

SPECIFICATION

TITLE OF THE INVENTION

COVER FILM AND ELECTRONIC COMPONENT PACKAGE

TECHNICAL FIELD

[0001] The present invention relates to a cover film used in packages for electronic components and an electronic component package.

BACKGROUND ART

[0002] With the downsizing of electronic devices, there have been advances in compactness and high performance of the electronic components used therein, and during the electronic component assembly process, components are automatically mounted on printed circuit boards. Electronic components for surface mounting are housed in carrier tapes that are consecutively embossed with pockets adapted to the shapes of the electronic components. After housing the electronic components, a cover film is placed as a lid member over the top surface of the carrier tape, and both edges of the cover film are continuously heat-sealed in the longitudinal direction using a heated seal bar. For the cover film material, a biaxially stretched polyester film is used as a substrate, which is laminated with a thermoplastic resin heat seal layer. For the carrier tape, thermoplastic resins such as polystyrenes or polycarbonates are mainly used.

[0003] In recent years, there have been significant advances in miniaturization, lightening and thinning of various electronic components such as capacitors and resistors, ICs, LEDs, connectors and switching devices, and the required performance when peeling the cover film to withdraw housed electronic components has become greater than in the past. If the difference between the maximum value and the minimum value of the peel strength when peeling the cover film, i.e. the “range width”, is large, the carrier tape can violently vibrate, causing the electronic components to pop out and resulting in mounting failures. Additionally, the electronic components that are transported or the like in the above-described electronic component packages are becoming higher in performance and more compact with the large improvements in surface mounting technology of recent years. Such electronic components can be destroyed by static electricity generated due to the electronic components rubbing against the inner surfaces of the embossments in the carrier tape or the inner surfaces of the cover film as a result of vibrations during transport of the electronic component packages. Additionally, similar situations may occur as a result of

static electricity or the like generated when peeling the cover film from the carrier tape. Therefore, the most important issue has been to provide carrier tape and cover film with measures for protection against static electricity.

[0004] Electronic components are sometimes inspected for the presence or absence of components, the direction of housing of the components, and the lack or bending of leads, while still housed in the package. In recent years, the downsizing of electronic components has been accompanied by a demand for extremely high transparency of cover films in order to inspect components housed in packages. Additionally, the downsizing of components is also leading to increased occurrences of cases in which a small amount of static electricity causes components to adhere to cover films, so the cover films currently on the market are protected against static electricity by adding conductive microparticles such as tin oxide or zinc oxide to the heat seal layer (see Patent Document 1). However, with such a method, the cover film surface is charged when peeling the cover film, and it is difficult to obtain adequate peel charge suppressing effects. On the other hand, a method of suppressing the static electricity generated when peeling the cover film from carrier tape by providing a static electricity diffusion layer between an intermediate layer and a heat seal layer has been proposed (see Patent Document 2). Additionally, a method of suppressing peel charge by providing the heat seal layer with a two-layer structure and causing cohesive failure of the heat seal layer during peeling has been proposed (see Patent Document 3). However, the downsizing of electronic components has led to a demand for even higher levels of performance in reducing the range of peel strength, and there are cases in which even the methods of Patent Documents 2 and 3 are not capable of achieving the required performance.

Patent Document 1: JP H8-258888 A

Patent Document 2: JP H7-223674 A

Patent Document 3: JP 2012-214252 A

SUMMARY OF THE INVENTION

[0005] In consideration of the above-described problems and circumstances, the present invention has the purpose of providing a cover film that suppresses charge due to friction between housed articles and cover film, and peel charge generated when withdrawing electronic components. Furthermore, it has the purpose of providing a cover film that reduces trouble during the mounting process by suppressing variations in peel strength.

[0006] The present inventors performed diligent research regarding the above-described problem, as a result of which they discovered that a cover film that overcomes the problems addressed by the present invention can be obtained by using a specific thermoplastic resin in

the heat seal layer, using a thermoplastic resin with a specific composition for the peel layer, and setting the Vicat softening temperature to a predetermined range, thereby achieving the present invention.

In other words, in one embodiment, the present invention offers a cover film having arranged, in the following order, a substrate layer (A), an intermediate layer (B), a peel layer (C) and a heat seal layer (D), wherein the peel layer (C) comprises a resin composition essentially consisting of 50 to 80 mass% of at least one copolymer chosen from among styrene-diene block copolymers and styrene-diene graft copolymers, and 50 to 20 mass% of an ethylene- α -olefin copolymer; and has a Vicat softening temperature of 55 to 80 °C; and the heat seal layer (D) comprises a styrene-(meth)acrylate copolymer having a styrene content of 50 to 80 mass%.

[0007] In the above embodiment, at least one of the peel layer (C) or the heat seal layer (D) may contain conductive microparticles. These conductive microparticles are preferably fibrous or spherical. Additionally, in one embodiment, the thickness of the substrate layer (A) is 12 to 20 μm , the thickness of the intermediate layer (B) is 10 to 40 μm , the thickness of the peel layer (C) is 5 to 20 μm , and the total thickness is 45 to 65 μm . Additionally, in one embodiment, the haze value of the cover film is 30% or less.

[0008] In another embodiment, the present invention provides an electronic component package using the cover film according to the present invention as a lid material for a thermoplastic resin carrier tape. In this case, the thermoplastic resin of the carrier tape should preferably be a polycarbonate. Additionally, in one embodiment, an absolute value of the peel charge voltage that is generated when peeling the cover film from the carrier tape is 70 V or less. In another embodiment, an absolute value of the frictional charge voltage that is generated between the cover film and the carrier tape is 70 V or less.

[0009] In the present invention, by using a cover film having a heat seal layer with a specific composition, and a peel layer having a specific composition, composition range and Vicat softening temperature, charge caused by friction between housed articles and the cover film, and peel charge generated when peeling the cover film to withdraw electronic components, can be significantly suppressed, even in low humidity environments. For this reason, when the cover film of the present invention is used as a lid material for carrier tape, trouble caused by charge during the mounting process can be significantly improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] [Fig. 1] A schematic section view of a cover film according to an embodiment of the present invention.

MODES FOR CARRYING OUT THE INVENTION

[0011] Herebelow, preferred embodiments of the cover film, carrier tape, and electronic component package according to the present invention will be explained in order.

[0012] <Cover Film>

The cover film according to an embodiment of the present invention is a cover film having arranged, in the following order, a substrate layer (A), an intermediate layer (B), a peel layer (C) and a heat seal layer (D). An example of the structure of a cover film according to the present embodiment is shown in Fig. 1.

[0013] [Substrate Layer (A)]

The substrate layer (A) is a layer comprising a biaxially stretched polyester or a biaxially stretched nylon, of which biaxially stretched polyethylene terephthalate (PET), biaxially stretched polyethylene naphthalate (PEN), biaxially stretched 6,6-nylon and biaxially stretched 6-nylon are particularly preferred. A charge preventing agent for a charge preventing treatment may be added to the biaxially stretched PET, biaxially stretched PEN, biaxially stretched 6,6-nylon or biaxially stretched 6-nylon. Additionally, the side of the substrate layer (A) on which the intermediate layer (B) is to be laminated may be treated by application of an acrylic, urethane, epoxy etc. two-liquid reaction-type or thermosetting-type anchor coating agent, or by a corona discharge treatment or an easy adhesion treatment.

[0014] The thickness of the substrate layer (A) is preferably 12 to 20 μm . By making the substrate layer (A) at least 12 μm thick, the tensile strength of the cover film itself can be increased, making "film rupture" less likely to occur when peeling the cover film. On the other hand, by making it 20 μm or less, the heat sealing properties with respect to carrier tape are improved.

[0015] [Intermediate Layer (B)]

The intermediate layer (B) is laminated onto one side of the substrate layer (A) with an adhesive layer or the like interposed therebetween according to need as mentioned above, and is disposed between the substrate layer (A) and the peel layer (C). While the resin constituting the intermediate layer (B) may be a polyolefin such as a polyethylene or a polypropylene, of these, linear low-density polyethylenes (hereinafter abbreviated to LLDPEs) are preferred for having flexibility and an appropriate degree of rigidity, while also excelling in tear strength at standard temperature. In particular, LLDPEs having a density of 0.880 to 0.925 ($\times 10^3 \text{ kg/m}^3$) are not susceptible to melt-out of the intermediate layer resin from the end portions of the cover film due to heat and pressure during heat sealing, so they tend not to cause the iron to be soiled during heat sealing. Additionally, LLDPEs with densities in this range excel in the property of alleviating stress partially generated by heat

sealing irons, so they tend to be able to provide stable peel strength when peeling the cover film.

[0016] LLDPEs include those polymerized by a Ziegler-type catalyst and those polymerized by a metallocene catalyst (hereinafter referred to as m-LLDPEs). Since m-LLDPEs have narrowly controlled molecular weight distributions, they have an especially high tear strength, and the intermediate layer (B) of the present invention preferably uses such m-LLDPEs.

[0017] The m-LLDPEs mentioned above are copolymers having, as comonomers, ethylenes and olefins having 3 or more carbon atoms, preferably linear, branched or aromatic nucleus-substituted α -olefins having 3 to 18 carbon atoms. Examples of linear mono-olefins include propylene, 1-butene, 1-pentene, 1-hexene, 1-octene, 1-nonene, 1-decene, 1-dodecene, 1-tetradecene, 1-hexadecene and 1-octadecene. Additionally, examples of branched mono-olefins include 3-methyl-1-butene, 3-methyl-1-pentene, 4-methyl-1-pentene and 2-ethyl-1-hexene. Furthermore, examples of aromatic nucleus-substituted mono-olefins include styrenes. These comonomers may be used singly or as a combination of two or more types, and copolymerized with ethylenes. The copolymerization may involve copolymerization with polyenes such as butadiene, isoprene, 1,3-hexadiene, dicyclopentadiene and 5-ethylidene-2-norbornene.

[0018] The thickness of the intermediate layer (B) is preferably 10 to 40 μm . By making the intermediate layer (B) at least 10 μm thick, the adhesive strength between the substrate layer (A) and the intermediate layer (B) can be improved, and it becomes easier to obtain the effect of reducing contact irregularities of the heat sealing iron when heat sealing the cover film to the carrier tape. On the other hand, by making the thickness 40 μm or less, the total thickness of the cover film can be set to an appropriate range, so that sufficient peel strength can be obtained when heat sealing the cover film to the carrier tape. Furthermore, the intermediate layer (B) may be a compound layer such as in the two-layer example to be described below.

[0019] [Peel Layer (C)]

The cover film of the present invention comprises a peel layer (C) between the intermediate layer (B) and the heat seal layer (D).

The peel layer (C) is formed of a resin composition essentially consisting of 50 to 80 mass% of at least one copolymer chosen from among styrene-diene block copolymers and styrene-diene graft copolymers, and 50 to 20 mass% of an ethylene- α -olefin copolymer. Here, the expression "essentially consisting of" refers to the fact that the inclusion of resin components other than styrene-diene block copolymers or styrene-diene graft copolymers and ethylene- α -olefin copolymers is not excluded as long as they are present in an amount

not interfering with the ability of the present invention to achieve the desired effects. By including at least 50 mass% of a copolymer of at least one type chosen from among styrene-diene block copolymers and styrene-diene graft copolymers, the adhesion with the heat seal layer can be improved, and a stable peel strength can be obtained between the peel layer and the heat seal layer. Additionally, by setting the amount to 80 mass% or less, the adhesive strength between the peel layer and the heat seal layer can be adjusted to an appropriate range, and variations in the peel strength due to the passage of time after heat sealing may be suppressed. In order to further stabilize the peel strength between the peel layer (C) and the heat seal layer (D), the amount of the at least one copolymer chosen from among styrene-diene block copolymers and styrene-diene graft copolymers should be set to 60 to 75 mass%, and the amount of the ethylene- α -olefin copolymer should be set to 40 to 25 mass%.

[0020] Examples of styrene-diene block copolymers include styrene and butadiene diblock copolymers, styrene-butadiene-styrene triblock copolymers, styrene and isoprene block copolymers, styrene-isoprene-styrene triblock copolymers, and hydrogenated resins thereof. Among these, diblock copolymers of styrene and butadiene are preferred for their heat sealing properties.

[0021] Examples of styrene-diene graft copolymers include high-impact polystyrenes (HI-PS) having polystyrene graft polymerized to polybutadiene, ABS resins having styrene and acrylonitrile graft polymerized to polybutadiene, and MBS resins having styrene and methylmethacrylate graft polymerized to polybutadiene. Among these, high-impact polystyrenes are preferred for their heat sealing properties.

[0022] Examples of the α -olefin in the ethylene- α -olefin copolymer include propylene, 1-butene, 2-methyl-1-propene, 2-methyl-1-butene, 3-methyl-1-butene, 1-hexene, 2-ethyl-1-butene, 2,3-dimethyl-1-butene, 1-pentene, 2-methyl-1-pentene, 3-methyl-1-pentene, 4-methyl-1-pentene, 3,3-dimethyl-1-butene, 1-heptene, methyl-1-hexene, dimethyl-1-pentene, ethyl-1-pentene, trimethyl-1-butene, methylethyl-1-butene, 1-octene, methyl-1-pentene, ethyl-1-hexene, dimethyl-1-hexene, propyl-1-heptene, methylethyl-1-heptene, trimethyl-1-pentene, propyl-1-pentene, diethyl-1-butene, 1-nonene, 1-decene, 1-undecene and 1-dodecene. While the ethylene- α -olefin copolymer may be either a random copolymer or a block copolymer, of these, a random copolymer is preferred for compatibility with the styrene-diene block copolymer and the styrene-diene graft copolymer. Additionally, two or more ethylene- α -olefin copolymers may be used in combination.

[0023] Furthermore, the peel layer (C) has a Vicat softening temperature, according to the JIS K-7206 A120 method, of 55 to 80 °C, preferably 60 to 75 °C. By setting the Vicat

softening temperature to at least 55 °C, excessive softening of the peel layer (C) and protrusion of the peel layer (C) when heat sealing the cover film can be suppressed, thereby reducing soiling of the sealing head and variations in peel strength. Additionally, by setting it to 80 °C or less, the peel layer (C) can be adequately softened, and good peel strength can be obtained.

The Vicat softening temperature can be adjusted by changing the copolymers constituting the resin composition of the peel layer (C) or the types or proportional content of the monomers.

[0024] Furthermore, the peel layer (C) preferably contains conductive microparticles. The conductive microparticles are preferably fibrous or spherical. Examples of fibrous conductive particles include fibrous carbons such as carbon nanotubes, carbon nanofibers and carbon fibers. Examples of spherical conductive microparticles include carbon blacks such as acetylene black and Ketjen black, metal powders such as aluminum powder, gold powder, silver powder, copper powder, nickel powder, platinum powder and palladium powder, and metal oxide powders such as alumina, zinc oxide and tin oxide. Of these, acetylene black and tin oxide are preferred for their dispersibility in resins and ease of achieving percolation, and antimony-doped tin oxide is more preferable. The conductive microparticle content is not limited as long as the surface resistivity of the resist layer is 10 to $10^{12} \Omega/\square$, preferably 10^6 to $10^{12} \Omega/\square$.

[0025] The thickness of the peel layer (C) is preferably 5 to 20 μm . By making the peel layer (C) at least 5 μm thick, sufficient peel strength can be obtained when heat sealing the cover film to the carrier tape. On the other hand, by making the thickness of the peel layer (C) 20 μm or less, adequate peel strength is more easily obtained for ultra-high speed heat sealing, while also suppressing variations in the peel strength when peeling the cover film. As will be described below, the peel layer (C) can normally be formed by a method of thermally melting a resin composition for forming the peel layer in an extruder, and extruding through an inflation die or a T-die.

[0026] [Heat Seal Layer (D)]

The cover film of the present invention comprises a heat seal layer (D) on the surface of the peel layer (C). While the heat seal layer (D) is formed of a thermoplastic resin, a copolymer of styrene and (meth)acrylate is preferably used. Examples of (meth)acrylates include acrylic acid esters such as methyl acrylate, ethyl acrylate, propyl acrylate and butyl acrylate, and methacrylic acid esters such as methyl methacrylate, ethyl methacrylate, propyl methacrylate, butyl methacrylate and cyclohexyl methacrylate. These may be copolymers of two or more (meth)acrylates. Additionally, the form of the copolymer may be either a random copolymer, a graft copolymer or a block copolymer of

styrene and (meth)acrylate.

[0027] The styrene content in the above-mentioned copolymer of the heat seal layer (D) should be 50 to 80 mass%, preferably 70 to 80 mass%. By setting the styrene content to at least 50 mass%, the peel charge voltage that is generated when peeling the cover film from the carrier tape can be held low, and for example, the absolute value of the peel charge voltage can be held to 70 V or less. Additionally, by setting the styrene content to 80 mass% or less, the frictional charge voltage with electronic components can be suppressed, and for example, the absolute value of the frictional charge voltage can be held to 70 V or less, thereby reducing component adherence.

[0028] The heat seal layer (D) preferably contains the conductive microparticles mentioned above for the peel layer (C). The method of making the heat seal layer (D) contain conductive microparticles may be a method of pre-mixing the resin to form the heat seal layer (D) and the conductive microparticles in a Henschel mixer, then melt-kneading at the time of extrusion for lamination of the peel layer (C), or a method of mixing the conductive microparticles and an emulsified resin for forming the heat seal layer (D) in water or an organic solvent medium, then coating the surface of the peel layer (C) with a roll coater or by spraying.

[0029] The conductive microparticle content in the heat seal layer (D) is not limited as long as the surface resistivity of the resist layer is 10 to $10^{12} \Omega/\square$, preferably 10^6 to $10^{12} \Omega/\square$, but should preferably be 100 to 700 parts by mass, more preferably 200 to 600 parts by mass with respect to 100 parts by mass of the thermoplastic resin forming the heat seal layer (D). By setting the amount of conductive microparticles added to at least 100 parts by mass, good conductivity is achieved. Additionally, by setting the amount to 700 parts by mass or less, aggregation of the conductive microparticles in the heat seal layer (D) can be reduced.

[0030] The thickness of the heat seal layer (D) is preferably 0.1 to 5 μm , more preferably 0.1 to 3 μm , and most preferably 0.1 to 0.5 μm . By setting the thickness of the heat seal layer (D) to 0.1 μm or more, good peel strength can be obtained in the heat seal layer (D). Additionally, by setting the thickness of the heat seal layer (D) to 5 μm or less, not only can cost increases be suppressed, but also, variations in the peel strength when peeling the cover film can be reduced.

[0031] <Production of Cover Film>

The method of producing the above-described cover film is not particularly limited, and a common method may be used. For example, a resin composition having an m-LLDPE for composing the intermediate layer (B) as the main component and a resin composition for composing the peel layer (C) may be extruded from separate uniaxial extruders, and laminated using a multi-manifold die to form a two-layer film consisting of an

intermediate layer (B) and a peel layer (C). Furthermore, a biaxially stretched polyester film, having an anchor coating agent such as a polyurethane, a polyester or a polyolefin coated onto the surface of a substrate layer (A), may be laminated with the two-layer film by dry lamination, resulting in a three-layer film consisting of the substrate layer, the intermediate layer and the peel layer. Furthermore, the surface of the peel layer (C) may be coated with a resin composition for composing the heat seal layer (D), for example, by using a gravure coater, a reverse coater, a kiss coater, an air knife coater, a Mayer bar coater or a dip coater, resulting in the desired cover film.

[0032] As another method, a peel layer (C) may be pre-formed by a method such as T-die casting or inflation, and the peel layer (C) film, together with a biaxially stretched polyester film, having an anchor coating agent such as a polyurethane, a polyester, a polyolefin or a polyethyleneimine coated onto the surface of a substrate layer (A), may be sandwich laminated with a resin composition having an m-LLDPE for composing the intermediate layer (B) extruded from a T-die, resulting in a three-layer film consisting of a substrate layer (A), an intermediate layer (B) and a peel layer (C). Furthermore, a resin composition for composing the heat seal layer (D) may be coated onto the surface of the peel layer (C) by using, for example, a gravure coater, a reverse coater, a kiss coater, an air knife coater, a Mayer bar coater or a dip coater, resulting in the desired cover film.

[0033] As yet another method, a resin composition having an m-LLDPE for composing the intermediate layer (B) as a main component, and a resin composition for composing the peel layer (C), may be extruded from separate uniaxial extruders, and laminated with a multi-manifold dye to form a two-layer film consisting of a portion of the intermediate layer (B) and the peel layer (C). Then, a biaxially stretched polyester film having an anchor coating agent such as a polyurethane, a polyester, a polyolefin or a polyethyleneimine coated on the surface of a substrate layer (A), and the two-layer film, may be sandwich laminated by extruding therebetween, from a T-die, a resin composition having an m-LLDPE for composing a portion of the intermediate layer (B) as a main component, so as to form a three-layer film consisting of a substrate layer (A), an intermediate layer (B) and a peel layer (C). Furthermore, a resin composition for composing the heat seal layer (D) may be coated onto the surface of the peel layer (C) by using, for example, a gravure coater, a reverse coater, a kiss coater, an air knife coater, a Mayer bar coater or a dip coater, resulting in the desired cover film. With this method, the intermediate layer (B) has a two-layer structure comprising a layer formed by co-extrusion with a peel layer (C) and a layer formed by sandwich lamination. The thickness of the layer formed by the above-described sandwich lamination is generally in the range of 10 to 20 μm . In this way, a film with a total thickness of 45 to 65 μm is obtained. When the total thickness is thinner than this, the

rupture resistance becomes lower, and when thicker, the variation in peel strength tends to become larger.

[0034] <Carrier Tape>

The cover film is used as a lid material for carrier tape which forms a container for housing electronic components. Carrier tape is a ribbon-shaped material having a width of about 8 mm to 100 mm, having pockets for housing electronic components. When heat sealing with a cover film as a lid material, the material composing the carrier tape is generally not particularly limited, and a commercially available type may be used, for example, polystyrene, polyester, polycarbonate, polyvinyl chloride or the like. However, in the case of the present embodiment using an acrylic resin in the heat seal layer (D), it is preferably combined with a polystyrene or polycarbonate carrier tape. The carrier tape may be provided with conductive properties by kneading carbon black or carbon nanotubes into the resin, or provided with charge prevention properties by kneading in a charge preventing agent or a conductive filler, or by coating the surface with a coating solution having a surfactant-type charge preventing agent or a conductive substance such as a polypyrrole or a polythiophene dispersed in an organic binder such as acrylic.

[0035] <Electronic Component Package>

A package housing electronic components can be obtained, for example, by housing electronic components or the like inside the electronic component housing portions of a carrier tape, then using a cover film as a lid material, continuously heat sealing both edge portions of the cover film in the longitudinal direction, and winding onto a reel. By packaging electronic components or the like in this form, they can be stored and transported. While conveying a package housing electronic components by means of holes, known as sprocket holes, for conveying the carrier tape, provided on the longitudinal edge portions of the carrier tape, the cover film is intermittently peeled away, and the electronic components are withdrawn by a component mounting device while verifying their presence, orientation and position, and mounted, for example, onto a substrate.

[0036] When peeling away the cover film, if the peel strength is low, it may strip away from the carrier tape and the housed components may fall out, and if too high, the carrier tape can become difficult to peel and the cover film may rupture when peeling. Therefore, when heat sealed at 120 to 220 °C, the carrier film preferably has a peel strength of 0.05 to 1.0 N. Additionally, regarding the “range width” which refers to the difference between the maximum value and the minimum value of peel strength when peeling the cover film, when the range width is large, the carrier tape can violently vibrate and the electronic components can pop out, causing mounting failures, so the range width is preferably less than 0.4 N.

EXAMPLES

[0037] Herebelow, the present invention will be explained in detail by referring to examples, but the present invention is not limited thereby. In the examples and comparative examples, the following resin materials were used in the substrate layer (A), the intermediate layer (B), the peel layer (C) and the heat seal layer (D).

[0038] Substrate Layer (A):

Biaxially stretched polyethylene terephthalate film (Futamura Chemical, "FB2001"), thickness 13 μm

[0039] Intermediate Layer (B):

(b-1) m-LLDPE (Japan Polyethylene, Harmolex[®] "NH745N")

(b-2) m-LLDPE (Ube-Maruzen Polyethylene, Umerit[®] "2040F")

[0040] Peel Layer (C):

(c-a-1) Styrene-butadiene block copolymer (Denka, Clearen "170ZR"), Vicat softening temperature 76 °C, styrene proportion 83 mass%

(c-a-2) Styrene-butadiene block copolymer (JSR, "TR-2000"), Vicat softening temperature 45 °C, styrene proportion 40 mass%

(c-b-1) Ethylene- α -olefin random copolymer (Japan Polyethylene, Kernel[®] "KF270T"), Vicat softening temperature 88 °C

(c-b-2) Ethylene- α -olefin random copolymer (Japan Polyethylene, Kernel[®] "KF360T"), Vicat softening temperature 72 °C

(c-b-3) Ethylene- α -olefin random copolymer (Mitsui Chemicals, Tafmer[®] "A"), Vicat softening temperature 55 °C

(c-b-4) Ethylene- α -olefin random copolymer (Japan Polyethylene, Kernel[®] "KS240T"), Vicat softening temperature 44 °C

(c-b-5) Ethylene- α -olefin random copolymer (Japan Polyethylene, Kernel[®] "KF283"), Vicat softening temperature 102 °C

(c-c-1) High-impact polystyrene (Toyo Styrene, Toyostyrol "E640N"), Vicat softening temperature 99 °C

[0041] Heat Seal Layer (D):

(d-1) Acrylic resin (Shin-Nakamura Chemical, NK Polymer "EC-24"), emulsion with solid part concentration 35%

(d-2) Styrene-acrylic copolymer (Shin-Nakamura Chemical, NK Polymer "ECS-704"), emulsion with styrene content 40 mass% and solid part concentration 35%

(d-3) Styrene-acrylic copolymer (Shin-Nakamura Chemical, NK Polymer "ECS-705"), emulsion with styrene content 50 mass% and solid part concentration 35%

(d-4) Styrene-acrylic copolymer (Shin-Nakamura Chemical, NK Polymer "ECS-706"),

emulsion with styrene content 60 mass% and solid part concentration 35%

(d-5) Styrene-acrylic copolymer (Shin-Nakamura Chemical, NK Polymer “ECS-707”), emulsion with styrene content 70 mass% and solid part concentration 35%

(d-6) Styrene-acrylic copolymer (Shin-Nakamura Chemical, NK Polymer “ECS-708”), emulsion with styrene content 80 mass% and solid part concentration 35%

(d-7) Styrene-acrylic copolymer (Shin-Nakamura Chemical, NK Polymer “ECS-709”), emulsion with styrene content 90 mass% and solid part concentration 35%

(d-8) Spherical antimony-doped tin oxide (conductive microparticles) (Ishihara Sangyo, “SN-100D”), number-average particle size 110 nm, aqueous dispersion slurry

[0042] (Example 1)

52.5 parts by mass of (c-a-1) styrene butadiene block copolymer, 12.5 parts by mass of (c-a-2) styrene butadiene block copolymer and 35 parts by mass of (c-b-1) ethylene- α -olefin random copolymer were pre-blended using a tumbler, then kneaded and extruded at 210 °C using a uniaxial extruder with a diameter of 40 mm, to obtain a resin composition for use in a peel layer. This resin composition and (b-2) m-LLDPE for composing the intermediate layer (2) described in Table 1 and Table 2 were separately extruded from uniaxial extruders, then extruded in layers using a multi-manifold T-die extruder at 225 °C, to obtain a two-layer film having a peel layer with a thickness of 5 μ m and an intermediate layer (2) with a thickness of 20 μ m.

[0043] Separately, a biaxially stretched polyethylene terephthalate film FE2001 (thickness 13 μ m) for forming a substrate layer was coated with a two-liquid cured polyurethane-type anchor coating agent using a roll coater, and a melted (b-1) m-LLDPE for composing an intermediate layer (1) was extruded at 330 °C so as to have a thickness of 13 μ m, between the coated surface and the intermediate layer (2) of the above-described two-layer film, so as to obtain a laminated film by means of sandwich lamination.

[0044] After performing a corona discharge treatment on the peel layer surface of this laminated film, an aqueous dispersion solution having a solid part concentration of 30% and containing 100 parts by mass of the (d-3) styrene-acrylic copolymer and 400 parts by mass of the (d-8) spherical antimony-doped tin oxide, pre-produced as the heat seal layer, was coated using a gravure coater so as to have a solid thickness of 0.5 μ m, thereby obtaining a cover film comprising a layered structure of substrate layer (A)/intermediate layer (B)/peel layer (C)/heat seal layer (D). The properties of this cover film are shown in Table 1 and Table 2.

[0045] (Examples 2-9, Comparative Examples 1-8)

A cover film was produced in the same manner as Example 1, aside from the fact that the peel layer (C) and the heat seal layer (D) were formed using the raw materials such

as resins shown in Table 1 and Table 2.

[0046] (Comparative Example 9)

A cover film was produced in the same manner as Example 1, with the proportional contents and composition shown in Table 2, aside from the fact that no peel layer (C) was provided, and the heat seal layer (D) was formed using the raw materials such as resins shown in Table 2.

[0047] (Comparative Example 10)

A cover film was produced in the same manner as Example 1, aside from the fact that no intermediate layer (B) was provided, and the peel layer (C) and the heat seal layer (D) were sequentially formed on the substrate layer (A) having a thickness of 25 μm .

[0048] (Comparative Example 11)

A cover film was produced in the same manner as Example 1, aside from the fact that no heat seal layer (D) was provided, and the intermediate layer (B) and the peel layer (C) were formed using raw materials such as resins shown in Table 2.

[0049] <Evaluation Method>

The cover films for use in a carrier tape for electronic components produced by the examples and comparative examples were evaluated as indicated below. These results are also shown together in Table 1 and Table 2.

[0050] (Vicat Softening Temperature)

A resin composition for forming the peel layer was extruded at 210 °C using an uniaxial extruder with a diameter of 40 mm, to obtain pellets of a resin composition. The resulting pellets were press molded at 210 °C to obtain test pieces of thickness 5 mm, width 10 mm and length 100 mm. The test pieces were measured for their Vicat softening temperature in accordance with method A120 of the JIS K-7206 standard, using a load of 10 N and raising the temperature by 120 °C/hour.

[0051] (Haze Value)

The haze value was measured in accordance with measurement method A of the JIS K7105:1998 standard, using an integrating sphere measurement device.

[0052] (Range Width of Peel Strength)

A taping machine (Shibuya Corporation, ETM-480) was used, with a sealing head width of 0.5 mm $\times$ 2, a sealing head length of 32 mm, a sealing pressure of 0.1 MPa, a feed length of 4 mm, and a sealing time of 0.1 seconds $\times$ 8 times with sealing iron temperatures from 130 °C to 190 °C in 20 °C intervals, to heat seal a 5.5 mm wide cover film to an 8 mm wide polystyrene carrier tape (product of Denka) so as to have a peel strength of 0.4 N. After letting stand for 24 hours in an atmosphere of temperature 23 °C and relative humidity 50%, the cover film was peeled in the same atmosphere of 23 °C and relative humidity 50%.

at a speed of 300 mm per minute and a peel angle of 170° to 180°. The difference between the maximum value and the minimum value (range width) of the peel strength was measured from a chart obtained when peeling 100 mm of cover film in the peel direction. Those with a peel strength range width of 0.2 N or less were graded “excellent”, those exceeding 0.2 N and less than or equal to 0.4 N were graded “good”, and those exceeding 0.4 N were graded “poor”.

[0053] (Frictional Charge Voltage)

A polycarbonate carrier tape (product of Denka) pre-containing LEDs was heat sealed so that the peel strength was in the range of 0.4 ± 0.05 N. After sealing, the package was placed on a CuteMixer (CM-1000), and elliptical vibrations were applied for 30 minutes at 1000 rpm, generating frictional static electricity between the LEDs (Stanley, PG 1111C) and the cover film. The package was placed on a metal plate with the cover film face down, and the carrier tape was peeled away to expose the LEDs. The LEDs were adhered to a conductive double-sided adhesive tape and affixed to a metal surface plate with the cover film-contacting surface facing upward. An electrometer (Monroe Electronics Isoprobe Electrostatic Voltmeter Model 279) and a measuring terminal (1034EH type) were used to measure the charge voltage on the fixed LEDs with an atmospheric temperature of 23 °C and an atmospheric humidity of 50% RH. In this case, the distance from the LEDs to the potential probe was 0.5 mm and the spatial resolution of the potential probe was $\phi 1.5$ mm. The measurements were performed for five LEDs, and the maximum value among the absolute values of the obtained results was taken as the frictional charge voltage for the present measurements. Those with a frictional charge voltage within ± 50 V were graded “excellent”, those exceeding ± 50 V and equal to or within ± 70 V were graded “good”, and those exceeding ± 70 V were graded “poor”.

[0054] (Peel Charge Voltage)

A polycarbonate carrier tape (product of Denka) was heat sealed so that the peel strength was in the range of 0.4 ± 0.05 N. The cover film was peeled, and the charge voltages of the cover film and the (D) heat seal layer at an atmospheric temperature of 23 °C and an atmospheric humidity of 50% RH were measured over 8 mm in the width direction and 30 mm in the length direction, at measurement intervals of 0.5 mm, using the above-described electrometer and measurement terminal. In this case, the distance from the cover film peel position to the potential probe was 0.5 mm and the spatial resolution of the potential probe was $\phi 1.5$ mm. The maximum value among the absolute values of the obtained results was taken as the peel charge voltage for the present measurements. Those with a peel charge voltage within ± 50 V were graded “excellent”, those exceeding ± 50 V and equal to or within ± 70 V were graded “good”, and those exceeding ± 70 V were graded

“poor”. The results are shown in the Peel Charge rows of Table 1 and Table 2.

[0055] (Surface Resistivity)

A resistivity meter (Mitsubishi Chemical, “Hiresta UP MCP-HT450”) was used to measure the surface resistance values of the heat seal layer surface according to the method of the JIS K6911 standard, at an atmospheric temperature of 23 °C, an atmospheric humidity of 50% RH and an applied voltage of 10 V.

[0056] [Table 1]

	Type of Resin		Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Ex. 7	Ex. 8	Ex. 9
	Resin										
Intermediate Layer (1)	Resin	b-1	Harmolex NI1745N	100	100	100	100	100	100	100	100
Intermediate Layer (2)	Resin	b-2	Umerit 2040F	100	100	100	100	100	100	100	100
Peel Layer Blend	Resin	c-a-1	Clearen 170ZR	52.5	52.5	52.5	52.5	52.5	52.5	45	60
	Resin	c-a-2	TR-2000	12.5	12.5	12.5	12.5	12.5	12.5	5	20
	Resin	c-b-1	Kernel KF270T	35	35	35	35			50	20
	Resin	c-b-2	Kernel KF360T					35			
		c-b-3	Tafmer A						35		
	Resin	c-b-4	Kernel KS240T								
	Resin	c-b-5	Kernel KF283								
	Resin	c-c-1	Toyostyrol E640N					10			
Heat Seal Layer Blend	Vicat softening temperature of peel layer (°C)		76	76	76	76	73	71	64	80	71
	Resin	d-1	NK polymer ECS-24								
	Resin	d-2	NK polymer ECS-704								
	Resin	d-3	NK polymer ECS-705								
	Resin	d-4	NK polymer ECS-706								
	Resin	d-5	NK polymer ECS-707								
	Resin	d-6	NK polymer ECS-708			100					
	Resin	d-7	NK polymer ECS-709								
Evaluated Properties etc.	Conductive filler	d-8	SN-100D	400	400	400	400	400	400	400	400
	Substrate layer thickness (μm)		13	13	13	13	13	13	13	13	13
	Intermediate layer (1) thickness (μm)		13	13	13	13	13	13	13	13	13
	Intermediate layer (2) thickness (μm)		20	20	20	20	20	20	20	20	20
	Peel layer thickness (μm)		5	5	5	5	5	5	5	5	5
	Heat seal layer thickness (μm)		0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
	Cover film thickness (μm)		51.2	51.2	51.2	51.2	51.2	51.2	51.2	51.2	51.2
	Haze value (%)		22	22	20	20	25	21	23	29	19
	Peel strength range width		excellent	excellent	excellent	excellent	excellent	excellent	good	good	good
	Frictional charge voltage (V)		-70	-67	-19	28	60	-63	-59	-70	-11
			good	good	excellent	excellent	good	good	good	good	excellent
	Peel charge voltage (V)		-63	-53	-49	-38	-69	-61	-64	-69	-60
	Surface resistivity (Ω/□)		good	good	excellent	excellent	good	good	good	good	excellent
			4E+09	5E+09	5E+09	2E+09	>1E+12	6E+09	4E+09	5E+09	4E+09

Note: The number following "E" represents the number of digits. (Ex. "1.00E+07" refers to 1.00×10^7)

[0057]

[Table 2]

	Type of Resin		Comp. Ex. 1	Comp. Ex. 2	Comp. Ex. 3	Comp. Ex. 4	Comp. Ex. 5	Comp. Ex. 6	Comp. Ex. 7	Comp. Ex. 8	Comp. Ex. 9	Comp. Ex. 10	Comp. Ex. 11
	Resin	b-1	100	100	100	100	100	100	100	100	100		100
Intermediate Layer (1)	Resin	Harmolex NH745N	100	100	100	100	100	100	100	100	100		100
Peel Layer Blend	Resin	Umerit 2040F	100	100	100	100	100	100	100	100	100		100
	Resin	c-a-1	52.5	52.5	52.5	52.5	52.5	52.5	65	36		52.5	52.5
	Resin	c-a-2	12.5	12.5	12.5	12.5	12.5	12.5	20	9		12.5	12.5
	Resin	c-b-1	35	35	35	35			15	55		35	35
	Resin	c-b-2											
	Resin	c-b-3											
	Resin	c-b-4						35					
	Resin	c-b-5					35						
	Resin	c-c-1											
	Resin	Toyostyrol E640N											
Heat Seal Layer Blend	Vicat softening temperature of peel layer (°C)		76	76	76	76	81	49	72	80		76	76
	Resin	d-1	100			100							
	Resin	d-2		100									
	Resin	d-3											
	Resin	d-4					100	100	100	100	100	100	
	Resin	d-5											
	Resin	d-6											
	Resin	d-7			100								
	Conductive filler	SN-100D	400	400	400		400	400	400	400	400	400	
	Substrate layer thickness (μm)		13	13	13	13	13	13	13	13	13	25	13
Evaluated Properties etc.	Intermediate layer (1) thickness (μm)		13	13	13	13	13	13	13	13	13	0	13
	Intermediate layer (2) thickness (μm)		20	20	20	20	20	20	20	20	25	0	20
	Peel layer thickness (μm)		5	5	5	5	5	5	5	5	0	25	5
	Heat seal layer thickness (μm)		0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0
	Cover film thickness (μm)		51.2	51.2	51.2	51.2	51.2	51.2	51.2	51.2	51.2	50.2	51.0
	Haze value (%)		25	24	20	26	26	26	30	20	16	33	25
	Peel strength range width		excel.	excel.	excel.	excel.	poor	poor	poor	poor	poor	poor	poor
	Frictional charge voltage (V)		-123.5	-82.9	75.9	-106.1	-65.8	-66.4	-66	-68	-70	-69	70.7
	Peel charge voltage (V)		poor	poor	poor	poor	good	good	good	good	good	good	poor
	Peel charge voltage (V)		-117	-106	-15	-318	-65	-63	-52	-321	-534	-61	-47
Surface resistivity (Ω/□)			poor	poor	excel.	poor	good	good	good	poor	poor	good	excel.
			1E+10	8E+09	2E+09	not measured	6E+09	4E+09	5E+09	6E+09	5E+09	5E+09	not measured

Note: The number following "E" represents the number of digits. (Ex. "1.00E+07" refers to 1.00×10^7)

DESCRIPTION OF REFERENCE NUMBERS

[0058]	1	Cover film
	2	Substrate layer
	3	Intermediate layer
	4	Peel layer
	5	Heat seal layer

CLAIMS

- [Claim 1] A cover film having arranged, in the following order, a substrate layer (A), an intermediate layer (B), a peel layer (C) and a heat seal layer (D), wherein
the peel layer (C):
comprises a resin composition essentially consisting of 50 to 80 mass% of at least one copolymer chosen from among styrene-diene block copolymers and styrene-diene graft copolymers, and 50 to 20 mass% of an ethylene- α -olefin copolymer; and
has a Vicat softening temperature of 55 to 80 °C; and
the heat seal layer (D) comprises a styrene-(meth)acrylate copolymer having a styrene content of 50 to 80 mass%.
- [Claim 2] The cover film according to claim 1, wherein at least one of the peel layer (C) or the heat seal layer (D) contains conductive microparticles.
- [Claim 3] The cover film according to claim 2, wherein the conductive microparticles are fibrous or spherical.
- [Claim 4] The cover film according to any one of claims 1 to 3, wherein the thickness of the substrate layer (A) is 12 to 20 μm , the thickness of the intermediate layer (B) is 10 to 40 μm , the thickness of the peel layer (C) is 5 to 20 μm , and the total thickness is 45 to 65 μm .
- [Claim 5] The cover film according to any one of claims 1 to 4, wherein a haze value is 30% or less.
- [Claim 6] An electronic component package using the cover film according to any one of claims 1 to 5 as a lid material for a thermoplastic resin carrier tape.
- [Claim 7] The electronic component package according to claim 6, wherein the thermoplastic resin is a polycarbonate.
- [Claim 8] The electronic component package according to claim 6 or 7, wherein an absolute value of a peel charge voltage when peeling the cover film from the carrier tape is 70 V or less.
- [Claim 9] The electronic component package according to any one of claims 6 to 8, wherein

an absolute value of a frictional charge voltage generated between the cover film and the carrier tape is 70 V or less.