DESCRIPTION

Title of Invention: FILM MATERIAL, STRUCTURE, AND WIRING BOARD

Technical Field

[0001] The present disclosure relates to a film material, a structure, and a wiring board.

Background Art

[0002] In general, heat-fusion films typified by polyethylene films and polyethylene terephthalate films are used as adhesives for forming packages.

[0003] In devices requiring high heat resistance, such as electronic component devices, a resin layer that adheres to other members is often formed by a thermosetting adhesive film. For example, in a wiring board in which a plurality of glass substrates are laminated and a resin layer is provided between adjacent glass substrates, the resin layer may be formed by a thermosetting adhesive having adhesiveness to glass substrates and the like (Patent Literatures 1 and 2).

Citation List

Patent Literature

[0004] [Patent Literature 1] Japanese Unexamined Patent Publication No. 2017-107934

[Patent Literature 2] Japanese Unexamined Patent Publication No. 2018-148126

Summary of Invention

Technical Problem

[0005] A thermosetting adhesive film has tackiness at room temperature before curing and is easily deformed, and therefore a certain degree of care is required for handling at room temperature. For this reason, it is common practice to protect both surfaces of the adhesive film with protective films or the like until use, and the adhesive film is often stored under refrigeration. In addition, a curing step is required to develop adhesive strength and heat resistance. On the other hand, in the case of a conventional heat-fusion film, it is not necessarily required to provide a protective film, and a curing step is also unnecessary; however, depending on the application, heat resistance may be insufficient.

[0006] The present disclosure relates to a film material that is excellent in handleability at room temperature, has sufficient heat resistance, and is capable of thermocompression bonding.

Solution to Problem

[0007] The present disclosure includes the following.

[1]

A film material having a first surface and a second surface on a back side thereof,

the film material comprising one or more thermocompression bonding layers,

wherein the thermocompression bonding layer is a resin layer that is non-adhesive at 25°C, has thermocompression bondability at a temperature 10°C or more higher than a glass transition temperature of the thermocompression bonding layer, and does not melt at 250°C or lower, and the outermost layers on both the first surface side and the second surface side are the thermocompression bonding layers.

[2]

The film material according to [1], wherein the thermocompression bonding layer comprises a polyamideimide resin.

[3]

The film material according to [1] or [2], wherein the thermocompression bonding layer comprises a polycarbonate resin, a polyethersulfone resin, or a polyarylate resin.

[4]

The film material according to any one of [1] to [3], wherein a content of an organic solvent in the thermocompression bonding layer is less than 10 mass ppm based on a mass of the thermocompression bonding layer.

[5]

A wound body comprising:

the film material according to any one of [1] to [4]; and

a core,

wherein the film material is wound around the core with the first surface and the second surface in direct contact with each other.

[6]

A structure comprising:

a plurality of sheet-shaped glass substrates; and

an adhesive layer,

wherein the plurality of glass substrates are laminated in a thickness direction of the structure,

the adhesive layer is provided between adjacent glass substrates, and

at least a part of the adhesive layer is the film material according to any one of [1] to [4].

[7]

A wiring board comprising:

a plurality of sheet-shaped glass substrates;

an adhesive layer; and

a wiring layer,

wherein the plurality of glass substrates are laminated in a thickness direction of the structure,

the adhesive layer and the wiring layer are provided between adjacent glass substrates, and

at least a part of the adhesive layer is the film material according to any one of [1] to [4].

Advantageous Effects of Invention

[0008] A film material that is excellent in handleability at room temperature, has sufficient heat resistance, and is capable of thermocompression bonding can be provided.

Brief Description of Drawings

[0009] FIG. 1 is a cross-sectional view illustrating an example of a film material.

FIG. 2 is a cross-sectional view illustrating an example of a film material.

FIG. 3 is a perspective view illustrating an example of a wound body.

FIG. 4 is a cross-sectional view illustrating an example of a wiring board (structure).

Description of Embodiments

[0010] The present invention is not limited to the following examples.

[0011] FIG. 1 is a cross-sectional view illustrating an example of a film material. The film material 10 illustrated in FIG. 1 is a single-layer film composed of one thermocompression bonding layer 1, having a first surface S1 and a second surface S2 on the back side thereof. In other words, the outermost layers of the film material 10 on both the first surface S1 side and the second surface S2 side are the thermocompression bonding layers 1.

[0012] The thermocompression bonding layer 1 is a resin layer that is non-adhesive at 25°C and has thermocompression bondability at a temperature 10°C or more higher than the glass transition temperature of the thermocompression bonding layer 1. The film material 10 can be bonded to other members by thermocompression bonding, in which the film material 10 is pressed against other members while being heated to a temperature 10°C or more higher than the glass transition temperature of the thermocompression bonding layer 1. In addition, since the thermocompression bonding layer 1 located at the outermost layer is non-adhesive at 25°C, the film material 10 can be appropriately stored alone at room temperature in a form such as a wound body without requiring additional members such as a protective film.

[0013] The thermocompression bonding layer 1 that is non-adhesive at 25°C does not substantially adhere to other members when pressed against other members at 25°C. For example, when a 90° peel strength measured by a peel test in which a film material is pressed against a glass plate (inorganic glass plate) at 25°C with a pressure of 6 MPa for 10

seconds so that the glass plate and the thermocompression bonding layer are in contact with each other, and then the film material is peeled off by pulling the film material at 25°C in a direction of 90° with respect to the surface of the glass plate is 5 N/m or less, the thermocompression bonding layer can be regarded as being non-adhesive at 25°C. In the present disclosure, the tensile speed in the peel test can be 50 mm/min.

[0014] The thermocompression bonding layer 1 has thermocompression bondability such that the thermocompression bonding layer 1 adheres to other members when pressed against other members while being heated to a temperature 10°C or more higher than the glass transition temperature of the thermocompression bonding layer 1. For example, when a 90° peel strength measured by a peel test in which a film material is pressed against a glass plate (inorganic glass plate) at a temperature 10°C or more higher than the glass transition temperature of the thermocompression bonding layer 1 with a pressure of 6 MPa for 10 seconds so that the glass plate and the thermocompression bonding layer are in contact with each other, and then the film material is peeled off by pulling the film material at 200°C in a direction of 90° with respect to the surface of the glass plate is 100 N/m or more, the thermocompression bonding layer can be regarded as having thermocompression bondability at a temperature 10°C or more higher than the glass transition temperature of the thermocompression bonding layer. The temperature for evaluation of thermocompression bondability may be 250°C or higher and 300°C or lower. When the film material 10 having the thermocompression bonding layer 1 is bonded to other members by thermocompression bonding, the thermocompression bonding layer 1

heated to a temperature equal to or higher than the glass transition temperature so as to be in a rubbery state is pressed against other members. Since the thermocompression bonding layer 1 normally maintains its form as a "layer" without being completely crushed during thermocompression bonding, re-peeling and re-thermocompression bonding of the film material 10 may be possible.

[0015] The thermocompression bonding layer 1 may have a glass transition temperature of 140°C or higher, or 140°C or higher and 280°C or lower. The thermocompression bonding layer 1 having a glass transition temperature of 140°C or higher can be non-adhesive at 25°C. In addition, when the glass transition temperature of the thermocompression bonding layer 1 is high, deformation such as foaming and wrinkling is less likely to occur in the film material at high temperatures. From the same viewpoint, the glass transition temperature of the thermocompression bonding layer 1 may be 150°C or higher, 160°C or higher, 170°C or higher, 180°C or higher, 190°C or higher, or 200°C or higher. The glass transition temperature of the thermocompression bonding layer 1 may be 280°C or lower, 270°C or lower, 260°C or lower, lower than 260°C, 250°C or lower, 240°C or lower, or 230°C or lower. The glass transition temperature of the thermocompression bonding layer 1 may be a value measured by thermomechanical analysis using a strip-shaped test piece cut out from the thermocompression bonding layer 1 or a strip-shaped test piece formed from the same material as the thermocompression bonding layer 1. The thermomechanical analysis for measuring the glass transition temperature is performed under the conditions of a test piece width of 2

mm, a chuck distance of 10 mm, a temperature range of 30°C to 300°C, under air, a heating rate of 10°C/min, and a tensile load of 98 mN. In a curve representing the relationship between the dimensions of the test piece and the temperature, the temperature at the intersection of the tangent line in the temperature range of the glassy state and the tangent line in the temperature range of the rubbery state can be taken as the glass transition temperature.

[0016] The thermocompression bonding layer 1 may be a resin layer that does not melt at 250°C or lower. "Does not melt at 250°C or lower" means, in other words, that the resin layer does not liquefy at 250°C. For example, if the melting point observed in differential scanning calorimetry of a resin layer exceeds 250°C, the resin layer can be regarded as not melting at 250°C or lower.

[0017] The thermocompression bonding layer 1 may contain, for example, one or more resins selected from a polyamideimide resin, a polycarbonate resin, a polyethersulfone resin, and a polyarylate resin. The thermocompression bonding layer 1 may contain a polyamideimide resin (particularly a thermoplastic polyamideimide resin). The content of these resins in the thermocompression bonding layer 1 may be 50% by mass or more and 100% by mass or less, 60% by mass or more and 100% by mass or less, 70% by mass or more and 100% by mass or less, 80% by mass or more and 100% by mass or less, 90% by mass or more and 100% by mass or less, or 95% by mass or more and 100% by mass or less, based on the mass of the thermocompression bonding layer 1.

[0018] The polyamideimide resin can be, for example, a resin synthesized by forming a polyamic acid by a reaction of a diamine with

an acid anhydride (for example, trimellitic anhydride chloride) and forming an imide group by an imidization reaction of the polyamic acid. In that case, a polyamideimide resin having a constitutional unit derived from a diamine and a constitutional unit derived from an acid anhydride is formed. The diamine may contain a compound having two or more aromatic rings and an ether bond (-O-) connecting the aromatic rings to each other, and the polyamideimide resin formed in that case may be particularly referred to as a polyetheramideimide. Examples of the diamine that is a compound having two or more aromatic rings and an ether bond connecting the aromatic rings to each other include 2,2-bis[4-(4-aminophenoxy)phenyl]propane and 1,3-bis(3-aminophenoxy)benzene. The diamine may contain a compound having a siloxane bond, and an example thereof includes 1,3-bis(3-aminopropyl)-tetramethyldisiloxane. The diamine may contain a compound having an alicyclic compound, and an example thereof includes 1,1-bis(4-aminophenyl)cyclohexane. Examples of other diamines include 1,4-bis[2-(4-aminophenyl)-2-propyl]benzene, 4,4'-methylenebis(2,6-diisopropylaniline), and 4,7,10-trioxa-1,13-tridecanediamine. The glass transition temperature of the thermocompression bonding layer containing the polyamideimide resin can be adjusted by adjusting the type of compound used as the diamine and the monomer ratio.

[0019] The thickness of the thermocompression bonding layer 1 may be, for example, 1 μm or more and 2000 μm or less. The thickness of the thermocompression bonding layer 1 may be 5 μm or more, or 10 μm or more, and may be 1000 μm or less, or 500 μm or less.

[0020] The thermocompression bonding layer 1 can be formed, for example, by a method including forming a film of a resin varnish containing a resin selected from a polyamideimide resin and the like and an organic solvent, and removing the organic solvent from the film of the resin varnish. An organic solvent may remain in the thermocompression bonding layer 1 formed by this method, but the thermocompression bonding layer 1 may be substantially free of an organic solvent. For example, the content of the organic solvent in the thermocompression bonding layer 1 may be less than 10 mass ppm based on the mass of the thermocompression bonding layer 1. A small content of the organic solvent is advantageous in terms of suppression of foaming during thermocompression bonding or when exposed to high temperatures after thermocompression bonding.

[0021] FIG. 2 is a cross-sectional view illustrating another example of a film material. The film material 10 illustrated in FIG. 2 is composed of an intermediate layer 2 and two thermocompression bonding layers 1 provided on both sides of the intermediate layer 2, respectively. In the case of the example of FIG. 2 as well, the outermost layers on both the first surface S1 side and the second surface S2 side of the film material 10 are the thermocompression bonding layers 1. The configuration of the thermocompression bonding layer 1 on the first surface S1 side and the configuration of the thermocompression bonding layer 1 on the second surface S2 side may be the same or different.

[0022] The intermediate layer 2 may be a resin layer different from the thermocompression bonding layer 1, a metal layer, or a combination thereof. The intermediate layer 2 may be, for example, a resin layer

containing a polyimide resin, a resin layer containing polyphenylene sulfide, an aluminum foil, or a copper foil. The thickness of the intermediate layer 2 may be, for example, 1 μm or more and 20000 μm or less.

[0023] The film material may be transported and stored, for example, in a state of being wound around a core. FIG. 3 is a perspective view illustrating an example of a wound body having a film material. A wound body 30 illustrated in FIG. 3 includes a core 31, a film material 10 wound around the core 31, and a side plate 32. The widths (lengths in the direction orthogonal to the winding direction) of the core 31 and the film material 10 may be, for example, 5 mm or more and 500 mm or less. In the wound body 30, the film material 10 is wound around the core 31 with the first surface S1 and the second surface S2 in direct contact with each other, without the first surface S1 and the second surface S2 being covered by other members such as a protective film and a support film. Since the thermocompression bonding layers located at the outermost layers of the film material 10 are non-adhesive at room temperature, the wound body 30 in such a form can be stably transported and stored at room temperature.

[0024] Various structures can be manufactured by thermocompression bonding the film material according to the present disclosure, which includes the thermocompression bonding layer, to other members. The film material may be used as an adhesive layer in various structures. Examples of structures having the film material as an adhesive layer include a fuel cell, a multilayer flexible substrate, a strain gauge, a probe card, and an inkjet head. The film material can also be used to impart

rigidity to a wafer.

[0025] For example, the film material can be used as an adhesive layer in a structure including a plurality of sheet-shaped glass substrates. FIG. 4 is a cross-sectional view illustrating an example of a wiring board that is a structure including an adhesive layer. The wiring board 50 illustrated in FIG. 4 has a plurality of sheet-shaped glass substrates 20, a plurality of adhesive layers 11, conductive wiring layers 3A and 3B, and a conductive via portion 5. The plurality of glass substrates 20 are laminated in the thickness direction of the wiring board 50 (structure), and an adhesive layer 11 is provided between adjacent glass substrates 20. At least a part of the plurality of adhesive layers 11 constituting the wiring board 50 (structure) can be the film material according to the present disclosure. The wiring layers 3A and 3B are provided on the glass substrates 20. Among these, the wiring layer 3A is an internal wiring layer provided between adjacent glass substrates 20. The wiring layer 3B is an external wiring layer exposed on the outer surface of the wiring board 50. Each glass substrate 20 has a through hole 20a, and the via portion 5 includes a portion provided in the through hole 20a. Each adhesive layer 11 functions as an insulating layer that bonds adjacent glass substrates 20 to each other and seals the wiring layer 3A and the via portion 5. The wiring board 50 can be obtained, for example, by a method including heating and pressurizing a laminate in which the film material according to the present disclosure and the glass substrates 20 are alternately laminated. The adhesive layers 11 formed from the film material according to the present disclosure have good adhesiveness to the glass substrates 20 and are less likely to undergo deformation such

as foaming and wrinkling even at high temperatures.

[0026] The glass substrate constituting a structure such as a wiring board may be, for example, a molded body of soda-lime glass, borosilicate glass, alkali-free glass, ceramic glass, or quartz glass. The shape of the glass substrate is not particularly limited. The shape of the glass substrate when viewed from the thickness direction of the glass substrate may be, for example, a polygonal shape, a circular shape, an elliptical shape, or any other irregular shape. The glass substrate may have a rectangular main surface. The main surface here is the surface of the glass substrate when viewed from the thickness direction of the glass substrate. The thickness of the glass substrate can have any appropriate thickness. The thickness of the glass substrate may be, for example, 0.05 mm or more and 5.0 mm or less, 0.1 mm or more and 2.0 mm or less, 0.7 mm or more and 1.5 mm or less, or 1.1 mm or more and 1.3 mm or less.

[0027] The visible light transmittance (total light transmittance) of the glass substrate may be, for example, 80% or more and 100% or less, or 90% or more and 100% or less.

Examples

[0028] The present invention is not limited to the following examples.

1. Resin Varnish

Resin Varnish A

In a 5-liter four-necked flask equipped with a thermometer, a stirrer, a nitrogen inlet tube, and a fractionating column, 270.9 g (0.66 mol) of 2,2-bis[4-(4-aminophenoxy)phenyl]propane and 8.7 g (0.035 mol) of 1,3-bis(3-aminopropyl)-tetramethyldisiloxane were dissolved in

1950 g of N-methyl-2-pyrrolidone under a nitrogen atmosphere. The resulting solution was cooled to -10°C, and 149.5 g (0.71 mol) of trimellitic anhydride chloride was added while maintaining the temperature. After the trimellitic anhydride chloride was dissolved, 100 g of triethylamine was added so that the temperature of the solution did not exceed 10°C. A polyamic acid was produced by a reaction at room temperature for 3 hours. Imidization was allowed to proceed by heating the solution at 180°C for 5 hours to produce a polyetheramideimide from the polyamic acid. The solution containing the polyetheramideimide was poured into methanol. The precipitated solid content was collected and dried. The dried solid content was dissolved in N-methyl-2-pyrrolidone, and the resulting solution was poured into methanol to precipitate the solid content again. The solid content was dried under reduced pressure to obtain a purified powdery polyetheramideimide A (thermoplastic polyamideimide resin). 120 g of this polyetheramideimide A and 3.6 g of a silane coupling agent (manufactured by Dow Toray Co., Ltd., trade name: XIAMETER (registered trademark) OFS-6040 Silane) were dissolved in 280 g of N-methyl-2-pyrrolidone to obtain a resin varnish A for forming a thermocompression bonding layer.

[0029] Resin Varnish B

In a 5-liter four-necked flask equipped with a thermometer, a stirrer, a nitrogen inlet tube, and a fractionating column, 258.6 g (0.63 mol) of 2,2-bis[4-(4-aminophenoxy)phenyl]propane and 67.0 g (0.27 mol) of 1,3-bis(3-aminopropyl)tetramethyldisiloxane were dissolved in 1550 g of N-methyl-2-pyrrolidone under a nitrogen atmosphere. The

resulting solution was cooled to -10°C, and 187.3 g (0.89 mol) of trimellitic anhydride chloride was added while maintaining the temperature. After the trimellitic anhydride chloride was dissolved, 100 g of triethylamine was added so that the temperature of the solution did not exceed 10°C. A polyamic acid was produced by a reaction at room temperature for 3 hours. Imidization was allowed to proceed by heating the solution at 180°C for 5 hours to produce a polyetheramideimide from the polyamic acid. The solution containing the polyetheramideimide was poured into methanol. The precipitated solid content was collected and dried. The dried solid content was dissolved in N-methyl-2-pyrrolidone, and the resulting solution was poured into methanol to precipitate the solid content again. The solid content was dried under reduced pressure to obtain a purified powdery polyetheramideimide B (thermoplastic polyamideimide resin). 120 g of this polyetheramideimide B and 3.6 g of a silane coupling agent (manufactured by Dow Toray Co., Ltd., trade name: XIAMETER (registered trademark) OFS-6040 Silane) were dissolved in 280 g of N-methyl-2-pyrrolidone to obtain a resin varnish B for forming a thermocompression bonding layer.

[0030] Resin Varnish C

18 g of polyetheramideimide A synthesized in the preparation of resin varnish A, 102 g of polyetheramideimide B synthesized for the preparation of resin varnish B, and 3.6 g of a silane coupling agent (manufactured by Dow Toray Co., Ltd., trade name: XIAMETER (registered trademark) OFS-6040 Silane) were dissolved in 280 g of N-methyl-2-pyrrolidone to obtain a resin varnish C for forming a

thermocompression bonding layer.

[0031] Resin Varnish D

In a 5-liter four-necked flask equipped with a thermometer, a stirrer, a nitrogen inlet tube, and a fractionating column, 235.3 g (0.80 mol) of 1,3-bis(3-aminophenoxy)benzene and 85.6 g (0.34 mol) of 1,3-bis(3-aminopropyl)tetramethyldisiloxane were dissolved in 1500 g of N-methyl-2-pyrrolidone under a nitrogen atmosphere. The resulting solution was cooled to -10°C, and 239.7 g (1.14 mol) of trimellitic anhydride chloride was added while maintaining the temperature. After the trimellitic anhydride chloride was dissolved, 138.0 g (1.36 mol) of triethylamine was added so that the temperature of the solution did not exceed 10°C. A polyamic acid was produced by a reaction at room temperature for 3 hours. Imidization was allowed to proceed by heating the solution at 180°C for 5 hours to produce a polyetheramideimide from the polyamic acid. The solution containing the polyetheramideimide was poured into methanol. The precipitated solid content was collected and dried. The dried solid content was dissolved in N-methyl-2-pyrrolidone, and the resulting solution was poured into methanol to precipitate the solid content again. The solid content was dried under reduced pressure to obtain a purified powdery polyetheramideimide D (thermoplastic polyamideimide resin). 120 g of this polyetheramideimide D and 6.0 g of a silane coupling agent (manufactured by Dow Toray Co., Ltd., trade name: XIAMETERTM (registered trademark) OFS-6040 Silane) were dissolved in 280 g of N-methyl-2-pyrrolidone to obtain a resin varnish D for forming a thermocompression bonding layer.

[0032] Resin Varnish E

In a 5-liter four-necked flask equipped with a thermometer, a stirrer, a nitrogen inlet tube, and a fractionating column, 172.4 g (0.42 mol) of 2,2-bis[4-(4-aminophenoxy)phenyl]propane and 153.7 g (0.42 mol) of 4,4'-methylenebis(2,6-diisopropylaniline) were dissolved in 1550 g of N-methyl-2-pyrrolidone under a nitrogen atmosphere. The resulting solution was cooled to -10°C, and 174.7 g (0.83 mol) of trimellitic anhydride chloride was added while maintaining the temperature. After the trimellitic anhydride chloride was dissolved, 130 g of triethylamine was added so that the temperature of the solution did not exceed 10°C. A polyamic acid was produced by a reaction at room temperature for 3 hours. Imidization was allowed to proceed by heating the solution at 180°C for 5 hours to produce a polyetheramideimide from the polyamic acid. The solution containing the polyetheramideimide was poured into methanol. The precipitated solid content was collected and dried. The dried solid content was dissolved in N-methyl-2-pyrrolidone, and the resulting solution was poured into methanol to precipitate the solid content again. The solid content was dried under reduced pressure to obtain a purified powdery polyetheramideimide E (thermoplastic polyamideimide resin). 120 g of this polyetheramideimide E and 6.0 g of a silane coupling agent (manufactured by Dow Toray Co., Ltd., trade name: XIAMETER (registered trademark) OFS-6040 Silane) were dissolved in 280 g of N-methyl-2-pyrrolidone to obtain a resin varnish E for forming a thermocompression bonding layer.

[0033] 2. Glass Transition Temperature of Thermocompression Bonding

Layer

Each of resin varnishes A, B, C, D, and E was applied to a support film. The coating film was dried by heating at 100°C for 10 minutes and at 300°C for 10 minutes to form a thermocompression bonding layer having a thickness of about 40 μm on the support film. A strip-shaped test piece having a size of 2 mm in width × 25 mm in length was cut out from the thermocompression bonding layer peeled off from the support film. This test piece was attached to a chuck for measurement in tensile mode of a thermomechanical analyzer (manufactured by Hitachi High-Tech Corporation, TMA/SS7100 type). The chuck distance was set to 10 mm. Measurement was performed under the conditions of a temperature range of 30°C to 300°C, under air, a heating rate of 10°C/min, and a tensile load of 98 mN. The glass transition temperature of the thermocompression bonding layer formed from each of resin varnishes A, B, C, D, and E was determined from the intersection of the tangent line in the temperature range of the glassy state and the tangent line in the temperature range of the rubbery state in the curve of the measurement results representing the relationship between the dimensions of the test piece and the temperature. The thermocompression bonding layers formed from each of resin varnishes A, B, C, D, and E did not melt at 250°C.

[0034] 3. Thermocompression Bondability

Examples A to E

Each of resin varnishes A, B, C, D, and E was applied to one surface of a polyimide substrate (manufactured by Toray-DuPont Co., Ltd., Kapton EN type, thickness: 0.025 mm), and the coating film was

dried by heating at 140°C for 10 minutes to form a thermocompression bonding layer (polyamideimide resin layer) having a thickness of 10 μm. Thereafter, the same type of resin varnish as the above-described resin varnish was applied to the surface of the polyimide substrate opposite to the thermocompression bonding layer, and the coating film was dried by heating at 300°C for 10 minutes to form a thermocompression bonding layer (polyamideimide resin layer) having a thickness of 10 μm on both surfaces of the polyimide substrate. A strip-shaped film for testing having a size of 10 mm in width × 50 mm in length was cut out from the obtained three-layer laminated film (total thickness: about 0.045 mm). The cut strip-shaped film was overlaid with a glass plate (manufactured by Toshin Riko Co., Ltd., soda-lime glass, 28 mm in width × 48 mm in length × 1.3 mm in thickness, total light transmittance: 90% or more). The resulting laminate was sandwiched between an upper heat stage and a lower heat stage of a thermocompression bonding machine. Subsequently, the laminate was pressurized at a predetermined bonding temperature with a pressure of 6 MPa for 10 seconds to obtain an adhesive body for a peel test after thermocompression bonding. The bonding temperature was set to Tg + 10°C or Tg + 20°C, where Tg is the glass transition temperature of each thermocompression bonding layer. For Examples B, C, and D, an adhesive body for a peel test after thermocompression bonding was also obtained under the condition of a bonding temperature of 250°C. The pressure (6 MPa) of the thermocompression bonding conditions is the pressure applied to the strip-shaped film. A fluororesin tape (thickness: 160 μm) was attached to the upper heat stage and the lower heat stage, and this was interposed

between each heat stage and the laminate. An adhesive body for a peel test after room-temperature bonding was obtained in the same manner except that the temperature of the thermocompression bonding machine was changed to 25°C.

[0035] Comparative Example A

A sheet-shaped laminate of an aluminum foil and a resin layer containing polyethylene (PE) (thickness: about 40 μm) was prepared. A strip-shaped film having a size of 10 mm in width × 50 mm in length was cut out from this laminate. The cut strip-shaped film and a glass plate were overlaid with each other in a direction in which the resin layer was in contact with the glass plate, and the resulting laminate was sandwiched between an upper heat stage and a lower heat stage of a thermocompression bonding machine, and pressurized with a pressure of 6 MPa for 10 seconds while being heated to a bonding temperature of 80°C or 140°C. A peel test was performed on the adhesive body obtained at a bonding temperature of 80°C or 140°C. The pressure (6 MPa) of the thermocompression bonding conditions is the pressure applied to the strip-shaped film. A fluororesin tape (thickness: 160 μm) was attached to the upper heat stage and the lower heat stage, and this was interposed between each heat stage and the laminate. An adhesive body for a peel test after room-temperature bonding was obtained in the same manner except that the temperature of the thermocompression bonding machine was changed to 25°C. The glass transition temperature of the resin layer containing polyethylene shown in Table 2 is the value of Tmg measured by differential scanning calorimetry in accordance with the method for measuring the transition temperature of plastics of Japanese Industrial

Standard JIS K7121-1987.

[0036] Comparative Example B

A sheet-shaped laminate of an aluminum foil and a resin layer containing polyethylene terephthalate (PET) (thickness: about 40 μm) was prepared. A strip-shaped film having a size of 10 mm in width × 50 mm in length was cut out from this laminate. The cut strip-shaped film and a glass plate were overlaid with each other in a direction in which the resin layer was in contact with the glass plate. The resulting laminate was sandwiched between an upper heat stage and a lower heat stage of a thermocompression bonding machine. Subsequently, the laminate was pressurized with a pressure of 6 MPa for 10 seconds while being heated to a bonding temperature of 80°C, 90°C, or 250°C. The pressure (6 MPa) of the thermocompression bonding conditions is the pressure applied to the strip-shaped film. A fluororesin tape (thickness: 160 μm) was attached to the upper heat stage and the lower heat stage, and this was interposed between each heat stage and the laminate. At a bonding temperature of 80°C or 90°C, the resin layer did not adhere to the glass plate, and an adhesive body for a peel test could not be obtained. A peel test was performed on the adhesive body obtained at a bonding temperature of 250°C. An adhesive body for a peel test after room-temperature bonding was obtained in the same manner except that the temperature of the thermocompression bonding machine was changed to 25°C. The glass transition temperature of the resin layer containing polyethylene terephthalate shown in Table 2 is the value of Tmg measured by differential scanning calorimetry in accordance with the method for measuring the transition temperature of plastics of Japanese

Industrial Standard JIS K7121-1987.

[0037] Comparative Example C

A sheet-shaped laminate of an aluminum foil and a thermosetting uncured resin layer containing an epoxy resin (epoxy-based adhesive film, thickness: about 40 μm) was prepared. A strip-shaped film having a size of 10 mm in width × 50 mm in length was cut out from this laminate. The cut strip-shaped film and a glass plate were overlaid with each other in a direction in which the resin layer was in contact with the glass plate. The resulting laminate was sandwiched between an upper heat stage and a lower heat stage of a thermocompression bonding machine. Subsequently, the laminate was pressurized with a pressure of 6 MPa for 10 seconds while being heated to 100°C or 140°C to obtain an adhesive body for a peel test after thermocompression bonding. The pressure (6 MPa) of the thermocompression bonding conditions is the pressure applied to the strip-shaped film. A fluororesin tape (thickness: 160 μm) was attached to the upper heat stage and the lower heat stage, and this was interposed between each heat stage and the laminate. An adhesive body for a peel test after room-temperature bonding was obtained in the same manner except that the temperature of the thermocompression bonding machine was changed to 25°C.

The glass transition temperature of the thermosetting uncured resin layer containing an epoxy resin was measured based on the temperature dependence of dynamic viscoelasticity. An uncured resin layer containing an epoxy resin (thickness: about 100 μm) was formed. A strip-shaped test piece having a size of 4 mm in width × 30 mm in length was cut out from the resin layer. This test piece was attached to a

dynamic viscoelasticity measuring instrument (manufactured by UBM Co., Ltd., Rheogel-E4000 type) with a chuck distance of 20 mm. The dynamic viscoelasticity of the test piece was measured under the conditions of tensile mode, a heating rate of 3°C/min, a temperature range of 30°C to 200°C, under air, a frequency of 10 Hz (constant), a sine wave, continuous vibration, and an initial load under manual control. From the measurement results, the temperature at which the Tan δ value of the uncured resin layer containing an epoxy resin showed the maximum value was determined as the glass transition temperature.

[0038] Peel Test

A 90° peel test was performed in which a laminated film containing a thermocompression bonding layer, or a laminate composed of an aluminum foil and a resin layer, was peeled off from the glass plate of each adhesive body by pulling in a direction of 90°C with respect to the surface of the glass plate, and the 90° peel strength between the thermocompression bonding layer or the resin layer and the glass plate was measured. The tensile speed was 50 mm/min. The 90° peel test was performed under the conditions in which the temperature of the adhesive body was 25°C or 200°C, and the 90° peel strength at each temperature was determined.

[0039] 4. Heat Resistance

Examples A to E

Each of resin varnishes A, B, C, D, and E was applied to a support film that was peelable after drying. The coating film was dried by heating at 100°C for 10 minutes and at 300°C for 10 minutes to form a thermocompression bonding layer having a thickness of about 40 μm on

the support film. A strip-shaped test piece having a size of 10 mm in width × 30 mm in length was cut out from the thermocompression bonding layer peeled off from the support film. The test piece was heat-treated at 120°C for 10 seconds to remove moisture absorbed. The heat-treated test piece (thermocompression bonding layer) was sandwiched between two glass plates, and an evaluation sample having a configuration of glass plate/thermocompression bonding layer/glass plate was placed on a hot plate set to an actual temperature of 200°C, 220°C, 250°C, or 260°C for 10 seconds. Thereafter, the thermocompression bonding layer of the evaluation sample was observed to confirm the presence or absence of foaming or wrinkling, wet spreading, and adhesion to the glass plate. When none of these changes are observed, it can be determined that the thermocompression bonding layer has good heat resistance. The evaluation results are shown in Table 1.

[0040] [Table 1]

		Examples				
		A	B	C	D	E
Thermocompression bonding layer	Resin varnish	A	B	C	D	E
	Glass transition temperature [°C]	230	180	190	150	260
Room-temperature bonding	Bonding conditions	25°C 6MPa 10 sec	25°C 6MPa 10 sec	25°C 6MPa 10 sec	25°C 6MPa 10 sec	25°C 6MPa 10 sec
	90° peel strength @25°C[N/m]	1	1	1	1	1
Thermocompression bonding Tg+10°C	Bonding conditions	240°C 6MPa 10 sec	190°C 6MPa 10 sec	200°C 6MPa 10 sec	160°C 6MPa 10 sec	270°C 6MPa 10 sec
	90° peel strength @25°C[N/m]	1100	130	200	10	1000
	90° peel strength @200°C[N/m]	480	220	250	130	400
Thermocompression bonding Tg+20°C	Bonding conditions	250°C 6MPa 10 sec	200°C 6MPa 10 sec	210°C 6MPa 10 sec	170°C 6MPa 10 sec	280°C 6MPa 10 sec
	90° peel strength @25°C[N/m]	1300	230	220	700	1200
	90° peel strength @200°C[N/m]	670	240	270	220	550
Thermocompression bonding 250°C	Bonding conditions	-	250°C 6MPa 10 sec	250°C 6MPa 10 sec	250°C 6MPa 10 sec	-
	90° peel strength @25°C[N/m]	-	650	730	Cannot be peeled	-
	90° peel strength @200°C[N/m]	-	280	280	270	-
Heat resistance	200°C/10 sec	No change	No change	No change	No change	No change
	220°C/10 sec	No change	No change	No change	No change	No change
	250°C/10 sec	No change	No change	No change	No change	No change
	260°C/10 sec	No change	No change	No change	No change	No change

[0041] Comparative Examples A to C

Strip-shaped test pieces of a resin layer containing polyethylene, a resin layer containing polyethylene terephthalate, or a thermosetting uncured resin layer containing an epoxy resin were prepared, and the heat resistance was evaluated by heating in a state of being sandwiched between glass plates in the same manner as described above. In the case of the resin layer containing polyethylene, the heat treatment at 120°C for 10 seconds for removing absorbed moisture was not performed because the resin layer melted at 120°C. The evaluation results are shown in Table 2.

[0042] [Table 2]

		Comparative Examples		
		A	B	C
Resin layer	Resin	PE	PET	Epoxy-based adhesive film
	Glass transition temperature [°C]	-125	70-80	Less than 100
Room-temperature bonding	Bonding conditions	25°C 6MPa 10 sec	25°C 6MPa 10 sec	25°C 6MPa 10 sec
	90° peel strength @25°C[N/m]	0	0	10
Thermocompression bonding	Bonding conditions	80°C 6MPa 10 sec	80°C or 90°C 6MPa 10 sec	100°C 6MPa 10 sec
	90° peel strength @25°C[N/m]	1	Cannot be measured	15
	90° peel strength @200°C[N/m]	10	Cannot be measured	50
Thermocompression bonding	Bonding conditions	140°C 6MPa 10 sec	250°C 6MPa 10 sec	140°C 6MPa 10 sec
	90° peel strength @25°C[N/m]	2	300	20
	90° peel strength @200°C[N/m]	130	50	50
Heat resistance	200°C/10 sec	Foaming, adhesion	No change	Wet spreading, adhesion
	220°C/10 sec	Foaming, adhesion	No change	Wet spreading, adhesion
	250°C/10 sec	Foaming, adhesion	Wrinkling	Wet spreading, foaming, adhesion
	260°C/10 sec	Foaming, adhesion	Wrinkling	Wet spreading, foaming, adhesion

Reference Signs List

[0043] 1: thermocompression bonding layer, 2: intermediate layer, 3A, 3B: wiring layer, 5: via portion, 10: film material, 11: adhesive layer, 20: glass substrate, 30: wound body, 31: core, 50: wiring board (structure), S1: first surface, S2: second surface.

CLAIMS

[Claim 1]

A film material having a first surface and a second surface on a back side thereof,

the film material comprising one or more thermocompression bonding layers,

wherein the thermocompression bonding layer is a resin layer that is non-adhesive at 25°C, has thermocompression bondability at a temperature 10°C or more higher than a glass transition temperature of the thermocompression bonding layer, and does not melt at 250°C or lower, and outermost layers on both the first surface side and the second surface side are the thermocompression bonding layers.

[Claim 2]

The film material according to claim 1, wherein the thermocompression bonding layer comprises a polyamideimide resin.

[Claim 3]

The film material according to claim 1, wherein the thermocompression bonding layer comprises a polycarbonate resin, a polyethersulfone resin, or a polyarylate resin.

[Claim 4]

The film material according to claim 1, wherein a content of an organic solvent in the thermocompression bonding layer is less than 10 mass ppm based on a mass of the thermocompression bonding layer.

[Claim 5]

A wound body comprising:

the film material according to any one of claims 1 to 4; and

a core,

wherein the film material is wound around the core with the first surface and the second surface in direct contact with each other.

[Claim 6]

A structure comprising:

a plurality of sheet-shaped glass substrates; and

an adhesive layer,

wherein the plurality of glass substrates are laminated in a thickness direction of the structure,

the adhesive layer is provided between adjacent glass substrates, and

at least a part of the adhesive layer is the film material according to any one of claims 1 to 4.

[Claim 7]

A wiring board comprising:

a plurality of sheet-shaped glass substrates;

an adhesive layer; and

a wiring layer,

wherein the plurality of glass substrates are laminated in a thickness direction of the wiring board,

the adhesive layer and the wiring layer are provided between adjacent glass substrates, and

at least a part of the adhesive layer is the film material according to any one of claims 1 to 4.