crosslinking agent reacting with the base polymer;

5 a first monomer polymerized after the reaction of the base polymer and the crosslinking agent; and

an initiator polymerizing the first monomer,

wherein the adhesive composition has a first adhesive force before the polymerization of the first monomer and a second adhesive force after the polymerization of the first monomer, after the reaction of the base polymer and the crosslinking agent, and the second adhesive force is higher than the first adhesive force.

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2. The adhesive composition of claim 1, wherein the adhesive composition has a haze of 2% or less after the polymerization of the first monomer.

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3. The adhesive composition of claim 1, wherein the base polymer contains a functional group reactive with the crosslinking agent.

4. The adhesive composition of claim 1, further comprising:

20 a second monomer different from the first monomer.

5. The adhesive composition of claim 4, wherein the second monomer forms an additional bond at the time of the reaction of the base polymer and the crosslinking agent.

6. An adhesive film comprising a reaction product of a base polymer and a crosslinking agent,

wherein the adhesive film contains a first monomer and an initiator and the first monomer is polymerizable by the initiator, and

5 the adhesive film has a first adhesive force before the polymerization of the first monomer and a second adhesive force after the polymerization of the first monomer, and the second adhesive force is higher than the first adhesive force.

7. The adhesive film of claim 6, wherein the adhesive film has a haze of 2% or less after
10 the polymerization of the first monomer.

8. The adhesive film of claim 6, further comprising:
a second monomer different from the first monomer, wherein the second monomer
forms an additional bond in the reaction product of the base polymer and the crosslinking
15 agent.

9. A preparation method of the adhesive film of claim 6, comprising:
mixing a base polymer, a first monomer, an initiator, and a crosslinking agent;
reacting the crosslinking agent with the base polymer to form a film-like polymer; and
20 preserving the first monomer and the initiator in the film-like polymer to obtain an
adhesive film.

10. A laminate comprising a substrate and the adhesive film of claim 6.

11. The laminate of claim 10, wherein the substrate includes polyimide.

5 12. The laminate of claim 10, wherein the laminate has an adhesive film application area and an adhesive film non-application area.

13. A preparation method of a laminate comprising:

applying the adhesive film of claim 6 to a substrate;

10 forming an adhesive film application area and an adhesive film non-application area on the substrate by removing a part of the adhesive film; and

polymerizing the first monomer contained in the adhesive film in the adhesive film application area by the initiator to improve an adhesive force of the adhesive film in the adhesive film application area.

15

14. A preparation method of a laminate comprising:

preparing the adhesive composition of claim 1;

reacting the base polymer with the crosslinking agent to form an adhesive film preserved with the first monomer and the initiator;

20 applying the adhesive film to a substrate;

forming an adhesive film application area and an adhesive film non-application area on the substrate by removing a part of the adhesive film; and

polymerizing a first monomer contained in the adhesive film in the adhesive film

application area by the initiator to improve an adhesive force of the adhesive film in the adhesive film application area.

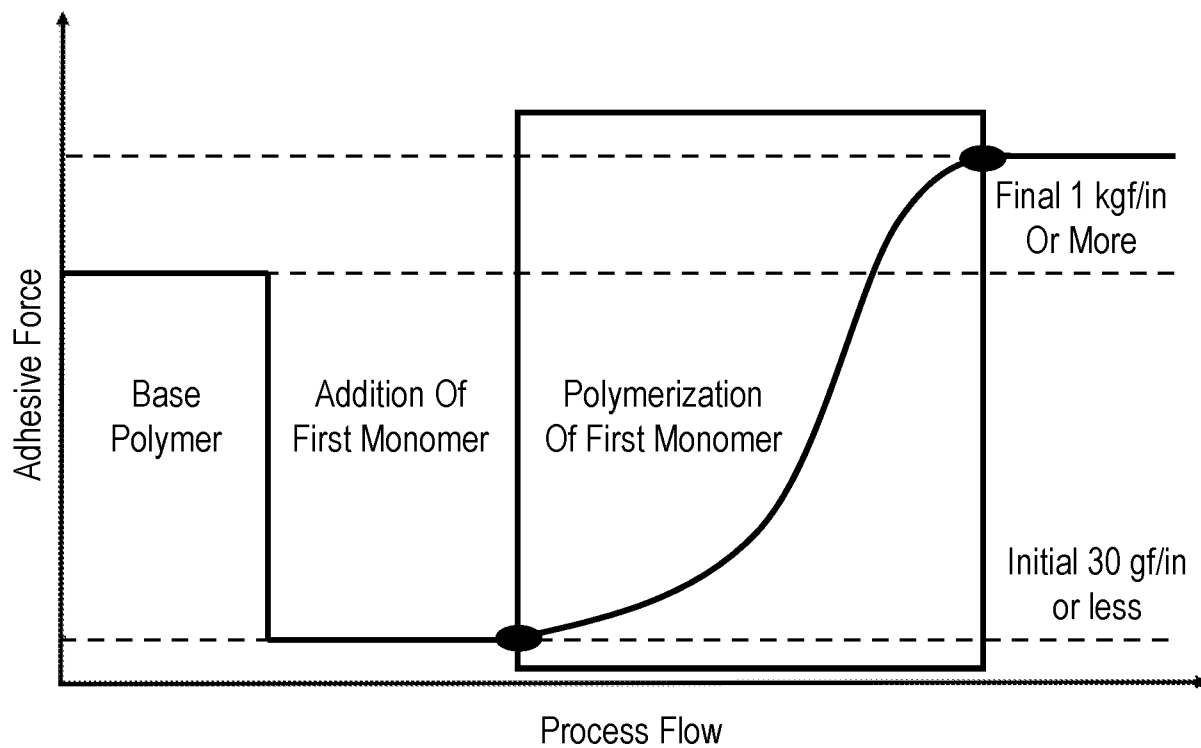
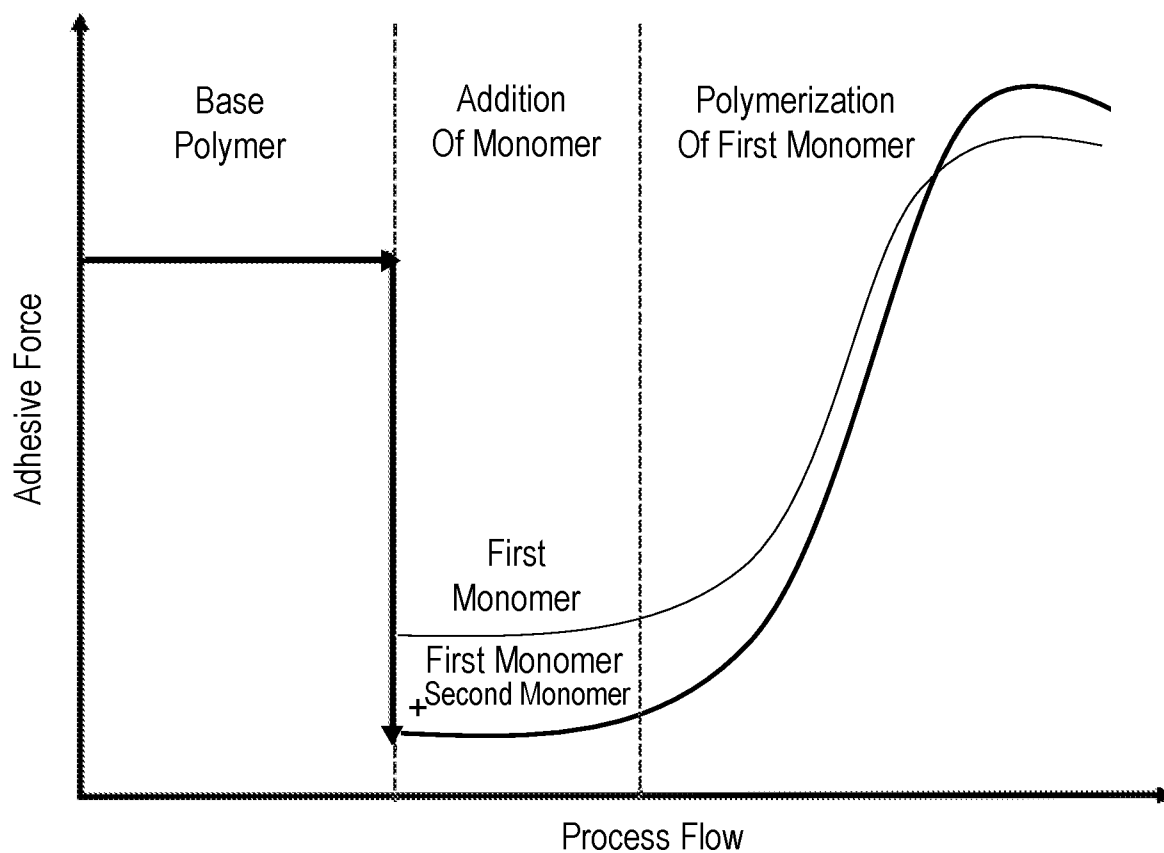
15. An apparatus comprising the laminate of claim 10.

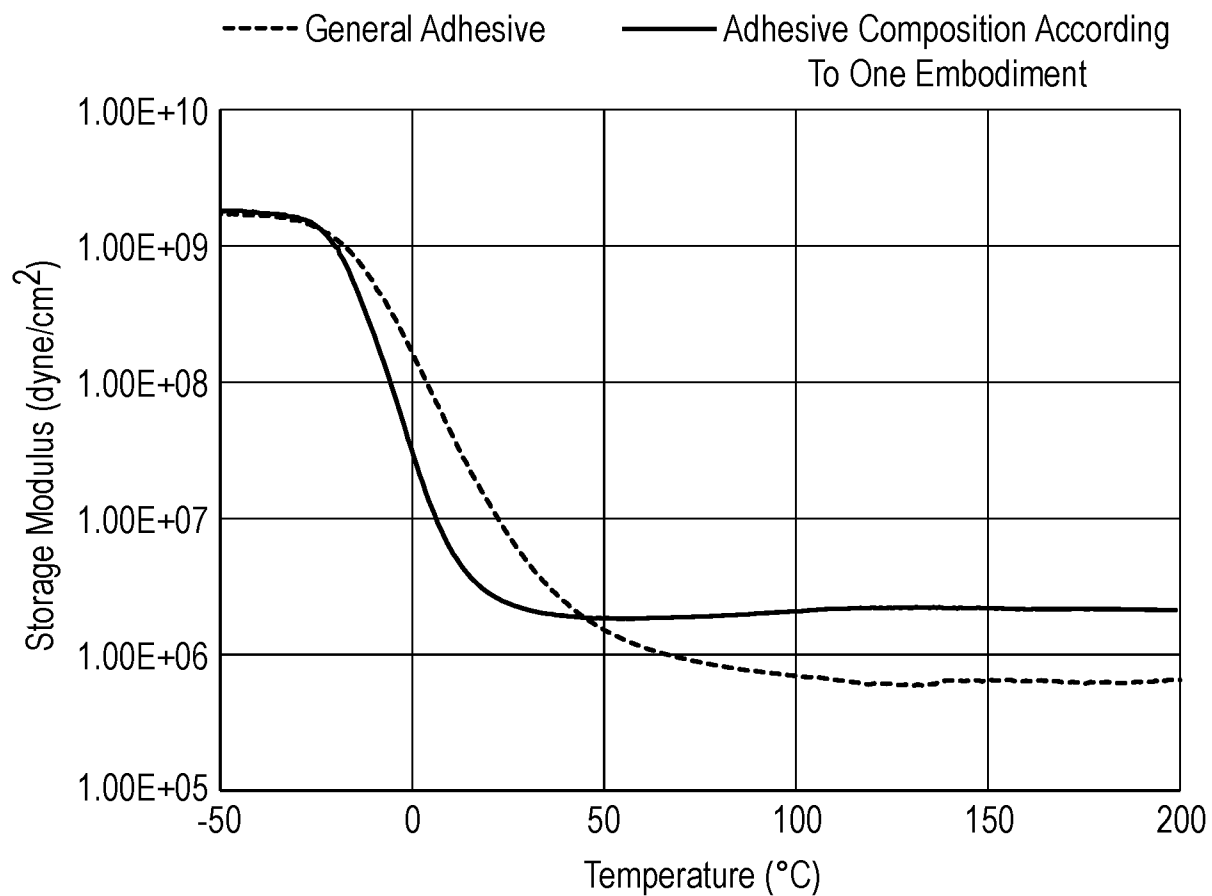
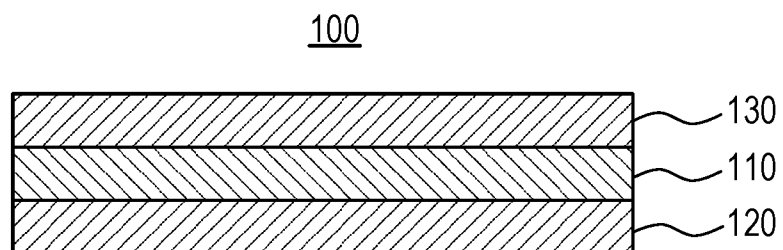
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16. A display device comprising:

a display panel; and

the laminate of claim 10 attached onto the display panel.

**Fig. 1****Fig. 2**

***Fig. 3******Fig. 4***

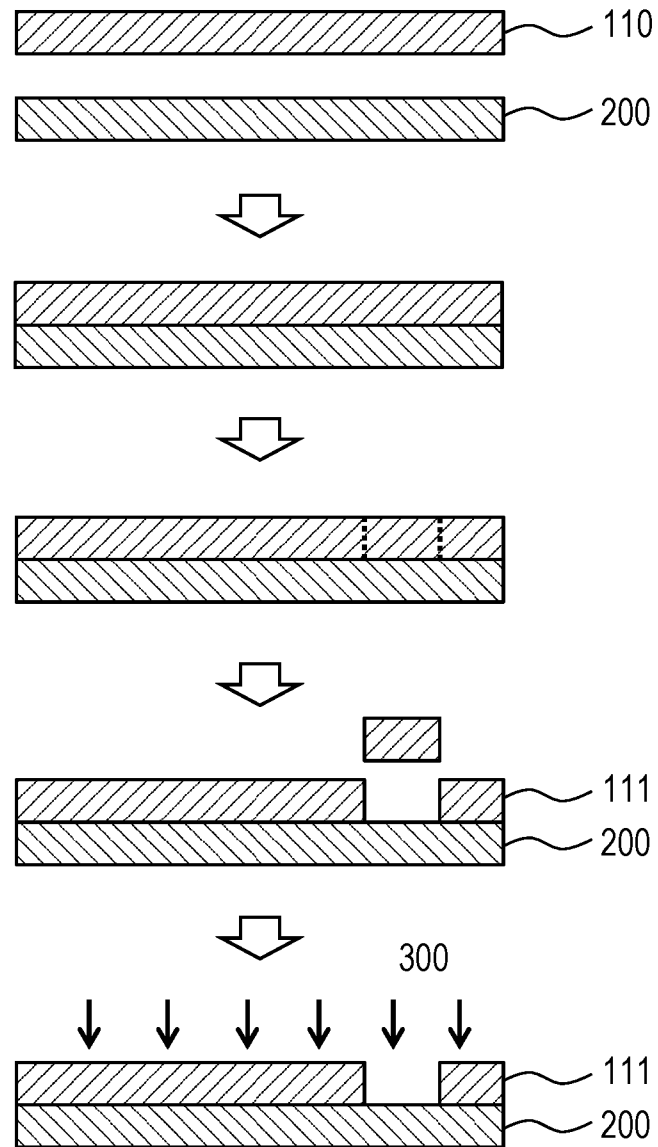
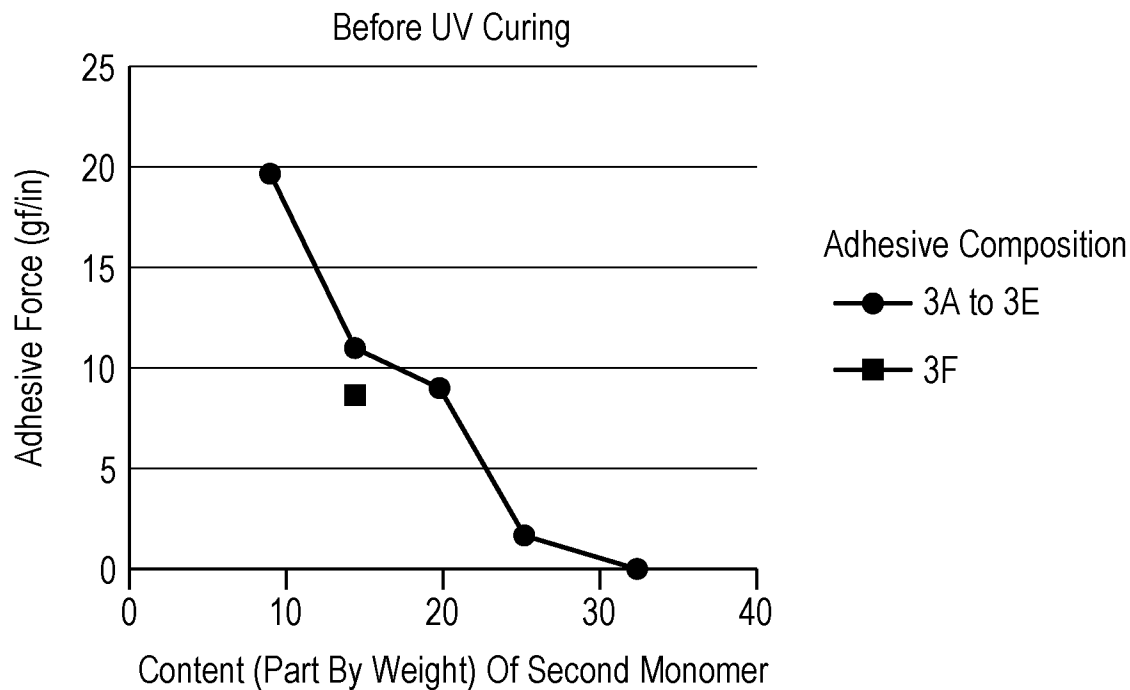
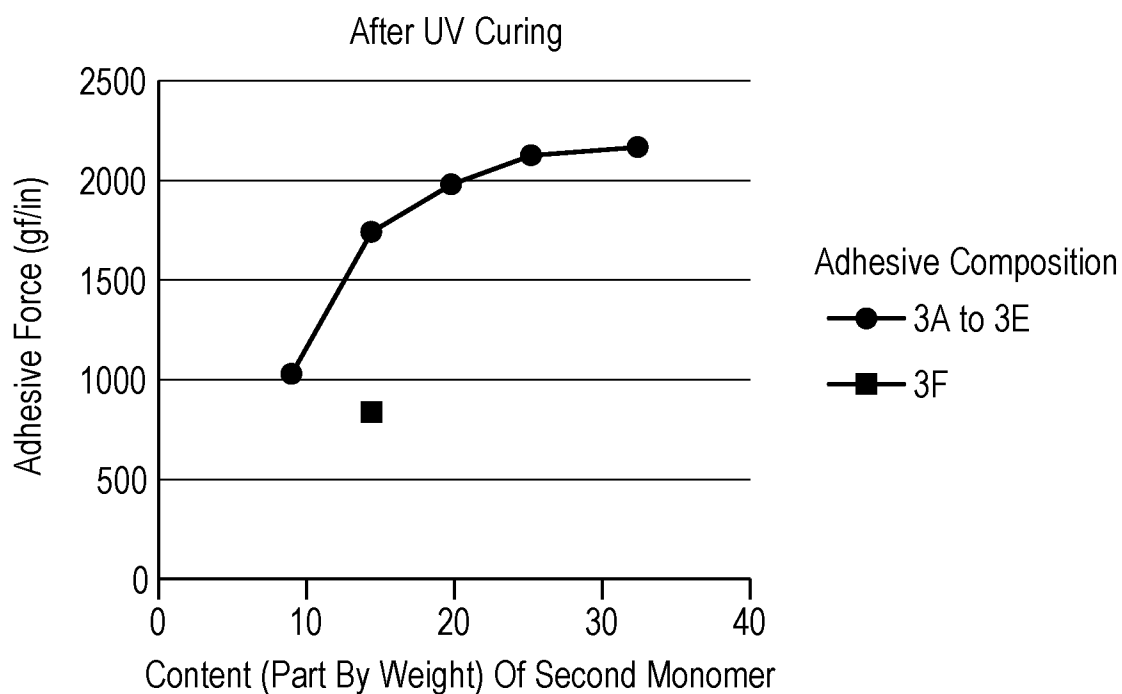


Fig. 5

**Fig. 6A****Fig. 6B**

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/056338

A. CLASSIFICATION OF SUBJECT MATTER

INV. C08F220/10 C08F220/26 C08F220/30 C08F220/18 C09J133/14
G06F3/041 C09J11/06 C09J4/00 C09J4/06 C09J7/38
G02F1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C08F C09J G06F C08J G02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 2015 0043078 A ((SMSU) SAMSUNG DISPLAY CO LTD) 22 April 2015 (2015-04-22) claim 1 paragraph [0041] - paragraph [0052] paragraph [0061] - paragraph [0078] paragraph [0098] figures 4,5	1-16
X	KR 101 668 745 B1 (JINYANG MTS CO LTD [KR]) 24 October 2016 (2016-10-24) claim 1 paragraph [0014] paragraph [0062] - paragraph [0078] -----	1-16

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

18 December 2019

Date of mailing of the international search report

08/01/2020

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Authorized officer

Costantini, Nicola

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2019/056338

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 20150043078 A	22-04-2015	NONE	

KR 101668745 B1	24-10-2016	NONE	
