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(54) Title: A POLYURETHANE ADHESIVE COMPOSITION, A POLYURETHANE ADHESIVE, A POLYURETHANE ADHESIVE TAPE, AND THE METHOD FOR PREPARING THE POLYURETHANE ADHESIVE TAPE

(57) Abstract: The present invention relates to a polyurethane adhesive composition, including: a) a polydiol, at least including a polyester diol having a weight average molecular weight of 400-4000; b) an aliphatic polycaprolactone triol having a weight average molecular weight of 100-600; and c) a polydiisocyanate, at least including one of a hexamethylene diisocyanate trimer and an isophorone diisocyanate trimer. A polyurethane adhesive prepared from the polyurethane adhesive composition provided by the present invention and a polyurethane adhesive tape including the polyurethane adhesive at least have good room-temperature adhesion performance and good high-temperature resistance.



**A POLYURETHANE ADHESIVE COMPOSITION, A POLYURETHANE
ADHESIVE, A POLYURETHANE ADHESIVE TAPE, AND THE METHOD FOR
PREPARING THE POLYURETHANE ADHESIVE TAPE**

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Technical Field

The present invention relates to the field of adhesives, in particular to a polyurethane adhesive composition, a polyurethane adhesive, an adhesive tape including the polyurethane adhesive, and a method for preparing the adhesive tape.

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Background

With the emergence and rapid development of electric vehicles, sensors, VR/AR (Virtual Reality/Augmented Reality), Internet of Things, block chains, 5G technologies and the like, the chip market is growing rapidly. In the chip manufacturing process, it is often necessary to use a protective film to protect a chip. For example, in the chip thinning process, a protective film is needed to protect a chip. For another example, in some chip processes involving high temperature (such as tin ball and copper column deposition processes), a protective film is also needed to protect a chip from 200°C or higher temperature (even more than 260°C) for several minutes to dozens of minutes. Therefore, it is necessary to provide a protective film with good adhesion performance at room temperature and high-temperature resistance to meet this demand.

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In addition, the deposition of high-performance coatings can be used to improve the optical properties of glass screens in the display manufacturing process. In order to keep the coatings smooth on an atomic scale, it is necessary to prepare the coatings through a vapor deposition process. Generally, in the vapor deposition process (generally, they must be deposited at 200°C or more than 200°C), a protective film is needed to protect regions on a glass screen where coatings are not needed to be coated. In addition, in the vapor deposition process, this protective film must have good adhesion performance with a substrate, so as to avoid blistering, warping and falling off. In addition, after the vapor deposition process, the

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protective film must be easily removed without leaving residual adhesives on the substrate. Therefore, it is necessary to provide a protective film with good adhesion performance at room temperature and high-temperature resistance to meet this demand.

Summary

5 One purpose of the present invention is to provide a polyurethane adhesive composition and a polyurethane adhesive based on the composition. The polyurethane adhesive at least has good room-temperature adhesion performance and high-temperature resistance, so it can be used to solve some problems in the process of manufacturing chips or display glass screens.

10 Another purpose of the present invention is to provide a polyurethane adhesive tape. Another purpose of the present invention is to provide a method for preparing a polyurethane adhesive tape.

For these purposes, in one aspect, the present invention provides a polyurethane adhesive composition, including: a) a polydiol, at least including a polyester diol having a weight average molecular weight of 400-4000; b) an aliphatic polycaprolactone triol having a weight average molecular weight of 100-600; and c) a polydiisocyanate, at least including one of a hexamethylene diisocyanate trimer and an isophorone diisocyanate trimer.

According to some technical solutions of the present invention, the polyester diol at least includes one of an aromatic polyester diol and a fatty acid based polyester diol.

20 According to some technical solutions of the present invention, the polyester diol has a weight average molecular weight of 500-3000.

According to some technical solutions of the present invention, the aliphatic polycaprolactone triol has a weight average molecular weight of 200-400.

According to some technical solutions of the present invention, the weight ratio of the polyester diol to the aliphatic polycaprolactone triol is 1:0.01-1:0.7, preferably 1:0.04-1:0.5, particularly preferably 1:0.06-1:0.3.

According to some technical solutions of the present invention, the polydiol further includes a dimer diol.

According to some technical solutions of the present invention, the weight ratio of the polyester diol to the dimer diol is 1:0.1-1:1.

5 According to some technical solutions of the present invention, the weight ratio of the polyester diol to the aliphatic polycaprolactone triol is 1:0.04-1:0.3, and the weight ratio of the polyester diol to the dimer diol is 1:0.1-1:1; preferably, the weight ratio of the polyester diol to the aliphatic polycaprolactone triol is 1:0.06-1:0.3, and the weight ratio of the polyester diol to the dimer diol is 1:0.1-1:1.

10 According to some technical solutions of the present invention, the polyurethane adhesive composition further includes d) silica particles.

According to some technical solutions of the present invention, the average particle size (D50) of the silica particles is 5-15 μm , preferably 6-10 μm .

15 According to some technical solutions of the present invention, the silica particles at least include one of polydimethylsiloxane (PDMS) surface-modified silica particles, wax surface-modified silica particles, and surface-unmodified silica particles.

According to some technical solutions of the present invention, the ratio of the weight of the silica particles to the total weight of the polydiol, aliphatic polycaprolactone triol and polydiisocyanate is 1.0:100-5.1:100.

20 In another aspect, the present invention provides a polyurethane adhesive, including a cured product of the polyurethane adhesive composition provided by the present invention.

25 According to another aspect, the present invention provides an adhesive tape, including a substrate and the polyurethane adhesive provided by the present invention disposed on the substrate.

According to some technical solutions of the present invention, the substrate is a polyimide substrate, a polyester substrate, a polyetheretherketone substrate, release paper, or a release film.

In another aspect, the present invention provides a method for preparing a polyurethane adhesive tape, including the following steps: disposing the polyurethane adhesive composition provided by the present invention on a substrate; and curing the polyurethane adhesive composition.

Hereinafter, the present invention will be described in more detail in combination with the detailed description of the present invention.

10 Detailed Description

Hereinafter, in order to describe the present invention more clearly, several technical solutions of the present invention and several technical solutions for comparison are described. However, this section only exemplifies some specific embodiments claimed, in which the technical features recited in one or more technical solutions can be combined with any one or more technical solutions, and these technical solutions obtained by combination also fall within the protection scope of the present invention as long as they do not depart from the spirit of the present invention.

“Good room-temperature adhesion performance” used herein refers to that a polyurethane adhesive or polyurethane adhesive tape can be adhered to a surface of a substrate (including but not limited to a glass substrate, a stainless steel substrate, or a silicon wafer substrate) at room temperature (23°C), and has good room-temperature 180° peeling force on the substrate.

“Good high-temperature resistance” used herein refers to that after a high-temperature process, a polyurethane adhesive or a polyurethane adhesive tape can still be adhered to the substrate without blistering and falling off, and can be completely removed from the surface of the protected substrate without leaving residual adhesives.

“Average particle size” used herein refers to the particle size of particles whose cumulative frequency (G or R) of particle size distribution is equal to 50%, also called as median diameter, also known as D50.

5 Polyurethane adhesive composition

A polyurethane adhesive composition provided by the present invention includes: a) a polydiol, at least including a polyester diol having a weight average molecular weight of 400-4000; b) an aliphatic polycaprolactone triol having a weight average molecular weight of 100-600; and c) a polydiisocyanate, at least including one of a hexamethylene
10 diisocyanate trimer and an isophorone diisocyanate trimer.

In the present invention, the polyester diol refers to a polyester polyol with a hydroxyl functionality of 2 obtained through condensation reaction of a dicarboxylic acid, a diol, and the like. The polyester diol has a molecular weight of 400-4000, preferably 500-3000. The polyester diol can adjust the polarity and cohesive strength of the
15 polyurethane adhesive, so as to adjust the room-temperature adhesion performance and high-temperature resistance of the polyurethane adhesive.

According to one embodiment of the present invention, the polyester diol may be a fatty acid based polyester diol. The fatty acid based polyester diol may be Priplast 3162, Priplast 3172, Priplast 3192, or Priplast 3190 purchased from Croda Chemical (Shanghai)
20 Co., Ltd. located in Shanghai, China.

According to one embodiment of the present invention, the polyester diol may also be an aromatic polyester diol. The aromatic polyester diol may be XCPA-110 or XCPA-195 purchased from of Xuchuan Chemical (Suzhou) Co., Ltd. located in Suzhou, China.

According to one embodiment of the present invention, the polydiol may further
25 include a dimer diol. The dimer diol may be prepared through hydrogenation reduction of dimer acid. The dimer acid may be a complex mixture consisting of C18 unsaturated fatty acid dimers with different structures and higher oligomers. The dimer diol can adjust the

polarity and cohesive strength of the polyurethane adhesive, so as to adjust the room-temperature adhesion performance and high-temperature resistance of the polyurethane adhesive.

According to one embodiment of the present invention, the dimer diol may be Pripol 2033 or Pripol 2030 purchased from Croda Chemical (Shanghai) Co., Ltd. located in Shanghai, China.

According to one embodiment of the present invention, the weight ratio of the polyester diol to the dimer diol is 1:0.1-1:1. When the weight ratio of the polyester diol to the dimer diol is 1:0.1-1:1, the polyurethane adhesive can have good high-temperature resistance.

In the present invention, the aliphatic polycaprolactone triol refers to a polyester polyol with a hydroxyl functionality of 3 formed through ring-opening polymerization of caprolactone, and the aliphatic polycaprolactone triol has a weight average molecular weight of 100-600, preferably 200-400. The aliphatic polycaprolactone triol can increase the cross-linking degree of the polyurethane adhesive, thereby improving the high-temperature resistance of the polyurethane adhesive.

According to one embodiment of the present invention, the aliphatic polycaprolactone triol may be Capa 3050 or Capa 3031 purchased from Perstorp UK Ltd. located in Cheshire, UK.

According to one embodiment of the present invention, the weight ratio of the polyester diol to the aliphatic polycaprolactone triol is 1:0.01-1:0.7, preferably 1:0.04-1:0.5. When the weight ratio of the polyester diol to the aliphatic polycaprolactone triol is 1:0.01-1:0.7, the polyurethane adhesive can have good high-temperature resistance.

According to one embodiment of the present invention, the weight ratio of the polyester diol to the aliphatic polycaprolactone triol is 1:0.01-1:0.7, preferably 1:0.04-1:0.5, and the weight ratio of the polyester diol to the dimer diol is 1:0.1-1:1. At this time, the polyurethane adhesive can have good high-temperature resistance.

In the present invention, the polydiisocyanate at least includes one of a hexamethylene diisocyanate trimer and an isophorone diisocyanate trimer. The hexamethylene diisocyanate trimer and isophorone diisocyanate trimer can provide good room-temperature adhesion performance and high-temperature resistance for the polyurethane adhesive.

According to one embodiment of the present invention, the hexamethylene diisocyanate trimer may be N3800, N3390 or N3300 purchased from Covestro located in Shanghai, China.

According to one embodiment of the present invention, the isophorone diisocyanate trimer may be Z4470 purchased from Covestro located in Shanghai, China.

According to some technical solutions of the present invention, the polyurethane adhesive composition provided by the present invention may further include silica particles. In the present invention, the average particle size D50 of the silica particles is 5-15 μm , preferably 6-10 μm . The silica particles can adjust the room-temperature adhesion performance of the polyurethane adhesive and improve the high-temperature resistance of the polyurethane adhesive.

According to one embodiment of the present invention, the silica particles may be one or more selected from the group consisting of polydimethylsiloxane (PDMS) surface-modified silica particles, wax surface-modified silica particles, and surface-unmodified silica particles.

According to one embodiment of the present invention, the polydimethylsiloxane (PDMS) surface-modified silica particles may be Acematt 3300 purchased from Evonik located in Shanghai, China. According to one embodiment of the present invention, the wax surface-modified silica particles may be OK520 purchased from Evonik located in Shanghai, China. According to one embodiment of the present invention, the surface-unmodified silica particles may be TS-100 purchased from Evonik located in Shanghai, China.

According to one embodiment of the present invention, in the polyurethane adhesive composition provided by the present invention, the ratio of the weight of the silica particles to the total weight of the polydiol, aliphatic polycaprolactone triol and polydiisocyanate is 1.0:100-5.1:100. The ratio (A/B) may be calculated according to the following formula:

5 A = weight of silica particles,

B = weight of polydiol + weight of aliphatic polycaprolactone triol + weight of polydiisocyanate,

$A/B = (\text{weight of silica particles}) / (\text{weight of polydiol} + \text{weight of aliphatic polycaprolactone triol} + \text{weight of polydiisocyanate}).$

10 The weight of the polydiol, the weight of the aliphatic polycaprolactone triol and the weight of the polydiisocyanate may be respectively calculated according to the following formulas:

Weight of polydiol = weight of polydiol solution $\times$ solid content of polydiol solution,

15 Weight of aliphatic polycaprolactone triol = weight of aliphatic polycaprolactone triol solution $\times$ solid content of aliphatic polycaprolactone triol solution,

Weight of polydiisocyanate = weight of polydiisocyanate solution $\times$ solid content of polydiisocyanate solution.

20 Polyurethane adhesive

A polyurethane adhesive provided by the present invention includes a cured product of the polyurethane adhesive composition provided by the present invention.

Components of the polyurethane adhesive composition are detailed in the “Polyurethane adhesive composition” in this description, and thus will not be repetitively
25 described here.

According to one embodiment of the present invention, the polyurethane adhesive may be prepared according to the following steps:

step 1: adding all component of the polyurethane adhesive composition into a suitable container for mixing at room temperature;

step 2: putting the all mixed components of the polyurethane adhesive composition into an oven for reaction and curing to obtain a polyurethane adhesive.

5 According to one embodiment of the present invention, in step 2, after the mixed components of the polyurethane adhesive composition are put into the oven, the temperature is increased from 120°C to 150°C and kept for 20 min to enable the polyurethane adhesive composition to react and be cured to obtain the polyurethane adhesive.

10 According to one embodiment of the present invention, in step 2, after the mixed components of the polyurethane adhesive composition are put into the oven, the temperature may be increased from 120°C to 150°C and kept for 20 min, and then the temperature may be decreased to 80°C and kept for 24h to complete the curing reaction.

 According to one embodiment of the present invention, in step 1, all components of
15 the polyurethane adhesive composition except silica particles may be first added into a suitable container, and then the silica particles may be added into the container and dispersed at high speed of 2500 rpm for 5-15 min.

 According to one embodiment of the present invention, the polyurethane adhesive may be stored at room temperature.

20 According to one embodiment of the present invention, the polyurethane adhesive provided by the present invention at least has good room-temperature adhesion performance and good high-temperature resistance.

 According to one embodiment of the present invention, when the polyurethane adhesive composition provided by the present invention includes an appropriate amount of
25 polydiol, aliphatic polycaprolactone triol and polydiisocyanate, the polyurethane adhesive prepared by using the polyurethane adhesive composition has good room-temperature

adhesion performance and good high-temperature resistance on the surface of a glass substrate.

According to one embodiment of the present invention, when the polyurethane adhesive provided by the present invention includes an appropriate amount of polydiol, aliphatic polycaprolactone triol, polydiisocyanate and silica particles, the polyurethane adhesive prepared by using the polyurethane adhesive composition has good room-temperature adhesion performance and good high-temperature resistance on the surface of a silicon wafer substrate.

According to one embodiment of the present invention, when the polyurethane adhesive provided by the present invention includes an appropriate amount of polydiol, aliphatic polycaprolactone triol, polydiisocyanate and silica particles, the polyurethane adhesive prepared by using the polyurethane adhesive composition has good room-temperature adhesion performance and good high-temperature resistance on the surface of a stainless steel substrate.

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Polyurethane adhesive tape

An adhesive tape (also called “protective film”) provided by the present invention includes a substrate and a polyurethane adhesive provided by the present invention disposed on the substrate. The polyurethane adhesive is detailed in the “Polyurethane adhesive” in this description, and thus will not be repetitively described here.

20

According to one embodiment of the present invention, the polyurethane adhesive may be provided on at least one side of the substrate.

According to one embodiment of the present invention, the substrate is a polyimide substrate, a polyester substrate, a polyetheretherketone substrate, release paper, or a release film.

25

According to one embodiment of the present invention, the polyurethane adhesive provided by the present invention at least has good room-temperature adhesion performance and good high-temperature resistance.

According to one embodiment of the present invention, when the polyurethane
5 adhesive composition provided by the present invention includes an appropriate amount of polydiol, aliphatic polycaprolactone triol and polydiisocyanate, the polyurethane adhesive tape prepared by using the polyurethane adhesive composition has good room-temperature adhesion performance and good high-temperature resistance on the surface of a glass substrate.

10 According to one embodiment of the present invention, when the polyurethane adhesive provided by the present invention includes an appropriate amount of polydiol, aliphatic polycaprolactone triol, polydiisocyanate and silica particles, the polyurethane adhesive tape prepared by using the polyurethane adhesive composition has good room-temperature adhesion performance and good high-temperature resistance on the
15 surface of a silicon wafer substrate.

According to one embodiment of the present invention, when the polyurethane adhesive provided by the present invention includes an appropriate amount of polydiol, aliphatic polycaprolactone triol, polydiisocyanate and silica particles, the polyurethane adhesive tape prepared by using the polyurethane adhesive composition has good
20 room-temperature adhesion performance and good high-temperature resistance on the surface of a stainless steel substrate.

Method for preparing polyurethane adhesive tape

A method for preparing a polyurethane adhesive tape provided by the present
25 invention includes the following steps: disposing the polyurethane adhesive composition provided by the present invention on a substrate; and curing the polyurethane adhesive composition.

Components of the polyurethane adhesive composition are detailed in the “Polyurethane adhesive composition” in this description, and thus will not be repetitively described here.

According to one embodiment of the present invention, in particular, the preparation method may comprise the following steps:

step 1: adding all component of the polyurethane adhesive composition into a suitable container for mixing at room temperature;

step 2: coating the mixed polyurethane adhesive composition on a surface of a substrate; and

step 3: putting the substrate coated with the polyurethane adhesive composition into an oven for reaction and curing to obtain a polyurethane adhesive.

According to one embodiment of the present invention, in step 3, after the substrate coated with the polyurethane adhesive composition is put into the oven, the temperature is increased from 120°C to 150°C and kept for 20 min to enable the polyurethane adhesive composition to react and be cured to obtain the polyurethane adhesive.

According to one embodiment of the present invention, in step 3, after the substrate coated with the polyurethane adhesive composition is put into the oven, the temperature may be increased from 120°C to 150°C and kept for 20 min, and then the temperature may be decreased to 80°C and kept for 24h to complete the curing reaction.

According to one embodiment of the present invention, in step 1, all components of the polyurethane adhesive composition except silica particles may be first added into a suitable container, and then the silica particles may be added into the container and dispersed at high speed of 2500 rpm for 5-15 min.

According to one embodiment of the present invention, the polyurethane adhesive tape may be stored at room temperature.

Examples

Hereinafter, preferred examples will be provided to better understand the present invention. However, the following examples are used for exemplary description purpose only and for those skilled in the art to better understand the present invention. The present invention should not be limited by these examples.

1. Raw materials

(1) Polyester diol

Priplast 3162 (abbreviated as “3162” in Table 1-1, Table 2-1, and Table 3-1, with solid content of 100 wt%), polyester diol, Croda Chemical (Shanghai) Co., Ltd. (located in Shanghai, China), having a molecular weight of 1000.

Priplast 3172 (abbreviated as “3172” in Table 1-1, Table 2-1, and Table 3-1, with solid content of 100 wt%), polyester diol, Croda Chemical (Shanghai) Co., Ltd. (located in Shanghai, China), having a molecular weight of 3000.

Priplast 3192 (abbreviated as “3192” in Table 1-1, Table 2-1, and Table 3-1, with solid content of 100 wt%), polyester diol, Croda Chemical (Shanghai) Co., Ltd. (located in Shanghai, China), having a molecular weight of 2000.

Priplast 3190 (abbreviated as “3190” in Table 1-1, Table 2-1, and Table 3-1, with solid content of 100 wt%), polyester diol, Croda Chemical (Shanghai) Co., Ltd. (located in Shanghai, China), having a molecular weight of 2000.

XCPA-110 (abbreviated as “110” in Table 1-1, Table 2-1, and Table 3-1, with solid content of 100 wt%), polyester diol, Xuchuan Chemical (Suzhou) Co., Ltd. (located in Suzhou, China), having a molecular weight of 1000.

XCPA-195 (abbreviated as “195” in Table 1-1, Table 2-1, and Table 3-1, with solid content of 100 wt%), polyester diol, Xuchuan Chemical (Suzhou) Co., Ltd. (located in Suzhou, China), having a molecular weight of 560.

XCP-1000N (abbreviated as “1000N” in Table 1-1, Table 2-1, and Table 3-1, with solid content of 100 wt%), polyester diol, Xuchuan Chemical (Suzhou) Co., Ltd. (located in Suzhou, China), having a molecular weight of 1000.

5 XCP-500N (abbreviated as “500N” in Table 1-1, Table 2-1, and Table 3-1, with solid content of 100 wt%), polyester diol, Xuchuan Chemical (Suzhou) Co., Ltd. (located in Suzhou, China), having a molecular weight of 500.

(2) Dimer diol

10 Pripol 2033 (abbreviated as “2033” in Table 1-1, Table 2-1, and Table 3-1, with solid content of 100 wt%), polyester diol, Croda Chemical (Shanghai) Co., Ltd. (located in Shanghai, China), having a molecular weight of 570.

(3) Aliphatic polycaprolactone triol

Capa 3031 (abbreviated as “3031” in Table 1-1, Table 2-1, and Table 3-1, with solid content of 100 wt%), aliphatic polycaprolactone triol, Perstorp UK Ltd. (located in Cheshire, UK), having a molecular weight of 300.

15 (4) Hexamethylene diisocyanate trimer

Desmodur N3800 (abbreviated as “N3800” in Table 1-1, Table 2-1, and Table 3-1, with solid content of 100 wt%), Covestro (located in Shanghai, China).

Desmodur N3390 (abbreviated as “N3390” in Table 1-1, Table 2-1, and Table 3-1, with solid content of 90 wt%), Covestro (located in Shanghai, China).

20 (5) Isophorone diisocyanate trimer

Desmodur Z4470 (abbreviated as “Z4470” in Table 1-1, Table 2-1, and Table 3-1, with solid content of 70 wt%), Covestro (located in Shanghai, China).

(6) Silica particles

25 TS-100, silica particles, Evonik (located in Shanghai, China), average diameter D50 = 6.5 μm .

Acematt 3300, polydimethylsiloxane (PDMS) surface-modified silica particles, Evonik (located in Shanghai, China), average diameter D50 = 10 μm .

EXP 3400, polydimethylsiloxane (PDMS) surface-modified silica particles, Evonik (located in Shanghai, China), average diameter D50 = 6.5 μm .

OK-520, wax surface-modified silica particles, Evonik (located in Shanghai, China), average diameter D50 = 6.5 μm .

5 (7) Substrate

PI film (polyimide film), Ningbo Jinshan Electronic Materials Co., Ltd. (located in Ningbo, China).

(8) Others

10 MEK (methyl ethyl ketone), Sinopharm Shanghai Co., Ltd. (located in Shanghai, China), analytical grade.

Dibutyltin dilaurate (DBTDL), Sinopharm Shanghai Co., Ltd. (located in Shanghai, China).

Propylene glycol 1-monomethyl ether 2-acetate, Dow Chemical Co., Ltd. (located in Shanghai, China).

15 MIBK (methyl isobutyl ketone), Sinopharm Shanghai Co., Ltd. (located in Shanghai, China), analytical grade.

BA (butyl acetate), Sinopharm Shanghai Co., Ltd. (located in Shanghai, China), analytical grade.

20 Xylene, Sinopharm Shanghai Co., Ltd. (located in Shanghai, China), analytical grade.

Acetyl acetone, Sinopharm Shanghai Co., Ltd. (located in Shanghai, China), analytical grade.

2. Test methods

25 (1) Room-temperature adhesion test (room-temperature 180° peeling force test)

The surface of a substrate (such as glass substrate, silicon wafer substrate, or stainless steel substrate) was cleaned by using isopropanol (IPA) and purging was performed by using compressed air to dry the surface of the substrate.

5 Cutting was performed to obtain a rectangular adhesive tape test sample with width of 1 inch.

The adhesive tape was laminated onto the surface of the substrate by rolling the adhesive tape back and forth once with an automatic roller (a roller press with an automatic roller, purchased from ChemInstruments located in Fairfield, Ohio, USA) at a load of 4.5 pounds and speed of 12 in/min.

10 The adhesive tape test sample laminated onto the surface of the substrate was placed at room temperature (23°C) for 20 min, then Instron (180° peeling force tester, purchased from Instron located in Boston, USA) was used to test the room-temperature 180° peeling force of the adhesive tape test sample on the surface of the substrate at speed of 12 in/min, and the numerical value of the measured room-temperature 180° peeling force was
15 recorded.

(2) High-temperature resistance test

The surface of a substrate (such as glass substrate, silicon wafer substrate, or stainless steel substrate) was cleaned by using isopropanol (IPA) and purging was
20 performed by using compressed air to dry the surface of the substrate.

Cutting was performed to obtain a rectangular adhesive tape test sample with width of 1 inch.

The adhesive tape was laminated onto the surface of the substrate by rolling the adhesive tape back and forth once with an automatic roller (a roller press with an automatic
25 roller, commercially available from ChemInstruments located in Fairfield, Ohio, USA) at a load of 4.5 pounds and speed of 12 in/min.

The substrate with the laminated adhesive tape test sample was put into a muffle furnace (VULCAN 3-550 muffle furnace commercially available from Densply International located in York, Pennsylvania, USA), the temperature of the furnace was increased from room temperature to preset temperature (for example, 230°C, or 260°C) at speed of 35°C/min, and the preset temperature was kept for a period of time (for example, 10 min, 30 min, or 1h).

The substrate with the laminated adhesive tape test sample was removed from the muffle furnace and cooled to room temperature, and whether blistering, bursting or falling-off appeared in the adhesive tape test sample was observed.

Then the adhesive tape test sample was manually pulled up from the laminated substrate to observe whether there was adhesive residue on the surface of the substrate.

If no blistering, bursting or falling off appeared on the adhesive tape test sample and no adhesive residue was left on the surface of the substrate, it was marked as “good”. Otherwise, it was marked as “unacceptable”.

15

Example E1

1.00 g of propylene glycol 1-monomethyl ether 2-acetate, 1.58 g of butyl acetate (BA), 0.54 g of methyl isobutyl ketone (MIBK), 0.98 g of xylene, 1.77 g of XCPA-110, 1.61 g of XCPA-195, 0.40 g of CAPA-3031, 0.15 g of 1 wt% DBTDL MEK solution, and 0.30 g of acetylacetone were added into a 30 ml plastic bottle. Then, a plastic bottle cap was tightly closed and put into a high-speed mixer ARE-310 (commercially available from Thinky located in Tokyo, Japan). First, mixing was performed for 2 min at speed of 2000 rpm. Then, defoaming was performed for 2 min at speed of 2200 rpm, so as to obtain uniform first solution.

Then, 5.22 g of N3800 and 0.24 g of TS-100 were added to the first solution. Stirring was performed for 5 min on a high-speed disperser SFJ-400 (commercially available from Shanghai Modern Environmental Engineering Technology Co., Ltd. located in Shanghai,

China) at speed of 2500 rpm to obtain uniform second solution (i.e., polyurethane adhesive solution). The components of the second solution and the content thereof were as shown in Table 1-1. For example, in this example, the molar ratio of NCO:OH was 1.034:1. Moreover, the ratio of the weight of silica particles to the total weight of polydiol, aliphatic polycaprolactone triol and polydiisocyanate was 2.67:100. The specific calculation formula of the ratio (A/B) was as follows:

A = weight of silica particles,

$A/B = (\text{weight of silica particles}) / (\text{weight of polydiol} + \text{weight of aliphatic polycaprolactone triol} + \text{weight of polydiisocyanate}).$

The weight of the polydiol, the weight of the aliphatic polycaprolactone triol and the weight of the polydiisocyanate may be respectively calculated according to the following formulas:

Weight of polydiol = weight of polydiol solution $\times$ solid content of polydiol solution,

Weight of aliphatic polycaprolactone triol = weight of aliphatic polycaprolactone triol solution $\times$ solid content of aliphatic polycaprolactone triol solution,

Weight of polydiisocyanate = weight of polydiisocyanate solution $\times$ solid content of polydiisocyanate solution.

In example 1, $A/B = 0.24 / (1.77 \times 100\% + 1.61 \times 100\% + 0.40 \times 100\% + 5.22 \times 100\%) = 2.67/100.$

A PI film with thickness of 25 μm was cut into the size of A4 paper.

The second solution (i.e., polyurethane adhesive solution) was coated on the PI film with a comma roller. The PI film was put into an oven, heated from 120°C to 150°C, and kept at 150°C for 20 min for drying and curing, so as to obtain a polyurethane adhesive tape.

According to the test methods described herein, the polyurethane adhesive tape was subjected to room-temperature 180° peeling force test (surface of glass substrate) and

high-temperature resistance test (surface of glass substrate, after 10 min at 260°C). The test results were listed in Table 1-2.

Examples E2-E15

5 Polyurethane adhesive tapes in examples E2-E15 were prepared by adopting the same method as that in example E1. The difference was that the components of the polyurethane adhesive composition used for preparing the polyurethane adhesive tapes and the content thereof were different, or the thickness of the polyurethane adhesive was different. The details were listed in Table 1-1 and Table 1-2.

10 According to the test methods described herein, the polyurethane adhesive tapes in examples E1-E15 were subjected to room-temperature 180° peeling force test (surface of glass substrate) and high-temperature resistance test (surface of glass substrate, after 10 min at 260°C). The test results were listed in Table 1-2.

15 Table 1-1

	Polyol (Weight ratio)	Polydiisocyanate	NCO: OH in polyurethane adhesive composition (Molar ratio)	Silica particles	A/B
E1	110:195:3031=1:0.91:0.23	N3800	1.026:1	TS-100	2.67/100
E2	110:195:3031=1:1:0.25	N3800	1.034:1	TS-100	4.17/100
E3	110:195:3031=1:1:0.25	N3800	1.034:1	TS-100	5.30/100
E4	110:195:3031=1:1:0.25	N3800	1.034:1	TS-100	6.43/100
E5	110:195:3031=1:1:0.25	N3800	1.034:1	TS-100	2.09/100
E6	110:195:3031=1:1:0.25	N3800	1.034:1	TS-100	1.02/100
E7	110:195:3031=1:1:0.25	N3800	1.034:1	OK 520	2.09/100
E8	110:195:3031=1:1:0.25	N3800	1.034:1	Acematt 3300	2.09/100
E9	3162:2033:3031=1:0.1:0.067	Z4470	1.034:1	---	---
E10	3162:2033:3031=1:0.3:0.067	Z4470	1.034:1	---	---
E11	3162:2033:3031=1:0.5:0.067	Z4470	1.034:1	---	---

E12	3192:3031=1:0.067	Z4470	1.034:1	---	---
E13	3192:3031=1:0.067	N3390:Z4490=7:3 (Molar ratio)	1.034:1	---	---
E14	3192:3031=1:0.067	N3390	1.034:1	---	---
E15	3162:3031=1:0.067	N3390	1.034:1	---	---

- Note 1: A/B = (weight of silica particles) / (weight of polydiol + weight of aliphatic polycaprolactone triol + weight of polydiisocyanate).

Table 1-2

	Average thickness of polyurethane adhesive in polyurethane adhesive tape (μm)	Room-temperature 180° peeling force test (surface of glass substrate) (N/mm)	High-temperature resistance test (surface of glass substrate, after 10 min at 260°C)
E1	41	0.030	Good
E2	38	0.180	Good
E3	46	0.191	Good
E4	40	0.147	Good
E5	32	0.127	Good
E6	57	0.108	Good
E7	47	0.067	Good
E8	55	0.052	Good
E9	44	0.001	Good
E10	41	0.002	Good
E11	40	0.002	Good
E12	29	0.014	Good
E13	30	0.005	Good
E14	39	0.003	Good
E15	33	0.003	Good

5

According to examples E1-E15, when the polyurethane adhesive composition provided by the present invention includes an appropriate amount of polydiol, aliphatic polycaprolactone triol and polydiisocyanate, the adhesive tapes prepared by using the polyurethane adhesive composition not only have good adhesion to the glass surface at

10 room temperature, but also have good high-temperature resistance (after 10 min at 260°C,

there is no blistering, bursting or falling off, and there is no adhesive residue on the surface of the glass substrate).

Example E16

5 61.63 g of MEK (methyl ethyl ketone), 24.17 g of XCPA-110, 24.17 g of XCPA-195, 6.36 g of CAPA-3031, and 2.27 g of 1 wt% DBTDL MEK solution were added into a 500 ml plastic container and uniformly mixed to obtain uniform first solution.

Then, 78.30 g of N3800 and 2.78 g of Acematt 3300 were added to the first solution. Stirring was performed for 5 min on a high-speed disperser SFJ-400 (commercially
10 available from Shanghai Modern Environmental Engineering Technology Co., Ltd. located in Shanghai, China) at speed of 2500 rpm to obtain uniform second solution (i.e., polyurethane adhesive solution). The components of the second solution and the content thereof were as shown in Table 2-1. For example, in this example, the molar ratio of NCO:OH was 1.034:1; and A/B = 2.09/100.

15 A PI film with thickness of 25 μm was cut into the size of A4 paper.

The second solution (i.e., polyurethane adhesive solution) was coated on the PI film with a comma roller. The PI film was put into an oven, heated from 120°C to 150°C for drying and curing, and kept at 150°C for 20 min, so as to obtain a polyurethane adhesive tape.

20 According to the test methods described herein, the polyurethane adhesive tape was subjected to room-temperature 180° peeling force test (surface of silicon wafer substrate) and high-temperature resistance test (surface of silicon wafer substrate). The test results were listed in Table 2-2.

25 Examples E17-E23 and comparative example C1

Polyurethane adhesive tapes in examples E17-E23 and comparative example C1 were prepared by adopting the same method as that in example E16. The difference was that

the components of the polyurethane adhesive composition used for preparing the polyurethane adhesive tapes and the content thereof were different, or the thickness of the polyurethane adhesive was different. The details were listed in Table 2-1 and Table 2-2.

According to the test methods described herein, the polyurethane adhesive tapes were subjected to room-temperature 180° peeling force test (surface of silicon wafer substrate) and high-temperature resistance test (surface of silicon wafer substrate). The test results were listed in Table 2-2.

Table 2-1

	Polyol (Weight ratio)	Polydiisocyanate	NCO: OH in polyurethane adhesive composition (Molar ratio)	Silica particles	A/B
E16	110:195:3031=1:1:0.25	N3800	1.034:1	Acematt 3300	2.09/100
E17	110:195:3031=1:1:0.25	N3800	1.034:1	EXP 3400	2.09/100
E18	110:195:3031=1:1:0.25	N3800	1.034:1	Acematt 3300	3.13/100
E19	110:195:3031=1:1:0.25	N3800	1.034:1	Acematt 3300	4.18/100
E20	110:195:3031=1:1:0.25	N3800	1.034:1	Acematt 3300	5.27/100
E21	110:195:3031=1:1:0.25	N3800	1.034:1	EXP 3400	1.04/100
E22	110:195:3031=1:1:0.25	N3800	1.034:1	EXP 3400	3.13/100
E23	110:195:3031=1:1:0.25	N3800	1.034:1	EXP 3400	5.27/100
C1	110:195:3031=1:1:0.25	N3800	1.034:1	---	---

- 10 • Note 2: A/B = (weight of silica particles) / (weight of polydiol + weight of aliphatic polycaprolactone triol + weight of polydiisocyanate).

Table 2-2

	Average thickness of polyurethane adhesive in polyurethane adhesive tape (μm)	Room-temperature 180° peeling force test (surface of glass substrate) (N/mm)	High-temperature resistance test (surface of silicon wafer substrate, after 1h at 230°C)
E16	55	0.104	Good
E17	21	0.087/0.058	Good
E18	44	0.028	Good
E19	46	0.023	Good
E20	41	0.023	Good
E21	41	0.031	Good
E22	39	0.031	Good
E23	48	0.019	Good
C1	41	0.023	Unacceptable

According to examples E16-E23, when the polyurethane adhesive composition provided by the present invention includes an appropriate amount of polydiol, aliphatic polycaprolactone triol, polydiisocyanate and silica particles, the adhesive tapes prepared by using the polyurethane adhesive composition not only have good adhesion to the surface of the silicon wafer substrate at room temperature, but also have good high-temperature resistance (after 60 min at 230°C, the adhesion to the surface of the silicon wafer substrate is still good, there is no blistering, bursting or falling off, and there is no adhesive residue on the surface of the silicon wafer substrate).

In comparative example C1, the polyurethane adhesive composition did not contain silica particles, so the polyurethane adhesive and adhesive tape prepared by using it failed to pass the high-temperature resistance test.

Example E24

46.18 g of MEK (methyl ethyl ketone), 18.09 g of Priplast 3162, 18.09 g of Pripol 2033, 4.76 g of CAPA-3031, and 1.70 g of 1 wt% DBTDL MEK solution were added into a 500 ml plastic container and uniformly mixed to obtain uniform first solution.

5 Then, 58.16 g of N3800 and 2.02 g of Acematt 3300 were added to the first solution. Stirring was performed for 5 min on a high-speed disperser SFJ-400 (commercially available from Shanghai Modern Environmental Engineering Technology Co., Ltd. located in Shanghai, China) at speed of 2500 rpm to obtain uniform second solution (i.e., polyurethane adhesive solution). The components of the second solution and the content
10 thereof were as shown in Table 3-1. For example, in this example, the molar ratio of NCO:OH was 1.034:1, and A/B = 2.04/100.

A PI film with thickness of 25 μm was cut into the size of A4 paper.

The second solution (i.e., polyurethane adhesive solution) was coated on the PI film with a comma roller. The PI film was put into an oven, heated from 120°C to 150°C for
15 drying and curing, and kept at 150°C for 20 min, so as to obtain a polyurethane adhesive tape.

According to the test methods described herein, the polyurethane adhesive tape was subjected to room-temperature 180° peeling force test (surface of stainless steel substrate) and high-temperature resistance test (surface of stainless steel substrate, after 1h at 260°C).
20 The test results were listed in Table 3-2.

Examples E25-E32 and comparative example C2

Polyurethane adhesive tapes in examples E25-E32 and comparative example C2 were prepared by adopting the same method as that in example E24. The difference was that
25 the components of the polyurethane adhesive composition used for preparing the polyurethane adhesive tapes and the content thereof were different, or the thickness of the polyurethane adhesive was different. The details were listed in Table 3-1 and Table 3-2.

According to the test methods described herein, the polyurethane adhesive tapes in examples E25-E32 and comparative example C2 were subjected to room-temperature 180° peeling force test (surface of stainless steel substrate) and high-temperature resistance test (surface of stainless steel substrate, after 1h at 260°C). The test results were listed in Table

5 3-2.

Table 3-1

	Polyol (Weight ratio)	Polydiisocyanate	NCO: OH in polyurethane adhesive composition (Molar ratio)	Silica particles	A/B
E24	3162:2033:3031=1:1:0.263	N3800	1:034:1	Acematt 3300	2.04/100
E25	3162:2033:3031=1:1:0.263	N3800	1.034:1	TS-100	2.04/100
E26	3172:2033:3031=1:1:0.263	N3800	1.034:1	TS-100	2.04/100
E27	3192:2033:3031=1:1:0.263	N3800	1.034:1	TS-100	2.04/100
E28	3190:2033:3031=1:1:0.263	N3800	1.034:1	TS-100	2.04/100
E29	3190/2033=1:1	N3800	1.034:1	TS-100	2.05/100
E30	3172:3031=1:0.132	N3800	1.034:1	TS-100	2.05/100
E31	3192:3031=1:0.132	N3800	1.034:1	TS-100	2.04/100
E32	3162:3031=1:0.132	N3800	1.034:1	TS-100	2.04/100
C2	3172	N3800	1.034:1	---	---

Note 3: A/B = (weight of silica particles) / (weight of polydiol + weight of aliphatic polycaprolactone triol + weight of polydiisocyanate).

10

Table 3-2

	Average thickness of polyurethane adhesive in polyurethane adhesive tape (μm)	Room-temperature 180° peeling force test (surface of glass substrate) (N/mm)	High-temperature resistance test (surface of stainless steel substrate, after 1h at 260°C)
E24	51	0.010	Good
E25	50	0.027	Good
E26	44	0.009	Good
E27	47	0.020	Good
E28	43	0.004	Good
E29	39	0.017	Good
E30	39	0.010	Good
E31	46	0.012	Good
E32	47	0.010	Good
C2	57	0.025	Unacceptable

According to examples E24-E32, when the polyurethane adhesive composition

5 provided by the present invention includes an appropriate amount of polydiol, aliphatic polycaprolactone triol, polydiisocyanate and silica particles, the adhesive tapes prepared by using the polyurethane adhesive composition provided by the present invention not only have good adhesion to the surface of the stainless steel substrate at room temperature, but also have good high-temperature resistance (after 60 min at 260°C, the adhesion to the

10 surface of the stainless steel substrate is still good, there is no blistering, bursting or falling off, and there is no adhesive residue on the surface of the stainless steel substrate).

In comparative example C1, the polyurethane adhesive composition only contained polyester diol but did not contain aliphatic polycaprolactone triol, so the polyurethane adhesive and adhesive tape prepared by using it failed to pass the high-temperature

15 resistance test.

To sum up, the polyurethane adhesive prepared by using the polyurethane adhesive composition provided by the present invention at least has good low-temperature adhesion performance and good high-temperature resistance.

According to the concept of the present invention, the inventor proposes at least the following technical solutions:

Solution 1: A polyurethane adhesive composition, including: a) a polydiol, at least including a polyester diol having a weight average molecular weight of 400-4000; b) an aliphatic polycaprolactone triol having a weight average molecular weight of 100-600; and c) a polydiisocyanate, at least including one of a hexamethylene diisocyanate trimer and an isophorone diisocyanate trimer.

Solution 2: The polyurethane adhesive composition according to solution 1, wherein the polyester diol at least includes one of an aromatic polyester diol and a fatty acid based polyester diol.

Solution 3: The polyurethane adhesive composition according to solution 1 or 2, wherein the polyester diol has a weight average molecular weight of 500-3000.

Solution 4: The polyurethane adhesive composition according to any one of the preceding solutions, wherein the aliphatic polycaprolactone triol has a weight average molecular weight of 200-400.

Solution 5: The polyurethane adhesive composition according to any one of the preceding solutions, wherein the weight ratio of the polyester diol to the aliphatic polycaprolactone triol is 1:0.01-1:0.7.

Solution 6: The polyurethane adhesive composition according to any one of the preceding solutions, wherein the weight ratio of the polyester diol to the aliphatic polycaprolactone triol is 1:0.04-1:0.5.

Solution 7: The polyurethane adhesive composition according to any one of the preceding solutions, wherein the polydiol further includes a dimer diol.

Solution 8: The polyurethane adhesive composition according to solution 7, wherein the weight ratio of the polyester diol to the dimer diol is 1:0.1-1:1.

Solution 9: The polyurethane adhesive composition according to solution 7 or 8, wherein the weight ratio of the polyester diol to the aliphatic polycaprolactone triol is
5 1:0.04-1:0.3, and the weight ratio of the polyester diol to the dimer diol is 1:0.1-1:1.

Solution 10: The polyurethane adhesive composition according to any one of the preceding solutions, wherein the polyurethane adhesive composition further includes d) silica particles.

Solution 11: The polyurethane adhesive composition according to solution 10,
10 wherein the average particle size of the silica particles is 5-15 μm .

Solution 12: The polyurethane adhesive composition according to solution 10 or 11, wherein the silica particles at least include one of polydimethylsiloxane surface-modified silica particles, wax surface-modified silica particles, and surface-unmodified silica particles.

15 Solution 13: The polyurethane adhesive composition according to solution 10, 11 or 12, wherein the ratio of the weight of the silica particles to the total weight of the polydiol, aliphatic polycaprolactone triol, and polydiisocyanate is 1.0:100-5.1:100.

Solution 14: A polyurethane adhesive, including a cured product of the polyurethane adhesive composition according to any one of solutions 1-13.

20 Solution 15: A polyurethane adhesive tape, including a substrate and the polyurethane adhesive according to solution 14 disposed on the substrate.

Solution 16: The polyurethane adhesive tape according to solution 15, wherein the substrate is a polyimide substrate, a polyester substrate, a polyetheretherketone substrate, release paper, or a release film.

25 Solution 17: A method for preparing a polyurethane adhesive tape, including the following steps: disposing the polyurethane adhesive composition according to any one of solutions 1-13 on a substrate; and curing the polyurethane adhesive composition.

Though the above specific embodiments comprise a great many concrete details for the purpose of illustration through examples, it is to be understood by those of ordinary skill in the art that, many variations, modifications, replacements, and changes to these details shall all fall within the scope of the present invention as claimed in the claims. Therefore,

5 the disclosure as described in the specific embodiments does not pose any limitation to the present invention as claimed in the claims. The proper scope of the present invention should be defined by the claims and proper legal equivalents thereof. All references referred to are incorporated herein by reference in their entireties.

What is claimed is:

1. A polyurethane adhesive composition, comprising:
 - a) a polydiol, at least comprising a polyester diol having a weight average molecular weight of 400-4000;
 - b) an aliphatic polycaprolactone triol having a weight average molecular weight of 100-600; and
 - c) a polydiisocyanate, at least comprising one of a hexamethylene diisocyanate trimer and an isophorone diisocyanate trimer.
2. The polyurethane adhesive composition according to claim 1, wherein the polyester diol at least comprises one of an aromatic polyester diol and a fatty acid based polyester diol.
3. The polyurethane adhesive composition according to claim 1, wherein the polyester diol has a weight average molecular weight of 500-3000.
4. The polyurethane adhesive composition according to claim 1, wherein the aliphatic polycaprolactone triol has a weight average molecular weight of 200-400.
5. The polyurethane adhesive composition according to claim 1, wherein the weight ratio of the polyester diol to the aliphatic polycaprolactone triol is 1:0.01-1:0.7.
6. The polyurethane adhesive composition according to claim 1, wherein the weight ratio of the polyester diol to the aliphatic polycaprolactone triol is 1:0.04-1:0.5.

7. The polyurethane adhesive composition according to claim 1, wherein the polydiol further comprises a dimer diol.
8. The polyurethane adhesive composition according to claim 7, wherein the weight ratio of the polyester diol to the dimer diol is 1:0.1-1:1.
9. The polyurethane adhesive composition according to claim 7, wherein the weight ratio of the polyester diol to the aliphatic polycaprolactone triol is 1:0.04-1:0.3, and the weight ratio of the polyester diol to the dimer diol is 1:0.1-1:1.
10. The polyurethane adhesive composition according to claim 1, wherein the polyurethane adhesive composition further comprises d) silica particles.
11. The polyurethane adhesive composition according to claim 10, wherein the average particle size of the silica particles is 5-15 μm .
12. The polyurethane adhesive composition according to claim 10, wherein the silica particles at least comprise one of polydimethylsiloxane surface-modified silica particles, wax surface-modified silica particles, and surface-unmodified silica particles.
13. The polyurethane adhesive composition according to claim 10, wherein the ratio of the weight of the silica particles to the total weight of the polydiol, aliphatic polycaprolactone triol, and polydiisocyanate is 1:100-5.1:100.

14. A polyurethane adhesive, comprising a cured product of the polyurethane adhesive composition according to any one of claims 1-13.

15. A polyurethane adhesive tape, comprising a substrate and the polyurethane adhesive
5 according to claim 14 disposed on the substrate.

16. The polyurethane adhesive tape according to claim 15, wherein the substrate is a polyimide substrate, a polyester substrate, a polyetheretherketone substrate, release paper, or a release film.
10

17. A method for preparing a polyurethane adhesive tape, comprising the following steps:
disposing the polyurethane adhesive composition according to any one of claims 1-13 on a substrate; and
15 curing the polyurethane adhesive composition.

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2021/055879

A. CLASSIFICATION OF SUBJECT MATTER

INV. C08G18/42 C08G18/79 C09D175/04 C09J175/04 C08L75/04
ADD.

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)

C08G C09D C09J C08L

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)

EPO-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	US 2017/002238 A1 (IHRIG RALF [DE] ET AL) 5 January 2017 (2017-01-05) paragraphs [0061] - [0062], [0098]; claims 1-19; examples 7-8,11 -----	1-17
A	DUNN D. J.: "Engineering and Structural Adhesives", RAPRA REVIEW REPORT, vol. 15, no. 1, 1 January 2004 (2004-01-01), XP055479251, point 2.4; page 7 page 8; table 1 -----	1-17



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2021/055879

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
US 2017002238	A1	05-01-2017	DE 102013226031 A1	18-06-2015
			EP 3083732 A1	26-10-2016
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