

SPECIFICATION

TITLE OF INVENTION: Mold release film

TECHNICAL FIELD

[0001] The present invention relates to mold release film.

BACKGROUND ART

[0002] "Mold release films provided with a mold release layer comprising poly(butylene terephthalate) resin (referred to below as "PBT mold release film")" have been proposed in the past (for example, see WO05/030466 and the like). Such mold release film are used in the manufacture of flexible printed circuit boards (hereafter referred to as "FPCs") with a cover lay film (hereafter referred to as "CL film") bonded using a hot press via an adhesive agent to a flexible film for exposed circuits (hereafter referred to as "circuit exposure film"). Thus, during bonding of the CL film to the circuit exposure film, such a mold release film prevents, that mold release layer bonds to the CL film and the circuit exposure film, and between the mold release layers, and exhibits comparatively better embedding (fit to the circuit components (irregularities) not covered by the CL film), and makes it possible prevent the oozing out onto the circuit pattern components of the adhesive agent between the circuit exposure film and the CL film and keep the amount within the permissible range.

PRIOR ART LITERATURE

PATENT LITERATURE

[0003] [Patent Document 1] WO05/030466

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0004] Thus, in the field of manufacture of such FPCs, it is further desirable to have a mold release film with superior embeddability.

[0005] The object of the present invention is to provide a mold release film that, during bonding of the CL film to the circuit exposure film, makes it possible to prevent that mold release layer bonds to the CL film and the circuit exposure film, and

between the mold release layers,
and to have better embeddability than conventional PBT mold release films.

MEANS TO SOLVE THE PROBLEM

[0006] (1)

The mold release film relating to the present invention is provided with a mold release layer as a surface layer on at least one side. Furthermore, this mold release film can be formed from a mold release layer alone. The main constituent of the mold release layer is a blend of poly(butylene terephthalate) homopolymer (A) and a poly(butylene terephthalate) – poly(tetramethylene glycol) copolymer (B).

[0007] Due to combination use of (A) and (B) in the mold release layer, the mold release film of the present invention can reduce the amount of oozes to the CL film adhesive agent onto the circuit pattern components as occurs in conventional mold release films, as well as it suppresses excessive adhesion of the CL adhesive agent and can further increase releasability.

[0008] (2)

For the poly(butylene terephthalate) homopolymer (A) and copolymer (B) in the mold release layer of the mold release film of the abovementioned (1), the weight ratio (A/B) is preferably 25/75 or greater and 80/20 or less.

[0009] (3)

For the poly(butylene terephthalate) homopolymer (A) and copolymer (B) in the mold release layer of the mold release film of the abovementioned (2), the weight ratio (A/B) is preferably 25/75 or greater and 50/50 or less.

[0010] (4)

For the poly(butylene terephthalate) and poly(tetramethylene glycol) copolymer (B) in the mold release films in any of the abovementioned (1) through (3), the copolymer ratio (PBT/PTMG) is preferably 80/20 or greater and 90/10 or less.

[0011] (5)

For the mold release films in any of the abovementioned (1) through (4), it is preferable further to have a cushion layer.

[0012] (6)

For the mold release film in the abovementioned (5), the thickness of the mold release layer is preferably 15 μm or less.

[0013] (7)

The mold release film relating to the present invention is comprises mold release layer as a surface layer on at least one side. Furthermore, this mold release film can be formed from a mold release layer alone. The mold release layer can be formed from a resin with a polyether-ester block copolymer as the main constituent. The polyether-ester block copolymer can be mainly constituted from polyester segments and polyether segments.

[0014] The mold release layer can be formed from a resin mainly constituted from a polyether-ester block copolymer, and along with being able to prevent that mold release layer bonds to the CL film and the circuit exposure film, and between the mold release layers, as with conventional PBT mold release films, this mold release film can reduce the amount of oozing to the adhesive agent between the circuit exposure film and the CL film onto the circuit pattern components compared to conventional PBT mold release films.

[0015] (8)

The mold release film relating to the present invention is comprises a mold release layer as a surface layer on at least one side. Furthermore, this mold release film can be formed from a mold release layer alone. The mold release layer can be formed from a resin with poly(butylene terephthalate)-type resin as the main constituent. Thus, this mold release layer has a thickness that is greater than 0 μm and 15 μm or less.

[0016] The abovementioned mold release film, and along with being able to prevent that mold release layer bonds to the CL film and the circuit exposure film, and between the mold release layers, as with conventional PBT mold release films, this mold release film can reduce the amount of oozing to the adhesive agent between the circuit exposure film and the CL film onto the circuit pattern components compared to conventional PBT mold release films. Furthermore, in

general, the thinner the mold release layer, the more readily cracks occur in the mold release layer under stress loads, but no cracks occur in this mold release film even under stress loads.

[0017] In addition, in this mold release film, the thickness of the mold release layer is greater than 0 μm and 15 μm or less, and this is thinner compared to the mold release layer in conventional PBT mold release films. For this reason, compared to conventional PBT mold release films, this mold release film can reduce the amount of resin used in forming the mold release layer. Consequently, this mold release film can contribute to reducing environmental loads and manufacturing costs.

[0018] (9)

For the mold release film in the abovementioned (8), the thickness of the mold release layer is preferably greater than 0 μm and 15 μm or less.

[0019] (10)

For the mold release film in the abovementioned (8) or (9), the poly(butylene terephthalate)-type resin is preferably poly(butylene terephthalate) resin.

[0020] (11)

For the mold release film in the abovementioned (8) or (9), the poly(butylene terephthalate)-type resin is preferably a polyether-ester block copolymer. The polyether-ester block copolymer is mainly constituted from polyether segments and polyester segments.

[0021] (12)

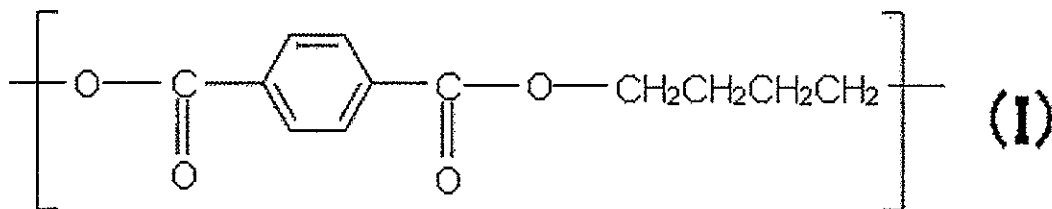
For the mold release film in the abovementioned (7) or (11), the weight ratio for the polyester segments and polyether segments is preferably within the range from 80:20 to 90:10.

[0022] (13)

For the mold release film in the abovementioned (12), the main structural unit of the polyether segments is preferably an oxybutylene unit, and the main structural unit of the polyester segments is an ester unit as shown in Chemical Formula (I) below.

[0023]

[Chemical Structure 1]

**EFFECT OF THE INVENTION**

- [0024] The mold release film relating to the present invention, makes it possible to prevent that mold release layer bonds to the CL film and the circuit exposure film, and between the mold release layers, and to have better embeddability than conventional PBT-type mold release films.

BRIEF EXPLANATION OF DIAGRAMS

- [0025] [Figure 1] A longitudinal section of a multilayer film relating to an embodiment of the present invention.
 [Figure 2] A longitudinal section of a multilayer film relating to Alternative Embodiment (A).
 [Figure 3] A diagram showing an example of a device for manufacturing a multilayer film relating to an embodiment of the present invention.
 [Figure 4] A diagram showing an example of a method of use of a multilayer film relating to an embodiment of the present invention.
 [Figure 5] A diagram showing a heating pattern for a hot press during the bonding of the CL film to the irregularities of the circuit pattern using a multilayer film relating to an embodiment of the present invention.

EXPLANATION OF SYMBOLS

- [0026] 100, 100a Multilayer film (mold release film)
 110 Mold release layer
 110a First mold release layer (mold release layer)
 110b Second mold release layer (mold release layer)
 120 Cushion layer

BEST MODE OF THE PRESENT INVENTION

[0027] — First Embodiment —

As shown in Figure 1, multilayer film 100 relating to a first embodiment of the present invention is chiefly constituted from mold release layer 110 and cushion layer 120. Furthermore, in the present embodiment, the thickness of multilayer film 100 is preferably 25 μm or greater and 300 μm or less. Such layers are described in respective detail below.

[0028] <Details of the layers of the multilayer film>

1. Mold release layer

Mold release layer 110 is formed from a resin that contains poly(butylene terephthalate) homopolymer (A), and copolymer (B) from a poly(butylene terephthalate) component and a poly(tetramethylene glycol) component.

[0029] For homopolymer (A) and copolymer (B) in mold release layer 110, the weight ratio A/B is preferably 10/90 or greater and 90/10 or less, more preferably 20/80 or greater and 80/20 or less, and further preferably 25/75 or greater and 80/20 or less. When A/B = 10/90 or greater and 90/10 or less, the releasability of mold release layer 110 is not decreased because the adhesion of the CL adhesive agent is not excessively strong, and it is possible to prevent an increase in the amount of oozing of the CL adhesive agent. In particular, A/B = 25/75 or greater and 50/50 is preferred from the perspective of increasing the embeddability.

[0030] For the poly(butylene terephthalate) component and poly(tetramethylene glycol) component in copolymer (B) contained in mold release film 110, the copolymer ratio (PBT/PTMG) is preferably 80/20 or greater and 90/10 or less. When PBT/PTMG = 80/20 or greater and 90/10 or less, it is possible to prevent an increase in the amount of oozing of the CL adhesive agent, and it is possible to prevent deterioration of the adhesiveness of the CL adhesive agent.

[0031] Examples resin components that can be contained in mold release layer-forming resins other than those of homopolymer (A) and copolymer (B) include elastomer resins, polyolefin type resins, polystyrene type resins, polyester type resins, polyamide type resins, poly(phenylene ether) resins, poly(phenylene

sulfide) resins (PPS), and the like. Furthermore, such resins can be used individually or in combinations of two or more.

[0032] Further examples of elastomer resins include natural rubber, polybutadiene, polyisoprene, polyisobutylene, neoprene, polysulfide rubber, thiokol rubber, acrylic rubber, urethane rubber, silicone rubber, epichlorohydrin rubber, styrene-butadiene block copolymer (SBR), hydrogenated styrene-butadiene block copolymer (SEB), styrene-butadiene-styrene block copolymer (SBS), hydrogenated styrene-butadiene-styrene block copolymer (SEBS), styrene-isoprene block copolymer (SIR), hydrogenated styrene-isoprene block copolymer (SEP), styrene-isoprene-styrene block copolymer (SIS), hydrogenated styrene-isoprene-styrene block copolymer (SEPS); or, olefin rubbers such as ethylene-propylene rubber (EPM), ethylene-propylene-diene rubber (EPDM), straight-chain low-density polyethylene elastomer, and the like; as well as core-shell type granular elastomers such as butadiene-acrylonitrile-styrene core-shell rubber (ABS), methyl methacrylate-butadiene-styrene core-shell rubber (MBS), methyl methacrylate-butyl acrylate-styrene core-shell rubber (MAS), octyl acrylate-butadiene-styrene core-shell rubber (MABS), alkyl acrylate-butadiene-acrylonitrile-styrene core-shell rubber (AABS), butadiene-styrene core-shell rubber (SBR), siloxane-containing core-shell rubbers such as methyl methacrylate-butyl acrylate-siloxane, and the like, as well as modified rubbers thereof.

[0033] Examples of polyolefin type resins include straight-chain high-density polyethylene, straight-chain low-density polyethylene, high-pressure low-density polyethylene, isotactic polypropylene, syndiotactic polypropylene, block polypropylene, random polypropylene, polybutene, 1,2-polybutadiene, poly(4-methylpentene), cyclic polyolefins, and copolymers thereof (for example,

- ethylene-methyl methacrylate copolymer, and the like), and the like.
- [0034] Examples of polystyrene resins include atactic polystyrene, isotactic polystyrene, high impact resistant polystyrene (HIPS), acrylonitrile-butadiene-styrene copolymer (ABS), acrylonitrile-styrene copolymer (AS), styrene-methacrylic acid copolymer, styrene-methacrylic acid alkyl ester copolymer, styrene-methacrylic acid glycidyl ester copolymer, styrene-acrylic acid copolymer, styrene-acrylic alkyl ester copolymer, styrene-maleic acid copolymer, styrene-fumaric acid copolymer, and the like.
- [0035] Examples of polyester resins include polycarbonate, poly(ethylene terephthalate), and the like.
- [0036] Examples of polyamide resins include Nylon[®] 6, Nylon[®] 66, and the like.
- [0037] Various types of additives can be blended into mold release layer-forming resins, such as antiblocking agents, antioxidant, nucleating agents, antistatic agents, processing oils, plasticizers, mold release agents, flame retardants, aids of flame retardant, pigments and the like.
- [0038] Furthermore, examples of antiblocking agents include the inorganic particles or organic particles described below. Examples of inorganic particles include oxides, hydroxides, sulfides, nitrides, halides, carbonates, sulfates, acetates, phosphates, phosphites, organic carboxylates, silicates, titanates, and borates of the elements of the I, II, IV, VI, VII, VIII, IX, X XI, XII, XIII, XIV, and XV families (IUPAC), and their hydrates, as well as complex compounds focused thereon and natural mineral particles.
- [0039] Specific examples of such inorganic particles include family I element compounds such as lithium fluoride, borax (sodium borate hydrate), and the like; family II element compounds such as magnesium carbonate, magnesium phosphate, magnesium oxide (magnesia), magnesium chloride, magnesium acetate, magnesium fluoride, magnesium titanate, magnesium silicate, magnesium silicate hydrate (talc), calcium carbonate, calcium phosphate,

calcium phosphite, calcium sulfate (gypsum), calcium acetate, calcium terephthalate, calcium hydroxide, calcium silicate, calcium fluoride, calcium titanate, strontium titanate, barium carbonate, barium phosphate, barium sulfate, barium sulfite, and the like; family IV element compounds such as titanium dioxide (titania), titanium monoxide, titanium nitride, zirconium dioxide (zirconia), zirconium monoxide, and the like; family VI element compounds such as molybdenum dioxide, molybdenum trioxide, molybdenum sulfide, and the like; family VII element compounds such as manganese chloride, manganese acetate, and the like; family IX element compounds such as cobalt chloride, cobalt acetate, and the like; family XI element compounds such as copper(I) iodide and the like; family XII element compounds such as zinc oxide, zinc acetate, and the like; family XIII element compounds such as aluminum oxide (alumina), aluminum hydroxide, aluminum fluoride, aluminosilicates (alumina silicate, kaolin, kaolinite), and the like; family XIV element compounds such as silicon oxide (silica, silica gel), plumbago, carbon, graphite, glass, and the like; and natural mineral particles such as carnallite, kainite, isinglass (mica, phlogopite), roasted ore, and the like.

[0040] Examples of organic particles include fluoro resins, melamine type resins, styrene-divinylbenzene copolymers, acrylic type silicone, and cross-linked forms thereof.

[0041] The mean particle diameter of the abovementioned inorganic particles and organic particles is preferably 0.1 μm or greater and 10 μm or less, and the amount added is preferably 0.01 wt% or greater and 15 wt% or less.

[0042] Furthermore, such antiblocking agents can be used individually or in combinations of two or more.

[0043] Examples of antioxidants include phosphorus-type oxidation-inhibiting agents, phenolic-type oxidation-inhibiting agents, sulfur-type oxidation-inhibiting agents, 2-[1-(hydroxy-3,5-di-*t*-pentylphenyl)ethyl]-4,6-di-*t*-pentylphenyl acrylate, and the like. Furthermore, such antioxidants can be used individually or in combinations of two or more.

- [0044] Examples of nucleating agents include metal carboxylates such as aluminum (p-t-butylbenzoate), and the like; metal phosphates such as sodium methylene-bis-(2,4-di-t-butylphenol) acid phosphate and the like; talc, phthalocyanine derivatives, and the like. Furthermore, such nucleating agents can be used individually or in combinations of two or more.
- [0045] Examples of plasticizers include poly(ethylene glycol), polyamide oligomers, ethylene bis(stearamide), phthalate esters, polystyrene oligomers, polyethylene waxes, silicone oils, and the like. Furthermore, such plasticizers can be used individually or in combinations of two or more.
- [0046] Examples of mold release agents include polyethylene waxes, silicone oils, long-chain carboxylic acids, metal long-chain carboxylates, and the like. Furthermore, such mold release agents can be used individually or in combinations of two or more.
- [0047] Examples of processing oils include paraffin type oils, naphtha type oils, aromatic type oils, and the like. Furthermore, among these, paraffin type oils with a C_p of 60% or greater for the number of carbons associated with paraffin (straight chain) as a percentage of the total number of carbons as calculated by the n-d-M method are preferred.
- [0048] The viscosity of the process oils is preferably 15 cS or greater and 600 cS or less for the kinetic viscosity at 40 °C, and further preferably 15 cS or greater and 500 cS or less. Moreover, based on 100 parts by weight of mold release layer-forming resin, the amount of processing oil added is preferably 0.01 parts by weight and 1.5 parts by weight or less, more preferably 0.05 parts by weight and 1.4 parts by weight or less, and further preferably 0.1 parts by weight and 1.3 parts by weight or less. Furthermore, such processing oils can be used individually or in combinations of two or more.
- [0049] 2. Cushion layer
In the present embodiment, cushion layer 120 is formed from a resin (referred to below as a cushion layer-forming resin) with an ethylene-methyl methacrylate copolymer as the main component. Furthermore, the cushion layer-forming resin can be formed from an ethylene-methyl methacrylate copolymer alone. With the aim of good adhesiveness with mold release film 110, a resin with the

same composition as the abovementioned mold release film can be added to this cushion layer-forming resin. With the aim of preventing this cushion layer-forming resin from bleeding out during heating, a polyolefin-type resin can be added. Furthermore, examples of polyolefin resins include straight-chain high-density polyethylene, straight-chain low-density polyethylene, high-pressure low-density polyethylene, isotactic polypropylene, syndiotactic polypropylene, block polypropylene, random polypropylene, polybutene, 1,2-polybutadiene, poly(4-methylpentene), cyclic polyolefins, and copolymers thereof, and the like. In the present embodiment, the thickness of cushion layer 120 is preferably three-fold or more the thickness of mold release layer 110, more preferably five-fold or more, and further preferably eight-fold or more. In the present embodiment, if the adhesiveness between mold release layer 110 and cushion layer 120 is not good, an anchor layer or a primer layer (adhesive layer) can be interposed between these layers.

[0050] Furthermore, according to need and within the scope that is not detrimental to the essence of the present invention, the abovementioned elastomer resins and additives can also be blended into this cushion layer-forming resin.

[0051] <Method for manufacturing a multilayer film>

Multilayer film 100 relating to the present embodiment can be manufactured by methods such as the co-extrusion method, extrusion lamination method, and the like.

[0052] In the co-extrusion method, multilayer film 100 is manufactured by simultaneous extrusion of mold release layer 110 and cushion layer 120 using a feed block and multi-manifold die. Furthermore, in the co-extrusion method, melt M is passed through dies 210 as shown in Figure 3, is introduced into first roller 230, and is cooled by first roller 230 during the period from first roller 230 until it is discharged to give multilayer film 100. Thereafter, this multilayer film 100 is led in the film feed direction (see arrow in Figure 3) to the downstream side by second roller 240, and finally is taken up on a take-up reel (not shown in the Figure). Furthermore, at this time, the temperature of first roller 230 is

preferably 30 °C or higher and 100 °C or lower, and the tip-speed ratio of second roller 240 vs. first roller 230 is preferably 0.990 or higher and 0.998 or lower. Furthermore, depending on need, a touch roller can be provided in the vicinity of the first roller.

- [0053] In the extrusion lamination method, the temperature of the extruder cylinder is set to 225 °C or higher and 250°C or lower, mold release layer 110 is extruded, and multilayer film 100 is manufactured by lamination of mold release layer 110 and cushion layer 120 by merging mold release layer 110 with cushion layer 120. Furthermore, in the extrusion lamination method, melt M is passed through dies 210 as shown in Figure 3, is introduced into first roller 230, and is cooled by first roller 230 during the period from first roller 230 until it is discharged to give mold release film F. Thereafter, this mold release film F is led in the film feed direction (see arrow in Figure 3) to the downstream side by second roller 240. Then, the resin blend melt (not shown in the Figure) that forms cushion layer 120 is merged with mold release film F that is passed to the downstream side in the film feed direction, and is integrated therewith to manufacture multilayer film 100. Furthermore, such a manufactured multilayer film 100 is furthermore taken up on the take-up reel (not shown in the Figure) provided at the downstream side in the film feed direction. Furthermore, also at this time, the temperature of first roller 230 is preferably 30 °C or higher and 100 °C or lower, and the tip-speed ratio of second roller 240 vs. first roller 230 is preferably 0.990 or higher and 0.998 or lower. Furthermore, depending on need, a touch roller can be provided in the vicinity of the first roller.
- [0054] In addition, when there are problems in forming a thin mold release layer 110 by the abovementioned method, molding methods such as the solution-cast molding method or the like can be employed, and mold release layer 110 can be molded from a mold release layer-forming resin solution.
- [0055] <An example of use of the multilayer film>
Since the CL film adheres to the irregularities of the circuit pattern during the bonding of the CL film to the circuit exposure film, multilayer film 100 relating to an embodiment of the present invention is arranged so as to envelope the CL film, and pressure is applied to both the circuit exposure film and the CL film

using a press device. Specifically, as shown in Figure 4, after the circuit exposure film and the CL film are temporarily bonded with an adhesive agent to give 340, and multilayer films 100 are inserted so as to be opposite to mold release layer 110, Teflon[®] sheets 330, rubber cushions 320, and stainless steel plates 310 are sequentially inserted, and hot platens 300 are pressed together (hollow arrow in Figure 4). Furthermore, the heating method using these heat platens 300 is as shown in Figure 5. In other words, after rapidly increasing the temperature from room temperature up to 170 °C over 15 minutes from when pressure application begins, heat platens 300 remain at this temperature for 35 minutes. Thereafter, heat platens 300 are cooled from 170 °C to room temperature over 50 minutes. Furthermore, the pressure applied by heat platens 300 begins at 0 minutes and is released at 100 minutes. Furthermore, the applied pressure of the press at this time is suitably adjusted to be 5 MPa or greater and 15 MPa or less.

[0056] <Alternative embodiment>

(A)

In the first embodiment, as in the second embodiment and third embodiment mentioned below, multilayer film 100 was introduced with mold release layer 110 provided only on one side of cushion layer 120, but as shown in Figure 2, the present invention also includes an embodiment in which multilayer film 110A is provided with mold release layers 110a, 110b on both sides of cushion layer 120. Furthermore, as explained below, the mold release layer with the symbol 110a is called the "first mold release layer", and the mold release layer with the symbol 110b is called the "second mold release layer".

[0057] First mold release layer 110a has the same structure as the abovementioned mold release layer 110. On the other hand, second mold release layer 110b can have the same structure as first mold release layer 110a, or it can have a structure different than that of first mold release layer 110a.

[0058] When second mold release layer 110b has the same structure as first mold release layer 110a, the thickness of second mold release layer 110b is preferably greater than 0 μm and 15 μm or less, more preferably greater than 0 μm and 12 μm or less, and further preferably greater than 0 μm and 10 μm or less, still more preferably greater than 0 μm and 8 μm or less, still more preferably greater than 0 μm and 6 μm or less, still more preferably greater than

0 μm and 5 μm or less, still more preferably greater than 0 μm and 4 μm or less, still more preferably greater than 0 μm and 3 μm or less, still more preferably greater than 0 μm and 2 μm or less, and still more preferably greater than 0 μm and 1 μm or less.

[0059] When second mold release layer 110b has a structure different from that of first mold release layer 110a, second mold release layer 110b can be formed from a resin having as the main component, for example, polypropylene resin, polymethylpentene resin, methylpentene- α -olefin copolymer, or a polystyrene-type resin having a syndiotactic structure. Furthermore, polymethylpentene resin and methylpentene- α -olefin copolymer can be obtained commercially under the trade name TPX[®] (Mitsui Chemicals). Additionally, a polystyrene-type resin having a syndiotactic structure can be obtained commercially under the trade name XAREC[®] (Idemitsu Kosan). In this case, the adhesive strength between second mold release layer 110b and cushion layer 120 would be reduced, but in such a case, an anchor layer or primer layer (adhesive layer) can be interposed between second mold release layer 110b and cushion layer 120. Furthermore, when second mold release layer 110b is formed from a resin with polypropylene resin as the main component, getting good adhesiveness between the abovementioned cushion layer 120 and second mold release layer 110b does not require the interposition of an anchor layer or primer layer (adhesive layer) therebetween. Moreover, in such cases, the thickness of second mold release layer 110b is preferably 5 μm or more, and further preferably 10 μm or more.

[0060] (B)

In an example using the multilayer film relating to the first embodiment, and the second embodiment and third embodiment mentioned below, Teflon[®] sheets 330, rubber cushions 320, and stainless steel plates 310 were sequentially inserted between multilayer films 100 and hot platens 300, but the Teflon[®] sheets 330, rubber cushions 320, and stainless steel plates 310 can also be omitted.

Working Examples

[0061] The present invention is explained below in further detail as shown in the working examples and reference examples.

[0062] (Working Example 1)

1. Manufacture of multilayer films

(1) Raw material for the first mold release layer

The resin composition used as the raw material for the first mold release layer is poly(butylene terephthalate) homopolymer (A) and copolymer (B) with a weight ratio A/B = 80/20.

Poly(butylene terephthalate) homopolymer (A):

NOVADURAN[®] 5020 (Mitsubishi Engineering Plastics)

Copolymer (B) with a poly(butylene terephthalate) component and poly(tetramethylene glycol) component:

NOVADURAN[®] 5505S (Mitsubishi Engineering Plastics)

(Copolymer ratio: PBT component/PTMG component = 90/10)

[0063] (2) Raw material for the cushion layer

Ethylene-methyl methacrylate copolymer (ACRYFT[®] WD106, Sumitomo Chemicals; content of methyl methacrylate-derived units: 5 wt%) was used as raw material for the cushion layer.

[0064] (3) Raw materials for the second mold release layer

Polypropylene (Noblen FS2011DG2, Sumitomo Chemicals) was used as raw material for the second mold release layer.

[0065] (4) Adhesive layer

Modified polyethylene (MODIC[®] F515A, Mitsubishi Chemicals) was used as the resin for forming an adhesive layer to bond the first mold release layer and the cushion layer.

[0066] (5) Manufacture of multilayer films

A multilayer film having the first mold release layer and second mold release layer on the top and bottom of the cushion layer was manufactured using a co-extruder (see Figure 2).

- [0067] Furthermore, specifically, using a feed block and multi-manifold die, a multilayer film is manufactured by simultaneous extrusion of a poly(butylene terephthalate) / poly(tetramethylene glycol) copolymer, modified polyethylene, ethylene-methyl methacrylate copolymer, and polypropylene. Furthermore, the device shown in Figure 3 was used for this, but the temperature of first roller 230 was 60 °C, and the tip-speed ratio of second roller 240 vs. first roller 230 was 1.
- [0068] The thickness of the first mold release layer of this multilayer film was 12 μm, the thickness of the adhesive layer was 10 μm, the thickness of the cushion layer was 88 μm, the thickness of the second mold release layer was 10 μm.
- [0069] 2. CL film bonding test
In practical terms, the CL film was temporarily joined to the circuit exposure film through an adhesive agent, and with both sides of the abovementioned multilayer film enclosed with the first mold release layer facing the circuit exposure film, this was hot-pressed with the heating pattern shown in Figure 5 using a hot platen press. This resulted in the amount of adhesive agent between the circuit exposure film and the CL film that oozed onto the circuit pattern being less than 90 μm (see Table 1). In addition, the multilayer film can be readily peeled off from the circuit exposure film, and the incidence of multilayer films with poor peel-off (film residues on the circuit, adherences) was less than 1.0% (see Table 1).
- [0070] 3. Test of peel-off from the CL adhesive agent
The first mold release layer was directly bonded to the CL adhesive layer surface formed on a polyimide film, and this was pressure treated at 170 °C and 4 MPa for 10 minutes. Thereafter, whether or not the CL adhesive agent could be readily peeled off from the first mold release layer was confirmed by peeling off the two bonded films. The result was that peel-off could be readily achieved, and no mold release film adherences occurred (see Table 1)
- [0071] (Working Example 2)
A multilayer film was prepared in the same manner as for Working Example 1 except for using a resin composition with a weight ratio A/B = 70/30 for poly(butylene terephthalate) homopolymer (A) and copolymer (B) as the raw material for the first mold release layer, and this multilayer film was evaluated in

the same manner as for Working Example 1.

[0072] The amount of adhesive agent between the circuit exposure film and the CL film that oozed onto the circuit pattern was less than 90 μm (see Table 1). Additionally, the multilayer film can readily be peeled off from the circuit exposure film after the hot press, and the incidence of poor multilayer film separation is less than 1.0% (see Table 1). In the test of peel-off from the CL adhesive agent, peel-off could be readily achieved, and no mold release film adherences occurred (see Table 1).

[0073] (Working Example 3)

A multilayer film was prepared in the same manner as for Working Example 1 except for using a resin composition with a weight ratio A/B = 50/50 for poly(butylene terephthalate) homopolymer (A) and copolymer (B) as the raw material for the first mold release layer, and this multilayer film was evaluated in the same manner as for Working Example 1.

[0074] The amount of adhesive agent between the circuit exposure film and the CL film that oozed onto the circuit pattern was less than 80 μm (see Table 1). Additionally, the multilayer film can readily be peeled off from the circuit exposure film after the hot press, and the incidence of poor multilayer film separation is less than 1.0% (see Table 1). In the test of peel-off from the CL adhesive agent, peel-off could be readily achieved, and no adherences occurred (see Table 1).

[0075] (Working Example 4)

A multilayer film was prepared in the same manner as for Working Example 1 except for using a resin composition with a weight ratio A/B = 25/75 for poly(butylene terephthalate) homopolymer (A) and copolymer (B) as the raw material for the first mold release layer, and this multilayer film was evaluated in the same manner as for Working Example 1.

[0076] The amount of adhesive agent between the circuit exposure film and the CL film that oozed onto the circuit pattern was less than 80 μm , which is superior to that obtained with a conventional PBT mold release film (see Table 1). Moreover, the multilayer film can readily be peeled off from the circuit exposure film after the hot press, and the incidence of poor multilayer film separation is less than 1.0%, which is equally as good as a conventional PBT mold release film (see

Table 1). In the test of peel-off from the CL adhesive agent, peel-off could be readily achieved, and no adherences occurred (see Table 1).

[0077] (Reference Example 1)

A multilayer film was prepared in the same manner as for Working Example 1 except that a copolymer with a poly(butylene terephthalate) component and a poly(tetramethylene glycol) component (NOVADURAN® 5505S, Mitsubishi Engineering Plastics; copolymer ratio: PBT component/PTMG component: 90/10) was used as the only raw material for the first mold release layer, and this multilayer film was evaluated. Furthermore, since the reference example was only intended for confirmation of the effect of the working examples, it does not represent an example of prior art such as a comparative example.

[0078] The amount of adhesive agent between the circuit exposure film and the CL film that oozed onto the circuit pattern was less than 80 μm (see Table 1). The incidence of poor multilayer film separation is less than 1.0% for the multilayer film after the hot press (see Table 1). However, it could not be readily peeled off from the CL adhesive agent, and adherences did occur (see Table 1).

[0079]

[Table 1]

		Working Example 1	Working Example 2	Working Example 3	Working Example 4	Reference Example 1
Component weight ratio in the mold release layer	Homo-PBT PBT copolymer	80 20	70 30	50 50	25 75	0 100
Evaluation results	Releasability: Incidence (%) of poor release of circuit exposure film	Less than 1.0%	Less than 1.0%	Less than 1.0%	Less than 1.0%	Less than 1.0%
	Amount of CL adhesive oozing (μm)	Less than 90 μm	Less than 90 μm	Less than 80 μm	Less than 80 μm	Less than 80 μm
	Releasability: Presence of CL adhesive adherences	Absent	Absent	Absent	Absent	Present

[0080] Furthermore, in Table 1, "homo-PBT" means poly(butylene terephthalate) homopolymer, and "copolymer PBT" means a copolymer with a poly(butylene terephthalate) component and poly(tetramethylene glycol) component.

[0081] — Second Embodiment —

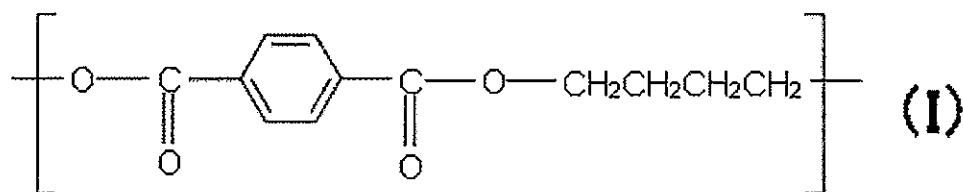
Multilayer film 100 relating to a second embodiment of the present invention is described. The main difference between multilayer film 100 relating to the first embodiment and multilayer film 100 relating to the second embodiment is from the perspective that the essential composition of mold release layer 110 is different. Furthermore, the composition that the multilayer film 100 relating to the second embodiment has in common with the multilayer film 100 relating to the abovementioned first embodiment is accordingly omitted from the description. In addition, in the present embodiment, the thickness of multilayer film 100 is preferably 25 μm or greater and 300 μm or less. The respective layers are described in respective detail below.

[0082] Mold release layer 110 is formed from a resin that has a polyether-ester block copolymer as the main component (referred to below as a "mold release layer-forming resin"). The polyether-ester block copolymer content in the mold release layer-forming resin is 90 wt% or higher, preferably 95 wt% or higher. Furthermore, mold release layer 110 can be formed from a polyether-ester block copolymer alone. The composition of the mold release layer-forming resin is discussed in detail below.

[0083] (1) Polyether-ester block copolymer

The polyether-ester block copolymer is mainly constituted from polyether segments and polyester segments. Furthermore, the weight ratio of the polyester segments and polyether segments is preferably within the range from 80:20 to 90:10. Additionally, the main structural unit of the polyether segments is preferably an oxybutylene unit, and the main structural unit of the polyester segments is an ester unit as shown in Chemical Formula (I) below. Furthermore, such a polyether-ester block copolymer is commercially available as NOVADURAN[®] 5505S or 5510S (Mitsubishi Engineering Plastics).

[0084] [Chemical Structure 2]



[0085] (2) Resins other than polyether-ester block copolymer

Examples of mold release layer-forming resins composed of resins other than polyether-ester block copolymer include elastomer resins, polyolefin type resins, polystyrene type resins, polyester type resins, polyamide type resins, poly(phenylene ether) resins, poly(phenylene sulfide) (PPS) resins, and the like. Furthermore, such resins can be used individually or in combinations of two or more.

[0086] Furthermore, examples of elastomer resins, polyolefin type resins, polystyrene type resins, and polyamide type resins are resins similar to those of the abovementioned first embodiment. Examples of polyester type resins include polycarbonate, poly(ethylene terephthalate), poly(butylene terephthalate), and the like.

[0087] (2) Miscellaneous

Various types of additives similar to those of the abovementioned first embodiment can be blended into mold release layer-forming resins, such as antiblocking agents, antioxidants nucleating agents, antistatic agents, processing oils, plasticizers, mold release agents, flame retardants, aids of flame retardant, pigments and the like.

[0088] 2. Cushion layer

Cushion layer 120 is formed in the same manner as that of the abovementioned first embodiment.

[0089] <Manufacture and use of the multilayer film>

Multilayer film 100 relating to the present embodiment can be manufactured and used in the same manner as that of the abovementioned first embodiment.

[0090] The present invention is explained below in further detail using working examples and comparative examples.

[0091] (Working Example 1)

1. Manufacture of multilayer films

- (1) Raw materials for the first mold release layer
Poly(butylene terephthalate) / poly(tetramethylene glycol) copolymer (NOVADURAN[®] 5505S, Mitsubishi Engineering Plastics; poly(butylene terephthalate) structural units / poly(tetramethylene glycol) structural units: 90 parts by weight / 10 parts by weight) was used as the raw material for the first mold release layer.
- [0092] (2) Raw material for the cushion layer
Ethylene-methyl methacrylate copolymer (ACRYFT[®] WD106, Sumitomo Chemicals; content of methyl methacrylate-derived units: 5 wt%) was used as raw material for the cushion layer.
- [0093] (3) Raw materials for the second mold release layer
Polypropylene (Noblen FS2011DG2, Sumitomo Chemicals) was used as raw material for the second mold release layer.
- [0094] (4) Adhesive layer
Modified polyethylene (MODIC[®] F515A, Mitsubishi Chemicals) was used as the resin for forming an adhesive layer to bond the first mold release layer and the cushion layer.
- [0095] (5) Manufacture of multilayer films
A multilayer film having the first mold release layer and second mold release layer on the top and bottom of the cushion layer was manufactured using a co-extruder (see Figure 2).
- [0096] Furthermore, specifically, using a feed block and multi-manifold die, a multilayer film is manufactured by simultaneous extrusion of a poly(butylene terephthalate) / poly(tetramethylene glycol) copolymer, modified polyethylene, ethylene-methyl methacrylate copolymer, and polypropylene. Furthermore, the device shown in Figure 3 was used for this, but the temperature of first roller 230 was 60 °C, and the tip-speed ratio of second roller 240 vs. first roller 230 was 1.
- [0097] The thickness of the first mold release layer of this multilayer film was 28 μm, the thickness of the adhesive layer was 10 μm, the thickness of the cushion

layer was 72 μm , the thickness of the second mold release layer was 10 μm .

[0098] 2. CL film bonding test

In practical terms, the CL film was temporarily joined to the circuit exposure film through an adhesive agent, and with both sides of the abovementioned multilayer film enclosed with the first mold release layer facing the circuit exposure film, this was hot-pressed with the heating pattern shown in Figure 5 using a hot platen press. This resulted in the amount of adhesive agent between the circuit exposure film and the CL film that oozed onto the circuit pattern being less than 80 μm , which is superior to that obtained with a conventional PBT mold release film (see Comparative Example 1) (see Table 2). Additionally, the incidence of poor release of the multilayer film after the hot press was less than 1.0%, which is equally as good as conventional PBT mold release films (see Table 2).

[0099] (Working Example 2)

A multilayer film was prepared in the same manner as for Working Example 1 except that a poly(butylene terephthalate) / poly(tetramethylene glycol) copolymer (NOVADURAN[®] 5510S, Mitsubishi Engineering Plastics; poly(butylene terephthalate) structural units / poly(tetramethylene glycol) structural units: 80 parts by weight / 20 parts by weight) was used as the raw material for the first mold release layer, and this multilayer film was evaluated.

[0100] The amount of adhesive agent between the circuit exposure film and the CL film that oozed onto the circuit pattern being less than 80 μm , which is superior to that obtained with a conventional PBT mold release film (see Comparative Example 1) (see Table 2). Additionally, the incidence of poor release of the multilayer film after the hot press was less than 1.0%, which is equally as good as conventional PBT mold release films (see Table 2).

[0101] (Comparative Example 1)

A multilayer film was prepared in the same manner as for Working Example 1 except that a poly(butylene terephthalate)-(NOVADURAN[®] 5020, Mitsubishi Engineering Plastics) was used as the raw material for the first mold release layer, and this multilayer film was evaluated.

[0102] The amount of adhesive agent between the circuit exposure film and the CL film

that oozed onto the circuit pattern was 150 μm or greater(see Table 2). The incidence of poor multilayer film separation is less than 1.0% for the multilayer film after the hot press (see Table 2).

[0103]

[Table 2]

		Working Example 1	Working Example 2	Comparative example 1
First mold release layer	Resin	PBT/PTMG (90/10)	PBT/PTMG (80/20)	PBT
	Layer thickness (μm)	28	28	28
Adhesive layer	Resin	Modified PE	Modified PE	Modified PE
	Layer thickness (μm)	10	10	10
Cushion layer	Resin	EMMA	EMMA	EMMA
	Layer thickness (μm)	72	72	72
Second mold release layer	Resin	PP	PP	PP
	Layer thickness (μm)	10	10	10
Entire thickness of multilayer film (μm)		120	120	120
Evaluation results	Amount of oozing	Less than 80 μm	Less than 80 μm	More than 150 μm
	Incidence (%) of poor release	Less than 1.0%	Less than 1.0%	Less than 1.0%

[0104] Furthermore, in Table 2, "PBT/PTMG (90/10)" means a poly(butylene terephthalate) / poly(tetramethylene glycol) copolymer (poly(butylene terephthalate) segments / poly(tetramethylene glycol) segments = 90 parts by weight / 10 parts by weight), "PBT/PTMG (80/20)" means a poly(butylene terephthalate) / poly(tetramethylene glycol) copolymer (poly(butylene terephthalate) segments / poly(tetramethylene glycol) segments = 80 parts by weight / 20 parts by weight), "PBT" means poly(butylene terephthalate), "modified PE" means modified polyethylene, "EMMA" means ethylene-methyl methacrylate copolymer (methyl methacrylate-derived unit content: 5 wt%), and "PP" means polypropylene.

[0105] — Third Embodiment —

Multilayer film 100 relating to a third embodiment of the present invention is explained. The main difference between multilayer film 100 relating to the first and second embodiment and multilayer film 100 relating to the third embodiment is from the perspective that the essential structure of mold release layer 110 is different. Furthermore, the composition that the multilayer film 100 relating to the third embodiment has in common with the multilayer film 100 relating to the abovementioned first embodiment is accordingly omitted from the description. In addition, in the present embodiment, the thickness of multilayer film 100 is preferably 25 μm or greater and 300 μm or less. The respective layers are described in respective detail below.

[0106] <Details of the layers of the multilayer film>

1. Mold release layer

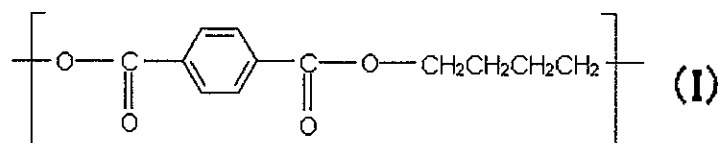
Mold release layer 110 is formed from a resin that has a poly(butylene terephthalate) resin as the main component (referred to below as a "mold release layer-forming resin"). Furthermore, the thickness of mold release layer 110 of the present embodiment is greater than 0 μm and 15 μm or less. Moreover, the thickness of this mold release layer is preferably greater than 0 μm and 12 μm or less, more preferably greater than 0 μm and 10 μm or less, still more preferably greater than 0 μm and 8 μm or less, still more preferably greater than 0 μm and 6 μm or less, still more preferably greater than 0 μm and 5 μm or less, still more preferably greater than 0 μm and 4 μm or less, still more

preferably greater than 0 μm and 3 μm or less, still more preferably greater than 0 μm and 2 μm or less, and still more preferably greater than 0 μm and 1 μm or less. Furthermore, in paragraph [0052] of WO05/030466, the "preferred lower limit for the thickness of the abovementioned mold release layer is 5 μm ", but the only mold release layer thickness disclosed in the working examples is 25 μm . The composition of the mold release layer-forming resin is discussed in detail below.

[0107] (1) Poly(butylene terephthalate)-type resin

Poly(butylene terephthalate)-type resin is, for example, poly(butylene terephthalate) resin or a copolymer with the poly(butylene terephthalate) unit as a main component, or the like (see Chemical Formula (I) below). An example of a copolymer with the poly(butylene terephthalate) unit as a main component is, for example, is a polyether-ester block copolymer composed of poly(butylene terephthalate) segments and polyoxybutylene segments. Furthermore, the weight ratio of the poly(butylene terephthalate) segments and polyoxybutylene segments is preferably within the range from 80:20 to 90:10. Furthermore, such a polyether-ester block copolymer is commercially available as NOVADURAN[®] 5505S or 5510S (Mitsubishi Engineering Plastics).

[0108] [Chemical Structure 3]



[0109] The poly(butylene terephthalate)-type resin content in the mold release layer-forming resin of the present embodiment is 90 wt% or higher, preferably 95 wt% or higher. Furthermore, mold release layer 110 can be formed from a poly(butylene terephthalate)-type resin alone.

[0110] (2) Resins other than poly(butylene terephthalate)-type resin

Examples of resins composed of mold release layer-forming resins other than poly(butylene terephthalate)-type resin include elastomer resins, polyolefin type resins, polystyrene type resins, polyester type resins, polyamide type resins, poly(phenylene ether) resins, poly(phenylene sulfide) (PPS) resins, and the like. Furthermore, such resins can be used individually or in combinations of two or more.

[0111] Furthermore, examples of elastomer resins, polyolefin type resins, polystyrene type resins, and polyamide type resins are resins similar to those of the abovementioned first embodiment. Examples of polyester-type resins include polycarbonate, poly(ethylene terephthalate), and the like.

[0112] (3) Miscellaneous

Various types of additives similar to those of the abovementioned first embodiment can be blended into mold release layer-forming resins, such as antiblocking agents, antioxidants nucleating agents, antistatic agents, processing oils, plasticizers, mold release agents, flame retardants aids of flame retardant, pigments and the like.

[0113] 2. Cushion layer

Cushion layer 120 is formed in a manner similar to that of the abovementioned first embodiment.

[0114] <Manufacture and use of the multilayer film>

Multilayer film 100 relating to the present embodiment can be manufactured and used in the same manner as that of the abovementioned first embodiment.

[0115] The present invention is explained below in further detail using working examples.

[0116] (Working Example 1)

1. Manufacture of multilayer films

(1) Raw materials for the first mold release layer

Poly(butylene terephthalate) / poly(tetramethylene glycol) copolymer (poly(butylene terephthalate) structural units / poly(tetramethylene glycol) structural units: 80 parts by weight / 20 parts by weight; NOVADURAN® 5510S, Mitsubishi Engineering Plastics) was used as the raw material for the first mold release layer.

- [0117] (2) Raw material for the cushion layer
Ethylene-methyl methacrylate copolymer (ACRYFT® WD106, Sumitomo Chemicals; content of methyl methacrylate-derived units: 5 wt%) was used as raw material for the cushion layer.
- [0118] (3) Raw materials for the second mold release layer
Polypropylene (Noblen FS2011DG2, Sumitomo Chemicals) was used as raw material for the second mold release layer.
- [0119] (4) Adhesive layer
Modified polyethylene (MODIC® F515A, Mitsubishi Chemicals) was used as the resin for forming an adhesive layer to bond the first mold release layer and the cushion layer.
- [0120] (5) Manufacture of multilayer films
A multilayer film having the first mold release layer and second mold release layer on the top and bottom of the cushion layer was manufactured using a co-extruder (see Figure 2).
- [0121] Furthermore, specifically, using a feed block and multi-manifold die, a multilayer film is manufactured by simultaneous extrusion of a poly(butylene terephthalate) / poly(tetramethylene glycol) copolymer, modified polyethylene, ethylene-methyl methacrylate copolymer, and polypropylene. Furthermore, the device shown in Figure 3 was used for this, but the temperature of first roller 230 was 60 °C, and the tip-speed ratio of second roller 240 vs. first roller 230 was 1.
- [0122] The thickness of the first mold release layer of this multilayer film was 6 µm, the thickness of the adhesive layer was 10 µm, the thickness of the cushion layer was 94 µm, the thickness of the second mold release layer was 10 µm.
- [0123] 2. CL film bonding test
In practical terms,
the CL film was temporarily joined to the circuit exposure film through an adhesive agent, and with both sides of the abovementioned multilayer film enclosed with the first mold release layer facing the circuit exposure film, this was hot-pressed with the heating pattern shown in Figure 5 using a hot platen press. This resulted in the amount of adhesive agent between the circuit

exposure film and the CL film that oozed onto the circuit pattern being less than 60 μm , which is superior to that obtained with a conventional PBT mold release film (see Table 3). Additionally, the incidence of poor release of the multilayer film after the hot press was less than 1.0%, which is equally as good as conventional PBT mold release films (see Table 3).

[0124] (Working Example 2)

A multilayer film was prepared in the same manner as for Working Example 1 except that a poly(butylene terephthalate) (NOVADURAN[®] 5020, Mitsubishi Engineering Plastics) was used as the raw material for the first mold release layer, and this multilayer film was evaluated.

[0125] The amount of adhesive agent between the circuit exposure film and the CL film that oozed onto the circuit pattern was less than 70 μm , which is superior to that obtained with a conventional PBT mold release film (see Table 3). Additionally, the incidence of poor release of the multilayer film after the hot press was less than 1.0%, which is equally as good as conventional PBT mold release films (see Table 3).

[0126] (Working Example 3)

A multilayer film was prepared in the same manner as for Working Example 1 except that a poly(butylene terephthalate) / poly(tetramethylene glycol) block copolymer (NOVADURAN[®] 5505S, Mitsubishi Engineering Plastics; poly(butylene terephthalate) structural units / poly(tetramethylene glycol) structural units: 90 parts by weight / 10 parts by weight) was used as the raw material for the first mold release layer, and this multilayer film was evaluated.

[0127] The amount of adhesive agent between the circuit exposure film and the CL film that oozed onto the circuit pattern was less than 70 μm , which is superior to that obtained with a conventional PBT mold release film (see Table 3). Additionally, the incidence of poor release of the multilayer film after the hot press was less than 1.0%, which is equally as good as conventional PBT mold release films (see Table 3).

[0128] (Working Example 4)

A multilayer film was prepared in the same manner as for Working Example 1 except that the thickness of the first mold release layer was 12 μm , the

thickness of the cushion layer was 98 μm , and a second mold release layer was not employed, and this multilayer film was evaluated.

[0129] The amount of adhesive agent between the circuit exposure film and the CL film that oozed onto the circuit pattern was less than 90 μm , which is superior to that obtained with a conventional PBT mold release film (see Table 3). Additionally, the incidence of poor release of the multilayer film after the hot press was less than 1.0%, which is equally as good as conventional PBT mold release films (see Table 3).

[0130] (Working Example 5)

A multilayer film was prepared in the same manner as for Working Example 1 except that the thickness of the first mold release layer was 12 μm , and the thickness of the cushion layer was 88 μm , and this multilayer film was evaluated.

[0131] The amount of adhesive agent between the circuit exposure film and the CL film that oozed onto the circuit pattern was less than 90 μm , which is superior to that obtained with a conventional PBT mold release film (see Table 3). Additionally, the incidence of poor release of the multilayer film after the hot press was less than 1.0%, which is equally as good as conventional PBT mold release films (see Table 3).

[0132] (Working Example 6)

A multilayer film was prepared in the same manner as for Working Example 1 except that the thickness of the first mold release layer was 4 μm , the thickness of the cushion layer was 62 μm , the thickness of the second mold release layer was 7 μm , and the thickness of the adhesive layer was 7 μm , and this multilayer film was evaluated.

[0133] The amount of adhesive agent between the circuit exposure film and the CL film that oozed onto the circuit pattern was less than 70 μm , which is superior to that obtained with a conventional PBT mold release film (see Table 3). Additionally, the incidence of poor release of the multilayer film after the hot press was less than 1.0%, which is equally as good as conventional PBT mold release films (see Table 3).

[0134] (Working Example 7)

A multilayer film was prepared in the same manner as for Working Example 1 except that the thickness of the first mold release layer was 5 μm , the thickness

of the cushion layer was 79 μm , the thickness of the second mold release layer was 8 μm , and the thickness of the adhesive layer was 8 μm , and this multilayer film was evaluated.

[0135] The amount of adhesive agent between the circuit exposure film and the CL film that oozed onto the circuit pattern was less than 70 μm , which is superior to that obtained with a conventional PBT mold release film (see Table 3). Additionally, the incidence of poor release of the multilayer film after the hot press was less than 1.0%, which is equally as good as conventional PBT mold release films (see Table 3).

[0136]

[Table 3]

		Working Example 1	Working Example 2	Working Example 3	Working Example 4	Working Example 5	Working Example 6	Working Example 7
First mold release layer	Resin	PBT/PTMG (80/20)	PBT	PBT/PTMG (90/10)	PBT/PTMG (80/20)	PBT/PTMG (80/20)	PBT/PTMG (80/20)	PBT/PTMG (80/20)
	Layer thickness (μm)	6	6	6	12	12	4	5
	Resin	Modified PE	Modified PE	Modified PE	Modified PE	Modified PE	Modified PE	Modified PE
Adhesive layer	Layer thickness (μm)	10	10	10	10	10	7	8
	Resin	EMMA	EMMA	EMMA	EMMA	EMMA	EMMA	EMMA
Cushion layer	Layer thickness (μm)	94	94	94	98	88	62	79
	Resin	PP	PP	PP	—	PP	PP	PP
Second mold release layer	Layer thickness (μm)	10	10	10	—	10	7	8
	Amount of oozing	120	120	120	120	120	80	100
Evaluation results	Thickness of entire multilayer film (μm)	60 μm	70 μm	70 μm	90 μm	90 μm	70 μm	70 μm
	Incidence (%) of poor release	Less than 1.0%	Less than 1.0%	Less than 1.0%	Less than 1.0%	Less than 1.0%	Less than 1.0%	Less than 1.0%

- [0137] Furthermore, in Table 3, "PBT/PTMG (90/10)" means a poly(butylene terephthalate) / poly(tetramethylene glycol) block copolymer (poly(butylene terephthalate) segments / poly(tetramethylene glycol) segments = 90 parts by weight / 10 parts by weight), "PBT/PTMG (80/20)" means a poly(butylene terephthalate) / poly(tetramethylene glycol) block copolymer (poly(butylene terephthalate) segments / poly(tetramethylene glycol) segments = 80 parts by weight / 20 parts by weight), "PBT" means poly(butylene terephthalate), "modified PE" means modified polyethylene, "EMMA" means ethylene-methyl methacrylate block copolymer (methyl methacrylate-derived unit content: 5 wt%), and "PP" means polypropylene.

INDUSTRIAL APPLICABILITY

- [0138] The mold release film of the present invention is characterized by, in addition to being able to prevent that mold release layer bonds to the CL film and the circuit exposure film, and between the mold release layers, in the same manner as for conventional PBT mold release films, being able to reduce the amount of oozing of the adhesive agent between the circuit exposure film and the CL film onto the circuit pattern components compared to conventional PBT mold release films, and is particularly useful as a mold release film that can be used to envelope the CL film during the bonding of the CL film to the circuit exposure film by the press so that the cover lay film adheres to the irregularities of the circuit pattern.
- [0139] In addition to being known for use as mold release films (1) during the manufacture of laminated boards, (2) during the manufacture of cutting edge composite materials, and (3) during the manufacture of sports and leisure products, the multilayer films relating to the present invention are also useful as such mold release films. Furthermore, mold release films are used during the manufacture of laminated boards, in the press-molding for manufacturing multilayer printed circuit boards, and the films can be interposed between such for preventing bonding between printed circuit boards and separator plates or other printed circuit boards. The films used as mold release films during the manufacture of cutting edge composite material products, for example, can be used as films for use in the manufacture of various products from cured pre-pregs made from glass cloth, carbon fibers or aramid fibers, and epoxy resins.

As mold release films used during the manufacture of sports and leisure products, for example, in the manufacture of fishing rods, golf club shafts, wind surfing poles, and the like, when the pre-preg is rolled into a cylindrical shape and cured in an autoclave, the film can be wound onto the pre-preg.

[0140] In addition, these mold release films can be used as release films in adhesive tape, double-sided tape, masking tape, labels, seals, stickers, moisturizing skin patches, and the like.

[0141] These mold release films can be used as processing films for use during the manufacture of printed circuits or ceramic electronic components, heat-curable resin products, decorative panels, and the like. Furthermore, processing film and described in above during the manufacture of printed circuits or ceramic electronic components, heat-curable resin products, decorative panels, and the like, the processing films mentioned here can prevent bonding between metallic plate parts and resin parts, where the film would be interposed in between the metal parts or the resin parts, and in particular are suitable for use during the manufacture of laminated boards, during the manufacture of flexible printed circuits, during the manufacture of cutting edge composite material products, and during the manufacture of sports and leisure products. Moreover, these mold release films are also useful as packaging films.

CLAIMS

- [Claim 1] Mold release film that is comprising a mold release layer that contains at least poly(butylene terephthalate) homopolymer (A), and a copolymer having a poly(butylene terephthalate) component (PBT) and a poly(tetramethylene glycol) component (PTMG).
- [Claim 2] The mold release film as recited in Claim 1, wherein the weight ratio A/B for the poly(butylene terephthalate) homopolymer (A) and copolymer (B) in the mold release layer of the mold release film is 25/75 or greater and 80/20 or less.
- [Claim 3] The mold release film as recited in Claim 2, wherein the weight ratio A/B for the poly(butylene terephthalate) homopolymer (A) and copolymer (B) in the mold release layer of the mold release film is 25/75 or greater and 50/50 or less.
- [Claim 4] The mold release film as recited in any one of Claims 1 through 3, wherein the copolymer ratio PBT/PTMG of the poly(butylene terephthalate) component (PBT) and a poly(tetramethylene glycol) component (PTMG) in the aforementioned copolymer (B) is 80/20 or more and 90/10 or less.
- [Claim 5] The mold release film as recited in any one of Claims 1 through 4 that further comprising a cushion layer.
- [Claim 6] The mold release film as recited in Claim 5, wherein the thickness of the aforementioned mold release layer is 15 μm or less.
- [Claim 7] Mold release film comprising a mold release layer, which is formed from a resin that has as a main component a polyether-ester block copolymer that is mainly constituted from polyether segments and polyester segments, as a surface layer on at least one side.
- [Claim 8] Mold release film comprising a mold release layer, which is formed from a resin with a poly(butylene terephthalate)-type resin as the main component, as a surface layer on at least one side.

- [Claim 9] The mold release film as recited in Claim 8, wherein the thickness of the aforementioned mold release layer is 10 μm or less.
- [Claim 10] The mold release film as recited in Claim 8 or Claim 9, wherein the aforementioned poly(butylene terephthalate)-type resin is poly(butylene terephthalate) resin.
- [Claim 11] The mold release film as recited in Claim 8 or Claim 9, wherein the aforementioned poly(butylene terephthalate)-type resin is a polyether-ester block copolymer that is mainly constituted from polyether segments and polyester segments.
- [Claim 12] The mold release film as recited in Claim 7 or Claim 11, wherein the weight ratio for the aforementioned polyester segments and the aforementioned polyether segments is within the range from 80:20 to 90:10.
- [Claim 13] The mold release film as recited in Claim 12, wherein the aforementioned polyether segment structural units are mainly oxybutylene units, and the aforementioned polyester segment structural units are mainly the ester units shown in Chemical Formula (I) below.
- [Chemical Structure 1]

