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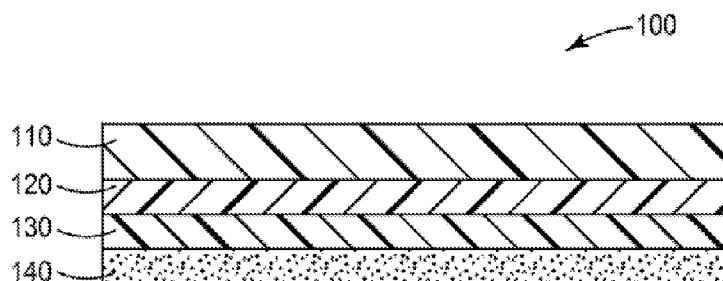


FIG. 1

(57) Abstract: Carrier tape articles include a carrier tape with a plurality of pockets and a heat-sealing cover tape. The multi-layer cover tape includes a thermoplastic base layer, a thermoplastic cushion layer, an antistatic layer, and a heat-sealing layer. The antistatic layer has a polymeric or co-polymeric binder and PEDOT-PSS (poly-3,4-ethylenedioxythiophene-polystyrene sulfonate) dispersed within the polymeric or co-polymeric binder. The sealing layer is a heat activated adhesive.



MULTI-LAYER COVER TAPE CONSTRUCTIONS

Field of the Disclosure

5 The present disclosure relates to a heat-sealing cover tape for electronic component packaging applications. In particular, the cover tape can be heat sealed to a carrier tape to facilitate storage, transport and mounting of small electronic components.

Background

10 As electronic parts have become more miniature, storage, transportation and handling of such components has become more difficult, and specialized methods have evolved. One such method is the use of a carrier tape. A carrier tape can be formed of a variety of materials, but is typically a plastic material formed in a strip which has multiple longitudinal recesses or indentions meant to hold individual components to prevent them
15 from touching each other or being otherwise exposed to trauma. Such indented segments must have an upper opening by which the component is placed into the recess, and then the opening must be sealed, generally by means of a cover tape.

 One material suggested for the cover tape used in punched carrier tapes is a multi-layer laminated polymeric foam structure, as in US Patent No. 4,657,137. This tape
20 requires the use of at least two separate layers and is produced by providing a flexible thin plastic or foam layer to which a strong and stable base layer is laminated.

 The carrier tape disclosed in US Patent No. 4,964,405 has a cover tape pasted with an adhesive which seals only the recesses and leaves the guide perforations open.

 The cover tapes normally used for carrier tapes have e.g., nylon based substrates
25 coated at least partially with an adhesive such as ethylene/vinyl acetate. See e.g., US Patent No. 4,963,405.

 One difficulty with carrier tapes and cover tapes has been providing an appropriate cover tape which seals the individual components which does not somehow provide contamination of adhesive or release agent as well. The carrier tape or the cover tape must
30 also provide some protection against the development of static electricity, which damages such fine electronic components; in fact, the winding and unwinding of the cover tape can

exacerbate such problems by generating static charges. Cover tapes are often made with a static dissipative strip in the middle of the adhesive, which is derived from a vapor coated metal. This strip covers the adhesive and protects the component from the electrical discharge by bleeding off developing tribocharges. However, such strips are opaque, which means that the component cannot be viewed in its indentation, and they are quite expensive.

In US Patent No. 6,171,672, static dissipative coatings are disclosed which contain carbon, a cation, an anion, and an unspecified organopolymeric conductor. Ionic salts are not permanent coatings, and may leach out, adding to the contamination issue. Further, they are humidity dependent and can be corrosive. Further, such carbon and metals are opaque. In US Patent Publication No. 2003/0049437 cover tapes are described that include an electrically conductive coating comprising a dispersion of conductive polymer.

Summary

The present disclosure relates to a heat-sealing cover tape for electronic component packaging applications. In particular, the cover tape can be heat sealed to a carrier tape to facilitate storage, transport and mounting of small electronic components. The disclosure includes cover tapes. In some embodiments, the cover tape comprises a base layer, a cushion layer, an antistatic layer, and a sealing layer. The base layer has a first major surface and a second major surface, and comprises a thermoplastic polymer with a thickness of from 10-20 micrometers. The cushion layer has a first major surface and a second major surface, where the first major surface of the cushion layer is in contact with or adhesively bonded to the second major surface of the base layer, and comprises a polymeric or co-polymeric thermoplastic composition with a thickness of from 20-35 micrometers. The antistatic layer has a first major surface and a second major surface, where the first major surface is in contact with the second major surface of the cushion layer, and comprises a polymeric or co-polymeric binder and PEDOT-PSS (poly-3,4-ethylenedioxythiophene-polystyrene sulfonate) dispersed within the polymeric or co-polymeric binder, where the PEDOT-PSS comprises 5-30 weight% of the antistatic layer. The sealing layer has a first major surface and a second major surface, where the first major surface of the sealing layer is in contact with the second major surface of the

antistatic layer, and comprising a heat activated adhesive, where the heat activated adhesive comprises a polymeric or copolymeric composition with a thickness of 0.5-2.0 micrometers. The cover tape has a heat activation bonding range of at least 135°C, and the cover tape peel adhesion is maintained when exposed to conditions of time, temperature, humidity or a combination thereof, and the cover tape has a surface resistance (SR) value of from 10^6 - 10^{11} ohms as measured on the second major surface of the sealing layer at a temperature of 23°C, and a relative humidity of 50%.

Also disclosed are articles. In some embodiments, the articles comprise a carrier tape comprising a plurality of pockets; and a cover tape bonded to the carrier tape and sealing the plurality of pockets. The cover tapes are described above.

Brief Description of the Drawings

The present application may be more completely understood in consideration of the following detailed description of various embodiments of the disclosure in connection with the accompanying drawings.

Figure 1 shows a cross-sectional view of an exemplary embodiment of a multi-layer cover tape of this disclosure.

Figure 2 shows a cross-sectional view of an exemplary embodiment of a multi-layer carrier tape construction of this disclosure.

In the following description of the illustrated embodiments, reference is made to the accompanying drawings, in which is shown by way of illustration, various embodiments in which the disclosure may be practiced. It is to be understood that the embodiments may be utilized and structural changes may be made without departing from the scope of the present disclosure. The figures are not necessarily to scale. Like numbers used in the figures refer to like components. However, it will be understood that the use of a number to refer to a component in a given figure is not intended to limit the component in another figure labeled with the same number.

Detailed Description

As electronic parts have become more miniature, storage, transportation and handling of such components has become more difficult, and specialized methods have

evolved. One such method is the use of a carrier tape. A carrier tape can be formed of a variety of materials, but is typically a plastic material formed in a strip which has multiple longitudinal recesses or indentions meant to hold individual components to prevent them from touching each other or being otherwise exposed to trauma. Such indented segments are frequently referred to as “pockets” and have an upper opening by which the component is placed into the recess, and then the opening is sealed, generally by means of a cover tape.

A number of specialized features are required of the cover tape constructions beyond the properties required of typical tapes, properties such as sealing at relatively low temperatures, stable peel values over time to allow consistent removal, and the like. Among the specialized properties are having an electrically conductive layer in the cover tape to prevent tribocharging when the tape is attached or removed from the carrier tape.

Typically, cover tape constructions are multi-layer articles and therefore interlayer adhesion is an important consideration. In other words, when used, the tape construction must hold together upon application to the carrier tape, transportation or storage, and removal of the cover tape from the carrier tape. If any of the layers in the cover tape are vulnerable to decomposition or loss of integrity, the entire cover tape construction can fail. In particular, the electrically conductive layer, also called an antistatic layer, can be vulnerable to environmental conditions. Among the environmental conditions that the cover tape is likely to encounter is heat and/or a combination of heat and humidity. It is desirable that the peel adhesion values of the cover tape remain stable over time even when exposed to a variety of environmental conditions. In this context, stable peel values means that the initial peel adhesion value and aged peel adhesion value are very similar and do not experience a major decrease indicating a loss of integrity of one or more layers within the cover tape construction. Therefore the development of cover tapes that have not only desirable adhesive properties such as relatively low sealing temperatures and stable peel values over time to allow consistent removal, but also have an electrically conductive antistatic layer that is stable to exposure to humid conditions is desirable.

In this disclosure, cover tapes, and carrier tape constructions that use the cover tapes, will be described. The cover tapes are multi-layer constructions comprising a base layer, a cushioning layer, an antistatic layer, and a sealing layer. The cover tapes have a

heat activation bonding temperature range as low as 135°C, the cover tape peel adhesion is maintained when exposed to conditions of time, temperature, humidity or a combination thereof, and the cover tape has a surface resistance (SR) value of from 10^6 - 10^{11} ohms as measured on the second major surface of the sealing layer at a temperature of 23°C, and a
5 relative humidity of 50%. The peel adhesion values being maintained when exposed to conditions of time, temperature, humidity or a combination thereof, refers to the peel adhesion remaining essentially unchanged over a range of time, temperature and humidity conditions. While of course some variation in the peel adhesion is to be expected, the initial peel adhesion and the peel adhesion after exposure to time, temperature, humidity or
10 a combination thereof are generally similar, and do not significantly decrease. A significant decrease in peel adhesion when exposed to time, temperature or humidity conditions is indicative of instability in one or more layers of the cover tape, generally the antistatic layer. While a variety of time, temperature and humidity conditions can be experienced by the cover tape, some typical ranges are suitable for these cover tape
15 constructions. As to aging times, typically aging times are on the order of days, in some embodiments up to 30 days or even longer. As to aging temperatures, typically the temperature ranges from room temperature up to 60°C. As to humidity, typically the humidity ranges from a typical ambient humidity of 50% RH (relative humidity) up to high humidity conditions such as 95% RH. Combinations of elevated temperatures (above
20 room temperature) and humidity levels are also possible such as 52°C and 95% RH. The cover tapes, and carrier tape constructions utilizing the cover tapes, are described in greater detail below.

Unless otherwise indicated, all numbers expressing feature sizes, amounts, and physical properties used in the specification and claims are to be understood as being
25 modified in all instances by the term "about." Accordingly, unless indicated to the contrary, the numerical parameters set forth in the foregoing specification and attached claims are approximations that can vary depending upon the desired properties sought to be obtained by those skilled in the art utilizing the teachings disclosed herein. The recitation of numerical ranges by endpoints includes all numbers subsumed within that
30 range (e.g. 1 to 5 includes 1, 1.5, 2, 2.75, 3, 3.80, 4, and 5) and any range within that range.

As used in this specification and the appended claims, the singular forms "a", "an", and "the" encompass embodiments having plural referents, unless the content clearly dictates otherwise. For example, reference to "a layer" encompasses embodiments having one, two or more layers. As used in this specification and the appended claims, the term "or" is generally employed in its sense including "and/or" unless the content clearly dictates otherwise.

The term "adhesive" as used herein refers to polymeric compositions useful to adhere together two adherends. Examples of adhesives are heat activated adhesives and pressure sensitive adhesives.

Heat activated adhesives are non-tacky at room temperature but become tacky and capable of bonding to a substrate at elevated temperatures. These adhesives usually have a T_g (glass transition temperature) or melting point (T_m) above room temperature. When the temperature is elevated above the T_g or T_m , the storage modulus usually decreases and the adhesive becomes tacky.

Pressure sensitive adhesive compositions are well known to those of ordinary skill in the art to possess properties including the following: (1) aggressive and permanent tack, (2) adherence with no more than finger pressure, (3) sufficient ability to hold onto an adherend, and (4) sufficient cohesive strength to be cleanly removable from the adherend. Materials that have been found to function well as pressure sensitive adhesives are polymers designed and formulated to exhibit the requisite viscoelastic properties resulting in a desired balance of tack, peel adhesion, and shear holding power. Obtaining the proper balance of properties is not a simple process.

The term "(meth)acrylate" refers to monomeric acrylic or methacrylic esters of alcohols. Acrylate and methacrylate monomers or oligomers are referred to collectively herein as "(meth)acrylates". Materials referred to as "(meth)acrylate functional" are materials that contain one or more (meth)acrylate groups.

The terms " T_g " and "glass transition temperature" are used interchangeably. If measured, T_g values are determined by Differential Scanning Calorimetry (DSC) at a scan rate of 10°C/minute, unless otherwise indicated. Typically, T_g values for copolymers are not measured but are calculated using the well-known Fox Equation, using the monomer T_g values provided by the monomer supplier, as is understood by one of skill in the art

As used herein, the term "conductivity" means a measure of the ability of electrical charge to move within a material. "Resistivity" is the reciprocal of conductivity.

As used herein, the term "cover tape" means a tape useful for sticking to the surface of a carrier tape, which has indented segments for accommodating and transporting chips and other sensitive electronic components.

As used herein, the term "indented segments" refers to individual carriers, e.g., pockets or cups formed in the carrier tape to hold typically a single unit of some product. Such segments are typically formed by vacuum forming, thermoforming, molding or other known process.

As used herein the term "room temperature" or "ambient temperature" are used interchangeably and refer to a temperature of from 20-25°C.

The term "adjacent" as used herein when referring to two layers means that the two layers are in proximity with one another with no intervening open space between them. They may be in direct contact with one another (e.g. laminated together) or there may be intervening layers.

All percentages, ratios and amounts herein are by weight unless otherwise specifically noted.

Disclosed herein are cover tapes. The cover tapes are multi-layer constructions comprising a base layer, a cushioning layer, an antistatic layer, and a sealing layer. Each of these layers will be described in detail.

The base layer has a first major surface and a second major surface, and comprises a thermoplastic polymer. A wide range of thermoplastic polymers are suitable. Among the suitable polymers are polyethylene terephthalate polymers, or polyimide thermoplastics. Because of their wide availability and desirable properties, polyethylene terephthalate polymers are particularly suitable. The base layer may have any suitable thickness, typically the thickness ranges from 10-20 micrometers.

The second major surface of the base layer is adjacent to the cushion layer described below. The base layer may be in contact with or adhesively bonded to the cushion layer. The first major surface of the base layer may be unmodified or it may contain a wide variety of coatings or layers. Examples of suitable layers or coatings that may be in contact with the first major surface of the base layer include hard coats such as

anti-scratch coatings, or anti-adhesive coatings such as release coatings. A wide range of release coating layers are suitable to be disposed upon the first major surface of the base layer. Particularly suitable release coatings include materials such as is used on the back side of rolled tape products to permit the tape to be rolled up and remain intact and then to be unwound for use. Such materials are sometimes called Low Adhesion Backsizes or LABs. A wide variety of LABs have been developed for use with a wide variety of adhesives. Examples of suitable LAB or release coatings that are suitable for use in the cover tape constructions of this disclosure include: the water-based fluorochemical materials described in US Patent No. 7,411,020 (Carlson et al.); the polysiloxane release coatings described in US Patent No. 5,753,346 (Leir et al.); the release compositions describe in US Patent No. 7,229,687 (Kinning et al.); the polyvinyl N-alkyl carbamates (polyurethanes) described in US Patent No. 2,532,011 (Dalquist et al.); the moisture-curable materials described in US Patent No. 6,204,350 (Liu et al.); and the organopolysiloxane-polyurea copolymer release agents described in US Patent No. 5,290,615 (Tushaus et al.).

The multi-layer cover tape construction also comprises a cushion layer. The cushion layer has a first major surface and a second major surface, where the first major surface of the cushion layer is adjacent to the second major surface of the base layer as described above. In this context, adjacent to second major surface of the base layer refers to the first major surface of the cushioning layer either being in contact with or being adhesively bonded to the second major surface of the base layer.

A wide range of a polymeric or co-polymeric thermoplastic materials can be used in the cushion layer. In many embodiments, the cushion layer comprises an ethylene-based polymer or co-polymer. Examples of suitable ethylene-based polymers or co-polymers include ethylene-vinyl acetate copolymers, polyethylene, blends of ethylene-vinyl acetate copolymers and polyethylene, and alternating layers of polyethylene and ethylene-vinyl acetate. In some embodiments, the ethylene-based polymer or co-polymer comprises an ethylene-vinyl acetate copolymer comprising 10-30 weight % vinyl acetate.

The cushion layer may have a wide range of suitable thicknesses. In some embodiments, the cushion layer has a thickness of from 20-35 micrometers.

In some embodiments, the base layer and cushion layer may be separately formed layers that are laminated or adhesively bonded together to form a composite construction. In other embodiments, a composite construction comprising the base layer and cushion layer is commercially available and can be used as purchased without the need to assemble the layers. Examples of commercially available composite constructions of layers comprising polyethylene terephthalate and ethylene/ethylene-vinyl acetate blends include ones available from ZhongHe Tongshen Lamination and Wangzhe Lamination as described in the Examples section.

The multi-layer cover tape also comprises an antistatic layer. The antistatic layer has a first major surface and a second major surface. The first major surface of the antistatic layer is in contact with the second major surface of the cushion layer. The antistatic layer comprises a polymeric or co-polymeric binder and conductive particles dispersed within the polymeric or co-polymeric binder.

While a variety of different types of conductive particles can be used such as carbon nanotubes, antimony-doped metal oxide particles, or carbon black particles, typically the conductive particles comprise PEDOT-PSS (poly-3,4-ethylenedioxythiophene-polystyrene sulfonate) particles. PEDOT-PSS is a polymer mixture of two ionomers. One component in this mixture is made up of sodium polystyrene sulfonate which is a sulfonated polystyrene. Part of the sulfonyl groups are deprotonated and carry a negative charge. The other component poly(3,4-ethylenedioxythiophene) or PEDOT is a conjugated polymer and carries positive charges and is based on polythiophene. Together the charged macromolecules form a macromolecular salt. PEDOT-PSS is commercially available as a water dispersion.

In some embodiments, the antistatic layer comprises 5-30 weight % of conductive particles, typically PEDOT-PSS. Weight percentages are calculated by dry weight, meaning that the percentages refer to the materials in the coating that has been dried to remove any volatile components such as solvents or water.

A wide range of polymeric and co-polymeric materials are suitable as the binder of the antistatic layer. Typically, the binder material comprises a modified acrylate polymer or copolymer, a styrene-based polymer or co-polymer, or a combination thereof. In some embodiments, the polymeric or co-polymeric binder of the antistatic layer comprises a

modified acrylate polymer or copolymer. In other embodiments, the polymeric or co-polymeric binder of the antistatic layer comprises a styrene-based polymer or copolymer. In yet other embodiments, the polymeric or co-polymeric binder comprises an acrylate-styrene copolymer. In some embodiments, the antistatic layer binder is the modified
5 styrene copolymer commercially available as NEOCRYL A-1091 from DSM, Wilmington, MA. Typically the polymeric or co-polymeric binder of the antistatic layer is water soluble or water dispersible.

As mentioned above, sensitivity to heat and humidity is a serious concern for the antistatic layer, therefore it is desirable that the polymeric or co-polymeric binder layer
10 material is a moisture resistant material. Moisture resistance can be defined or measured in a variety of ways. In this disclosure, the polymeric or co-polymeric binder layer material is a moisture resistant material, such that when soaked in water for 24 hours the uptake of water is less than 5 weight%.

In some particular embodiments, the antistatic layer is a dried layer formed from a
15 dispersion mixture comprising an aqueous dispersion of the polymeric or co-polymeric binder; and an aqueous dispersion of PEDOT-PSS (poly-3,4-ethylenedioxythiophene-polystyrene sulfonate), where the polymeric or co-polymeric binder material is a moisture resistant material, such that when soaked in water for 24 hours the uptake of water is less than 5 weight%.

The cover tape also comprises a sealing layer. Just as the antistatic layer provides
20 the antistatic properties to the cover tape, the sealing layer provides the adhesive properties of the cover tape. The sealing layer has a first major surface and a second major surface, where the first major surface of the sealing layer is in contact with the second major surface of the antistatic layer. The sealing layer is a heat activated adhesive layer that is
25 able to adhere the cover tape to a carrier tape to form a carrier tape construction. Heat activated adhesives are non-tacky at room temperature but become tacky and capable of bonding to a substrate at elevated temperatures. These adhesives usually have a T_g (glass transition temperature) or melting point (T_m) above room temperature. When the temperature is elevated above the T_g or T_m , the storage modulus usually decreases and the
30 adhesive becomes tacky.

A wide range of heat activated adhesives are suitable for use in the cover tape. Particularly suitable heat activated adhesives are those that provide the cover tape with the desirable properties of a relatively low heat bonding temperature and also provide consistent peel adhesion, meaning that the peel adhesion does not change with time, temperature, humidity or a combination of these factors. Generally, the heat activated adhesive provides the cover tape with a heat activation bonding range down to a temperature of 135°C, or stated another way, the heat activated adhesive provides the cover tape with a heat activation bonding range temperature of at least 135°C. While typically it is desirable to heat seal the cover tape constructions of the present disclosure at a temperature of as low as 135°C, in some embodiments it may be suitable to heat seal the cover tape constructions at a temperature of from 135°C to 170°C, or even 140°C to 160°C.

A wide range of polymeric or co-polymeric materials are suitable for use in the heat activated adhesive composition of the sealing layer. Particularly suitable heat activated adhesive compositions include at least one (meth)acrylate-based polymer or co-polymer. In some embodiments, the at least one (meth)acrylate-based polymer or co-polymer comprises a (meth)acrylate polymer or copolymer with a weight average molecular weight of 50,000-100,000 grams/mole. In other embodiments, the at least one (meth)acrylate-based polymer or co-polymer comprises a mixture of at least two (meth)acrylate polymers or copolymers comprising a (meth)acrylate polymer or copolymer with a weight average molecular weight of 50,000-100,000 grams/mole and a (meth)acrylate polymer or copolymer with a weight average molecular weight of 100,000-200,000 grams/mole.

Besides the polymeric or co-polymeric components described above, the heat activated adhesive composition may further comprise one or more additional components. Examples of suitable additional components include tackifiers, plasticizers, stabilizers, and fillers. Examples of fillers include particulate fillers such as silica particles or polymer beads. Examples of polymer beads include, for example, polyacrylate beads. The additional components may be present in any suitable amount. In some embodiments, a particulate filler comprising silica polymers or polymer beads are present in the heat activated adhesive composition at about 5-20 weight%.

The sealing layer may have a wide range of suitable thicknesses. Typically the sealing layer thickness ranges from a thickness of 0.5-2.0 micrometers.

Disclosed herein are multi-layer cover tape constructions that have antistatic properties which are stable over time, temperature and humidity, and have desirable adhesive properties. The cover tape has a surface resistance (SR) value of from 10^6 - 10^{11} ohms as measured on the second major surface of the sealing layer at a temperature of 23°C, and a relative humidity of 50%. Additionally, the cover tape has a heat activation bonding range temperature of at least 135°C, and a peel adhesion that is maintained when exposed to conditions of time, temperature and humidity. In some embodiments, the cover tape has a peel adhesion value from a carrier tape of from 30-70 gf (grams force). As mentioned above, maintenance of peel adhesion refers to initial and aged peel adhesion values being very similar without a marked decrease. While a variety of time, temperature and humidity conditions can be experienced by the cover tape, some typical ranges are suitable for these cover tape constructions. The ranges of aging conditions can be mimicked or modeled in a variety of ways, and a range of aging conditions are desirable. As to aging times, typically aging times are on the order of days, in some embodiments up to 30 days or even longer. As to aging temperatures, typically the temperature ranges from room temperature up to 60°C. As to humidity, typically the humidity ranges from a typical ambient humidity of 50% RH (relative humidity) up to high humidity conditions such as 95% RH. Combinations of elevated temperatures (above room temperature) and humidity levels are also possible such as 52°C and 95% RH.

Also disclosed herein are articles comprising a carrier tape comprising a plurality of pockets, and a cover tape bonded to the carrier tape and sealing the plurality of pockets or indented segments. The cover tape has been described above and comprises a base layer with a first major surface and a second major surface, comprising a thermoplastic polymer with a thickness of from 10-20 micrometers, a cushion layer with a first major surface and a second major surface, where the first major surface of the cushion layer is in contact with or adhesively bonded to the second major surface of the base layer comprising a polymeric or co-polymeric thermoplastic composition with a thickness of from 20-35 micrometers, an antistatic layer with a first major surface and a second major surface, where the first major surface is in contact with the second major surface of the cushion

layer, comprising a polymeric or co-polymeric binder and PEDOT-PSS (poly-3,4-ethylenedioxythiophene-polystyrene sulfonate) dispersed within the polymeric or co-polymeric binder, wherein the PEDOT-PSS comprises 5-30 weight% of the antistatic layer, and a sealing layer with a first major surface and a second major surface, where the first major surface of the sealing layer is in contact with the second major surface of the antistatic layer, comprising a heat activated adhesive wherein the heat activated adhesive comprises a polymeric or copolymeric composition with a thickness of 0.50-2.0 micrometers. The cover tape has a heat activation bonding range of at least 135°C, the cover tape peel adhesion is maintained when exposed to conditions of time, temperature, humidity or a combination thereof, and the cover tape has a surface resistivity (SR) value of from 10^6 - 10^{11} ohms as measured on the second major surface of the sealing layer at a temperature of 23°C, and a relative humidity of 50%.

Carrier tapes are well understood in the electronics art. Typically the carrier tape is prepared from a thermoplastic polymeric material. In some embodiments, the carrier tape comprises a polystyrene or polycarbonate carrier tape.

Typically, electronic components are placed in the carrier tape pockets, and the cover tape is placed over the openings of the pockets in the carrier tape and the cover tape is heat sealed. The heat sealing is carried out at a temperature suitable for forming a stable bond between the cover tape and carrier tape. Typically, the carrier tape is sealed at a temperature of at least 135°C. In some embodiments, the carrier tape is sealed at a temperature of from 135°C-170°C, 135°C-160°C, or even 140°C-160°C.

When the electronic components in the carrier tape constructions are delivered to their desired location the cover tape is removed to permit removal of the electronic components. To facilitate this process, it is desirable that the heat sealed bond be stable over time, meaning that the adhesion of the heat sealed bond does not change appreciably over time. It is desirable that the peel adhesion be in the range from 30-70 grams-force (gf).

The disclosure can be further understood by referring to the figures. An embodiment of a multi-layer cover tape is shown in Figure 1. Figure 1 is a cross sectional view of cover tape 100, which includes base polymeric layer 110, cushion polymeric layer

120, antistatic layer 130, and heal sealing layer 140. The layers are merely illustrative and are not drawn to scale. Each of these layers has been further described above.

Figure 2 shows a top view of carrier tape construction 200 which includes indented pockets 210 which contain electronic components 230, and cover tape 220 covering and sealing the electronic components 230 in indented pockets 210.

This disclosure includes the following embodiments:

Among the embodiments are cover tapes. Embodiment 1 is a cover tape comprising: a base layer with a first major surface and a second major surface, comprising a thermoplastic polymer with a thickness of from 10-20 micrometers; a cushion layer with a first major surface and a second major surface, wherein the first major surface of the cushion layer is in contact with or adhesively bonded to the second major surface of the base layer comprising a polymeric or co-polymeric thermoplastic composition with a thickness of from 20-35 micrometers; an antistatic layer with a first major surface and a second major surface, wherein the first major surface is in contact with the second major surface of the cushion layer, comprising a polymeric or co-polymeric binder and PEDOT-PSS (poly-3,4-ethylenedioxythiophene-polystyrene sulfonate) dispersed within the polymeric or co-polymeric binder, wherein the PEDOT-PSS comprises 5-30 weight% of the antistatic layer; and a sealing layer with a first major surface and a second major surface, wherein the first major surface of the sealing layer is in contact with the second major surface of the antistatic layer, comprising a heat activated adhesive composition wherein the heat activated adhesive composition comprises a polymeric or copolymeric composition with a thickness of 0.5-2.0 micrometers; and wherein the cover tape has a heat activation bonding range of at least 135°C, the cover tape peel adhesion is maintained when exposed to conditions of time, temperature, humidity or a combination thereof, and the cover tape has a surface resistance (SR) value of from 10^6 - 10^{11} ohms as measured on the second major surface of the sealing layer at a temperature of 23°C, and a relative humidity of 50%.

Embodiment 2 is the cover tape of embodiment 1, wherein the base layer comprises a polyethylene terephthalate polymer, or polyimide thermoplastic.

Embodiment 3 is the cover tape of embodiment 1 or 2, wherein the cushion layer comprises an ethylene-based polymer or co-polymer.

Embodiment 4 is the cover tape of embodiment 3, wherein the ethylene-based polymer or co-polymer comprises an ethylene-vinyl acetate copolymer, polyethylene, a blend of ethylene-vinyl acetate copolymer and polyethylene, or alternating layers of polyethylene and ethylene-vinyl acetate.

5 Embodiment 5 is the cover tape of embodiment 3, wherein the ethylene-based polymer or co-polymer comprises an ethylene-vinyl acetate copolymer comprising 10-30 weight % vinyl acetate.

Embodiment 6 is the cover tape of any of embodiments 1-5, wherein the polymeric or co-polymeric binder of the antistatic layer comprises a modified acrylate polymer or copolymer, a styrene-based polymer or co-polymer, or a combination thereof.

Embodiment 7 is the cover tape of embodiment 6, wherein the polymeric or co-polymeric binder of the antistatic layer comprises a modified acrylate polymer or copolymer.

15 Embodiment 8 is the cover tape of embodiment 6, wherein the polymeric or co-polymeric binder of the antistatic layer comprises a styrene-based polymer or copolymer.

Embodiment 9 is the cover tape of embodiment 6, wherein the polymeric or co-polymeric binder comprises an acrylate-styrene copolymer.

Embodiment 10 is the cover tape of any of embodiments 1-9, wherein the antistatic layer is a dried layer formed from a dispersion mixture comprising: an aqueous dispersion of the polymeric or co-polymeric binder; and an aqueous dispersion of PEDOT-PSS (poly-3,4-ethylenedioxythiophene-polystyrene sulfonate); wherein the polymeric or co-polymeric binder material is a moisture resistant material, such that when soaked in water for 24 hours the uptake of water is less than 5 weight%.

25 Embodiment 11 is the cover tape of any of embodiments 1-10, wherein the heat activated adhesive composition of the sealing layer comprises at least one (meth)acrylate-based polymer or co-polymer.

Embodiment 12 is the cover tape of embodiment 11, wherein the at least one (meth)acrylate-based polymer or co-polymer comprises a (meth)acrylate polymer or copolymer with a weight average molecular weight of 50,000-100,000 grams/mole.

30 Embodiment 13 is the cover tape of embodiment 11, wherein the at least one (meth)acrylate-based polymer or co-polymer comprises a mixture of at least two

(meth)acrylate polymers or copolymers comprising a (meth)acrylate polymer or copolymer with a weight average molecular weight of 50,000-100,000 grams/mole and a (meth)acrylate polymer or copolymer with a weight average molecular weight of 100,000-200,000 grams/mole.

5 Embodiment 14 is the cover tape of any of embodiments 1-13, wherein the heat activated adhesive composition further comprises a particulate filler comprising silica particles or polymer beads present at about 5-20 weight%.

 Also disclosed are articles. Embodiment 15 is an article comprising: a carrier tape comprising a plurality of pockets; and a cover tape bonded to the carrier tape and sealing
10 the plurality of pockets; wherein the cover tape comprises: a base layer with a first major surface and a second major surface, comprising a thermoplastic polymer with a thickness of from 10-20 micrometers; a cushion layer with a first major surface and a second major surface, wherein the first major surface of the cushion layer is in contact with or adhesively
15 bonded to the second major surface of the base layer comprising a polymeric or co-polymeric thermoplastic composition with a thickness of from 20-35 micrometers; an antistatic layer with a first major surface and a second major surface, wherein the first major surface is in contact with the second major surface of the cushion layer, comprising a polymeric or co-polymeric binder and PEDOT-PSS (poly-3,4-ethylenedioxythiophene-polystyrene sulfonate) dispersed within the polymeric or co-polymeric binder, wherein the
20 PEDOT-PSS comprises 5-30 weight% of the antistatic layer; and a sealing layer with a first major surface and a second major surface, wherein the first major surface of the sealing layer is in contact with the second major surface of the antistatic layer, comprising a heat activated adhesive composition wherein the heat activated adhesive composition comprises a polymeric or copolymeric composition with a thickness of 0.50-2.0
25 micrometer thickness; and wherein the cover tape has a heat activation bonding range of at least 135°C, the cover tape peel adhesion is maintained when exposed to conditions of time, temperature, humidity or a combination thereof, and the cover tape has a surface resistivity (SR) value of from 10^6 - 10^{11} ohms as measured on the second major surface of the sealing layer at a temperature of 23°C, and a relative humidity of 50%.

30 Embodiment 16 is the article of embodiment 15, wherein the carrier tape comprises a polycarbonate or polystyrene carrier tape.

Embodiment 17 is the article of embodiment 15 or 16, wherein the peel value of the cover tape from the carrier tape sealed at a temperature of at least 135°C, ranges from 30-70 grams-force (gf).

Embodiment 18 is the article of any of embodiments 15-17, wherein the base layer
5 comprises a polyethylene terephthalate polymer, or polyimide thermoplastic.

Embodiment 19 is the article of any of embodiments 15-18, wherein the cushion layer comprises an ethylene-based polymer or co-polymer.

Embodiment 20 is the article of embodiment 19, wherein the ethylene-based polymer or co-polymer comprises an ethylene-vinyl acetate copolymer, polyethylene, a
10 blend of ethylene-vinyl acetate copolymer and polyethylene, or alternating layers of polyethylene and ethylene-vinyl acetate.

Embodiment 21 is the article of embodiment 19, wherein the ethylene-based polymer or co-polymer comprises an ethylene-vinyl acetate copolymer comprising 10-30 weight % vinyl acetate.

Embodiment 22 is the article of any of embodiments 15-21, wherein the polymeric or co-polymeric binder of the antistatic layer comprises a modified acrylate polymer or copolymer, a styrene-based polymer or co-polymer, or a combination thereof.
15

Embodiment 23 is the article of embodiment 22, wherein the polymeric or co-polymeric binder of the antistatic layer comprises a modified acrylate polymer or copolymer.
20

Embodiment 24 is the article of embodiment 22, wherein the polymeric or co-polymeric binder of the antistatic layer comprises a styrene-based polymer or copolymer.

Embodiment 25 is the article of embodiment 22, wherein the polymeric or co-polymeric binder comprises an acrylate-styrene copolymer.

Embodiment 26 is the article of any of embodiments 15-25, wherein the antistatic layer is a dried layer formed from a dispersion mixture comprising: an aqueous dispersion of the polymeric or co-polymeric binder; and an aqueous dispersion of PEDOT-PSS (poly-3,4-ethylenedioxythiophene-polystyrene sulfonate); wherein the polymeric or co-polymeric binder material is a moisture resistant material, such that when soaked in water for 24
25
30 hours the uptake of water is less than 5 weight%.

Embodiment 27 is the article of any of embodiments 15-26, wherein the heat activated adhesive composition of the sealing layer comprises at least one (meth)acrylate-based polymer or co-polymer.

5 Embodiment 28 is the article of embodiment 27, wherein the at least one (meth)acrylate-based polymer or co-polymer comprises a (meth)acrylate polymer or copolymer with a weight average molecular weight of 50,000-100,000 grams/mole.

10 Embodiment 29 is the article of embodiment 27, wherein the at least one (meth)acrylate-based polymer or co-polymer comprises a mixture of at least two (meth)acrylate polymers or copolymers comprising a (meth)acrylate polymer or copolymer with a weight average molecular weight of 50,000-100,000 grams/mole and a (meth)acrylate polymer or copolymer with a weight average molecular weight of 100,000-200,000 grams/mole.

15 Embodiment 30 is the article of any of embodiments 15-29, wherein the heat activated adhesive composition further comprises a particulate filler comprising silica particles or polymer beads present at about 5-20 weight%.

Embodiment 31 is the article of any of embodiments 15-30, wherein the heat activation bonding range is 135°C-170°C.

Embodiment 32 is the article of any of embodiments 15-30, wherein the heat activation bonding range is 135°C-160°C,

20 Embodiment 33 is the article of any of embodiments 15-30, wherein the heat activation bonding range is 140°C-160°C.

Embodiment 34 is the article of any of embodiments 15-33, wherein the peel adhesion is maintained for up to 30 days.

25 Embodiment 35 is the article of any of embodiments 15-34, wherein the peel adhesion is maintained when exposed to a temperature of up to 60°C.

Embodiment 36 is the article of any of embodiments 15-34, wherein the peel adhesion is maintained when exposed to a temperature of up to 52°C and a relative humidity of up to 95%.

Examples

The following examples and comparative examples are offered to aid in the understanding of the present disclosure and are not to be construed as limiting the scope thereof. Unless otherwise noted, all parts, percentages, ratios, etc. in the examples and the rest of the specification are by weight, and all reagents used in the examples were obtained, or are available, from general chemical suppliers such as, for example, Sigma-Aldrich Corp., Saint Louis, MO, US.

The following abbreviations are used in this section: °C = degrees Celsius, J/cm² = Joules per square centimeter, min = minutes, ft/min = feet per minute, m/min = meters per minute, V = Volts, cm = centimeters, g = grams, gf = grams force, μm = micrometers, wt% = percentage by weight.

Sample Preparation Procedures

Base and Cushion Layers

A substrate comprised of a biaxially oriented polyethylene terephthalate (BOPET) base layer and an ethylene-vinyl acetate (EVA) cushion layer (ITF0160 from Yixing Wangzhe Lamination, Jiangsu, China) was used to prepare the exemplary cover tapes. The substrate contained 18 mass % VA, and had a Vicat softening temperature of 56°C (data from manufacturer.)

Antistatic Layer

Antistatic Layer AS-1 was made by adding 550 g water to 50 g ORGACON ICP 1010 (a PEDOT-PSS dispersion having 1.22 wt % solids, available from AGFA Specialty Products, Mortsel, Belgium). To this mixture, 25 g of NEOCRYL A-1091 (modified styrene copolymer dispersion having 44% solids, available from DSM Engineering Plastics, Genk, Belgium) was slowly added with stirring to form a stable, blue colored dispersion. On coating and drying, this dispersion yielded an antistatic coating with 94.7% copolymer binder.

The dispersion was roll-to-roll coated onto the EVA side of the substrate by a reverse kiss coating method. A tri-helical patterned gravure bar of volume factor 19.8 cm³/m² was used. Prior to coating, the substrate was exposed to inline nitrogen corona treatment at a power level of 5.17 J/cm². The line speed was 10 ft/min (3 m/min), and the

gravure roll speed was 15 ft/min (4.6 m/min). After coating, the film was passed through a 3-stage drying oven with temperature settings at 65, 65, and 75°C, respectively.

Antistatic Layer AS-2 was made by adding 50 g water and 350 g isopropanol to 50 g ORGACON ICP 1010 while stirring. This dispersion was coated onto the substrate under the identical conditions as for production of the AS-1, with the exception that no corona treatment was used.

Antistatic Layer AS-3 was prepared in the same way as Antistatic Layer AS-1, with the following modifications. The dispersion was roll-to-roll coated onto the EVA side of the substrate using a line speed of 6 m/min, and a gravure roll speed of 12 m/min. After coating, the film was passed through a 4-stage drying oven with temperature settings at 50, 55, 60, and 65°C, respectively.

Sealing Layer

Tables 1-4 list the polymers used in the sealing layers and the formulations of the sealing layers. Sealing layer formulations SL1, SL2, SL3, and SL4 included SSX-102 beads (highly cross-linked polymethylmethacrylate spherical particles with an average diameter of 2 μ m, available from Sekisui Plastics, Tokyo, Japan.) Ethyl acetate (EtOAc) was used as the solvent. Sealing layer formulations were prepared by slowly adding the polymer resin to the ethyl acetate while stirring until an even distribution was formed.

TABLE 1: Sealing Layer Materials

	Source	Composition	T _g * (°C)	MW* (g/mole)
MB-2588	Dianal America, Pasadena, TX, US	butyl methacrylate (BMA) resin	49	120,000
MB-7017	Dianal America, Pasadena, TX, US	BMA resin	59	45,000
MB-2777	Dianal America, Pasadena, TX, US	BMA resin	54	170,000
ELVACITE 2028	Lucite International, Cordova, TN, US	methyl methacrylate co-polymer	45	59,000
ELVACITE 2016	Lucite International, Cordova, TN, US	methyl methacrylate/ n-butyl methacrylate copolymer	59	60,000

ELVACITE 4115	Lucite International, Cordova, TN, US	iso-butyl methacrylate/ dimethylaminoethyl methacrylate copolymer	50	50,000
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** Information obtained from manufacturer's data sheet.*

**TABLE 2: Sealing layer formulations SL1-SL4
in parts by weight**

Sealing Layer Formulation	Polymer		Beads	EtOAc	Solids Content, % by weight
	MB-7017	MB-2588	SSX-102		
SL-1	30	10	10	450	10
SL-2	20	10	10	360	10
SL-3	40	0	10	450	10
SL-4	40	10	10	540	10

5

TABLE 3: Sealing layer formulations SL5-SL10

Sealing Layer Formulation	Polymer Type	Polymer Amount, g	EtOAc Amount, g	Solids Content, wt%
SL-5	MB-2777	60	940	6
SL-6	MB-2588	60	940	6
SL-7	ELVACITE 2028	60	940	6
SL-8	ELVACITE 2016	60	940	6
SL-9	ELVACITE 4115	60	940	6
SL-10	MB-7017	60	940	6

TABLE 4: Sealing layer formulations SL11-SL12

Sealing Layer Formulation	Polymer Amount, g		EtOAc Amount, g	Solids Content, wt %
	MB-2777	ELVACITE 4115		
SL-11	45	15	940	10
SL-12	30	30	940	10

Exemplary and Comparative Cover Tapes

Cover tape Examples 1-10 and Comparative Examples CE1 and CE2 were prepared using the various combinations of substrate (base + cushion) layer, antistatic layer formulation, and sealing layer formulation summarized in Table 5.

5 To prepare Examples 1-8, a substrate coated with antistatic coating AS-3 (prepared as described above) was roll-to-roll coated with the selected sealing layer using a tri-helical patterned gravure bar of 140#. The line speed was 6 m/min, and the gravure roll speed was 12 m/min. After coating, the film was passed through a 4-stage drying oven with temperature settings of 50, 55, 60, and 65 °C, respectively.

10 To prepare Examples 9 and 10 and Comparative Examples CE1 and CE2, a substrate coated with the designated antistatic coating was roll-to-roll coated with the appropriate sealing layer at a line speed of 10 ft/min (3 m/min), and a gravure roll speed of 15 ft/min (4.6 m/min). After coating, the film was passed through an in-line 3-stage drying oven with temperature settings at 65, 65, and 75°C, respectively. Comparative
15 Examples CE1 and CE2 contained no binder in the antistatic layer.

TABLE 5: Cover Tape Configurations

Example	Substrate (Base/Cushion)	Antistatic Layer	Sealing Layer
1	BOPET/EVA	AS-3	SL-5
2	BOPET/EVA	AS-3	SL-6
3	BOPET/EVA	AS-3	SL-7
4	BOPET/EVA	AS-3	SL-8
5	BOPET/EVA	AS-3	SL-9
6	BOPET/EVA	AS-3	SL-10
7	BOPET/EVA	AS-3	SL-11
8	BOPET/EVA	AS-3	SL-12
9	BOPET/EVA	AS-1	SL-1
10	BOPET/EVA	AS-1	SL-2

CE1	BOPET/EVA	AS-2	SL-3
CE2	BOPET/EVA	AS-2	SL-4

Carrier Tape

A polycarbonate carrier tape (3M 3000 Carrier Tape, available from 3M Company, St. Paul, MN, USA) was used for evaluation of the exemplary cover tapes. Dimensions of the carrier tape were as follows: width = 8 mm; center-to-center distance between pockets (pitch) = 4 mm; nominal dimensions of pockets = 3.15 mm long x 2.77 mm wide x 1.22 mm deep.

Test Methods

Crossover temperature of the polymers used in sealing layer formulations SL5-SL10 was determined via Dynamic Mechanical Analysis (DMA) using an ARES-G2 rheometer (available from TA Instruments, New Castle, DE, US) in a parallel plate geometry. The start temperature was 80°C, the end temperature was 180°C, the temperature was increased at a rate of 5°C/min, and the oscillation frequency was 1.0 Hz. The crossover temperature was measured as the temperature at which the loss modulus (G'') was equal to the storage modulus (G'); that is, the temperature at which $\tan(\delta) = G''/G' = 1$.

Prior to peel strength measurement, a 20 cm portion of each of the cover tape samples was sealed to an empty portion of 3M 3000 carrier tape at the desired bonding temperature, a pressure of 0.09 MPa, and a dwell time of 40 milliseconds using a MBM-4000 sealing machine (available from Ismeca Europe Semiconductor, La Chaux-de-Fonds, Switzerland). Peel strength was measured using a PT-55 Peel Force Tester (available from V-TEK, Mankato, MN, US). During the test, the values of maximum peel force, minimum peel force, and mean (average) peel force were recorded. The difference between the maximum peel force and the minimum peel force was calculated as the peel force range.

The usable sealant temperature (UST) was determined by bonding the cover tape samples to 3M 3000 carrier tape. Because the peel force increases slightly with the bonding temperature, the bonding temperature was adjusted until the peel force was

approximately 45 gf, and this temperature was recorded as the usable sealant temperature. The peel force range was recorded at the UST.

Surface resistance was measured using a Model 152-1 Surface/Volume Resistance Meter (available from TREK, Lockport, NY, US), using a two-point resistance probe and a test voltage of 100 V.

Haze and transmittance were measured by a HAZE-GARD meter (available from BYK Additives and Instruments, Wesel, Germany.)

Results

Table 6 summarizes the sealing properties of cover tape Examples 1-8, in comparison to the crossover temperature of the polymer used in the sealing layer.

TABLE 6: Properties of Examples 1-8

Example	Crossover Temp of Polymer in Sealing Layer, °C	Useable Sealant Temperature (UST), °C	Peel Force Range at UST, gf
Ex. 1	179.6	180	17.7
Ex. 2	153	180	15.6
Ex. 3	136	160	22.1
Ex. 4	131	140	30
Ex. 5	124	130	45
Ex. 6	116	126	28
Ex. 7		180	20.3
Ex. 8		140	31.1

The optical and electrical properties of Examples 9 and 10 are compared to those of Comparative Examples CE1 and CE2 in Table 7. Tables 8 and 9 summarize the peel performance of Examples 9, 10, CE1, and CE2 before and after aging at two sets of conditions: at 60 °C and at 52 °C and 95% relative humidity (RH), respectively.

TABLE 7: Optical and electrical properties of cover tapes

	Antistatic Layer	Sealing Layer	Surface Resistance (ohms)	Haze (%)	Total Transmittance (%)
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Ex. 9	AS-1	SL-1	6.7×10^9	31	88
Ex. 10	AS-1	SL-2	7.4×10^9	33	85
CE1	AS-2	SL-3	2.3×10^8	30	89
CE2	AS-2	SL-4	2.8×10^8	27	90

**TABLE 8: Peel Force of Cover Tapes after Aging at 60°C
(Bonding temperature = 145°C and Pressure = 0.09 MPa)**

Aging Time	Ex. 9		Ex. 10		CE1		CE2	
	Mean (gf)	Range (gf)	Mean (gf)	Range (gf)	Mean (gf)	Range (gf)	Mean (gf)	Range (gf)
0 days	48	18	47	21	43	20	47	20
1/48 day (30 min)	54.1	31.8	53.8	24.7	47	21	54	27
3 days	58	24	55	22				
5 days	59	27	57	17				
30 days	64	30.7	61.7	22.8				

5

**TABLE 9: Peel Force of Cover Tapes after Aging at 52°C and 95% RH
(Bonding temperature = 145°C and Pressure = 0.09 MPa)**

Aging Time	Ex. 9		Ex. 10		CE1		CE2	
	Mean (gf)	Range (gf)	Mean (gf)	Range (gf)	Mean (gf)	Range (gf)	Mean (gf)	Range (gf)
0 days	48	18	47	21	43	20	47	20
1/48 day (30 min)	51.2	23.4	50.8	21.8	33	19	18	22
3 days	57	25	52	21				

5 days	57	19	59	17				
30 days	63.2	25.8	59.8	21.2				

Table 10 lists the minimum peel force (min), maximum peel force (max), mean peel force, and peel force range as a function of bonding temperature. The process window was determined as the temperature range within which the minimum peel strength was greater than 30 gf and the maximum peel strength was less than 70 gf. Table 10 shows that Example 9 can be bonded over a process window of approximately 135°C – 160°C and Example 10 can be bonded over a process window of approximately 140°C – 160°C.

TABLE 10: Peel Force of Cover Tapes at Various Bonding Temperatures

Bonding Temperature (°C)	Ex. 9				Ex. 10			
	Min (gf)	Max (gf)	Mean (gf)	Range (gf)	Min (gf)	Max (gf)	Mean (gf)	Range (gf)
130	23.7	44	36	16.7	15.2	29.4	22	15.2
140	37.8	52.8	46.4	15	31	47.7	41.2	16.3
145	39.1	55.9	49.1	15.8	38.6	56.1	47.7	17.5
150	42	58.7	51	16.7	42.1	57.3	50.7	15.1
160	50.6	72.6	62.7	22	48.6	67.8	58.7	19.1
170	54.7	78.5	67.6	23.8	50.3	74.6	63.9	24.4

Although specific embodiments have been illustrated and described herein for purposes of description of the preferred embodiment, it will be appreciated by those of ordinary skill in the art that a wide variety of alternate and/or equivalent implementations may be substituted for the specific embodiments shown and described without departing from the scope of the present disclosure. This application is intended to cover any adaptations or variations of the preferred embodiments discussed herein. Therefore, it is manifestly intended that this disclosure be limited only by the claims and the equivalents thereof.

What is claimed is:

1. A cover tape comprising:

a base layer with a first major surface and a second major surface, comprising a thermoplastic polymer with a thickness of from 10-20 micrometers;

5 a cushion layer with a first major surface and a second major surface, wherein the first

major surface of the cushion layer is in contact with or adhesively bonded to the second major surface of the base layer, comprising a polymeric or co-polymeric thermoplastic composition with a thickness of from 20-35 micrometers;

10 an antistatic layer with a first major surface and a second major surface, wherein the

first major surface is in contact with the second major surface of the cushion layer, comprising a polymeric or co-polymeric binder and PEDOT-PSS (poly-3,4-ethylenedioxythiophene-polystyrene sulfonate) dispersed within the polymeric or

15 co-polymeric binder, wherein the PEDOT-PSS comprises 5-30 weight% of the antistatic

layer; and

20 a sealing layer with a first major surface and a second major surface, wherein the first

major surface of the sealing layer is in contact with the second major surface of the antistatic layer, comprising a heat activated adhesive, wherein the heat activated adhesive comprises a polymeric or copolymeric composition with a thickness of 0.5-2.0 micrometers; and

25 wherein the cover tape has a heat activation bonding range of at least 135°C, the cover tape peel adhesion is maintained when exposed to conditions of time, temperature, humidity or a combination thereof, and the cover tape has a surface resistance (SR) value of from 10^6 - 10^{11} ohms as measured on the second major surface

30 of the sealing layer at a temperature of 23°C, and a relative humidity of 50%.

2. The cover tape of claim 1, wherein the base layer comprises a polyethylene terephthalate polymer, or polyimide thermoplastic.

3. The cover tape of claim 1, wherein the cushion layer comprises an ethylene-based polymer or co-polymer.

4. The cover tape of claim 3, wherein the ethylene-based polymer or co-polymer comprises an ethylene-vinyl acetate copolymer, polyethylene, a blend of ethylene-vinyl acetate copolymer and polyethylene, or alternating layers of polyethylene and ethylene-vinyl acetate.

5. The cover tape of claim 3, wherein the ethylene-based polymer or co-polymer comprises an ethylene-vinyl acetate copolymer comprising 10-30 weight % vinyl acetate.

6. The cover tape of claim 1, wherein the polymeric or co-polymeric binder of the antistatic layer comprises a modified acrylate polymer or copolymer, a styrene-based polymer or co-polymer, or a combination thereof.

7. The cover tape of claim 6, wherein the polymeric or co-polymeric binder of the antistatic layer comprises a modified acrylate polymer or copolymer.

8. The cover tape of claim 6, wherein the polymeric or co-polymeric binder of the antistatic layer comprises a styrene-based polymer or copolymer.

9. The cover tape of claim 6, wherein the polymeric or co-polymeric binder comprises an acrylate-styrene copolymer.

10. The cover tape of claim 1, wherein the antistatic layer is a dried layer formed from a dispersion mixture comprising:

- an aqueous dispersion of the polymeric or co-polymeric binder; and
- an aqueous dispersion of PEDOT-PSS (poly-3,4-ethylenedioxythiophene-

polystyrene sulfonate);
wherein the polymeric or co-polymeric binder material is a moisture resistant material,
such that when soaked in water for 24 hours the uptake of water is less than 5 weight%.

5 11. The cover tape of claim 1, wherein the heat activated adhesive of the sealing layer
comprises at least one (meth)acrylate-based polymer or co-polymer.

12. The cover tape of claim 11, wherein the at least one (meth)acrylate-based polymer or
co-polymer comprises a (meth)acrylate polymer or copolymer with a weight average
10 molecular weight of 50,000-100,000 grams/mole.

13. The cover tape of claim 11, wherein the at least one (meth)acrylate-based polymer or
co-polymer comprises a mixture of at least two (meth)acrylate polymers or copolymers
comprising a (meth)acrylate polymer or copolymer with a weight average molecular
15 weight of 50,000-100,000 grams/mole and a (meth)acrylate polymer or copolymer with a
weight average molecular weight of 100,000-200,000 grams/mole.

14. The cover tape of claim 11, wherein the heat activated adhesive further comprises a
particulate filler comprising silica particles or polymer beads present at about 5-20
20 weight%.

15. An article comprising:
a carrier tape comprising a plurality of pockets; and
a cover tape bonded to the carrier tape and sealing the plurality of pockets; wherein the
25 cover tape comprises:

a base layer with a first major surface and a second major surface, comprising a
thermoplastic polymer with a thickness of from 10-20 micrometers;
a cushion layer with a first major surface and a second major surface, wherein the
first
30 major surface of the cushion layer is in contact with or adhesively bonded to the
second major surface of the base layer, comprising a polymeric or co-polymeric

thermoplastic composition with a thickness of from 20-35 micrometers;
an antistatic layer with a first major surface and a second major surface, wherein
the
first major surface is in contact with the second major surface of the cushion layer,
5 comprising a polymeric or co-polymeric binder and PEDOT-PSS (poly-3,4-
ethylenedioxythiophene-polystyrene sulfonate) dispersed within the polymeric or
co-
polymeric binder, wherein the PEDOT-PSS comprises 5-30 weight% of the
antistatic
10 layer; and
a sealing layer with a first major surface and a second major surface, wherein the
first
major surface of the sealing layer is in contact with the second major surface of the
antistatic layer, comprising a heat activated adhesive wherein the heat activated
15 adhesive comprises a polymeric or copolymeric composition with a thickness of
0.50-
2.0 micrometer thickness; and
wherein the cover tape has a heat activation bonding range of at least 135°C, the
cover tape peel adhesion is maintained when exposed to conditions of time,
20 temperature, humidity or a combination thereof, and the cover tape has a surface
resistivity (SR) value of from 10^6 - 10^{11} ohms as measured on the major surface of
the
sealing layer at a temperature of 23°C, and a relative humidity of 50%.

25 16. The article of claim 15, wherein the carrier tape comprises a polycarbonate or
polystyrene carrier tape.

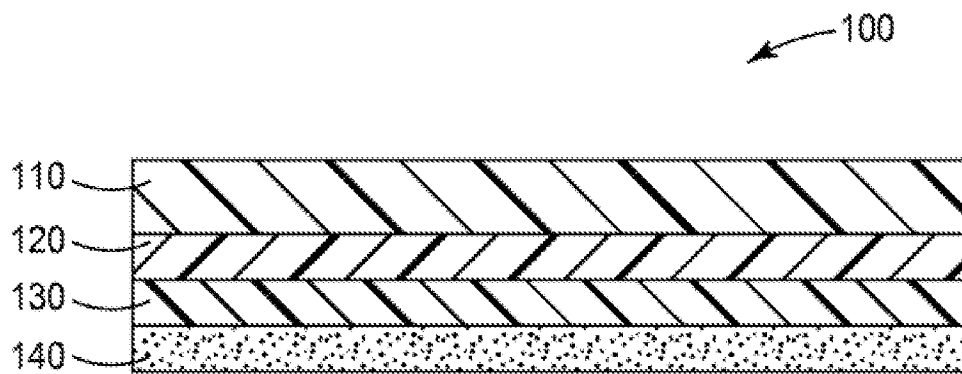
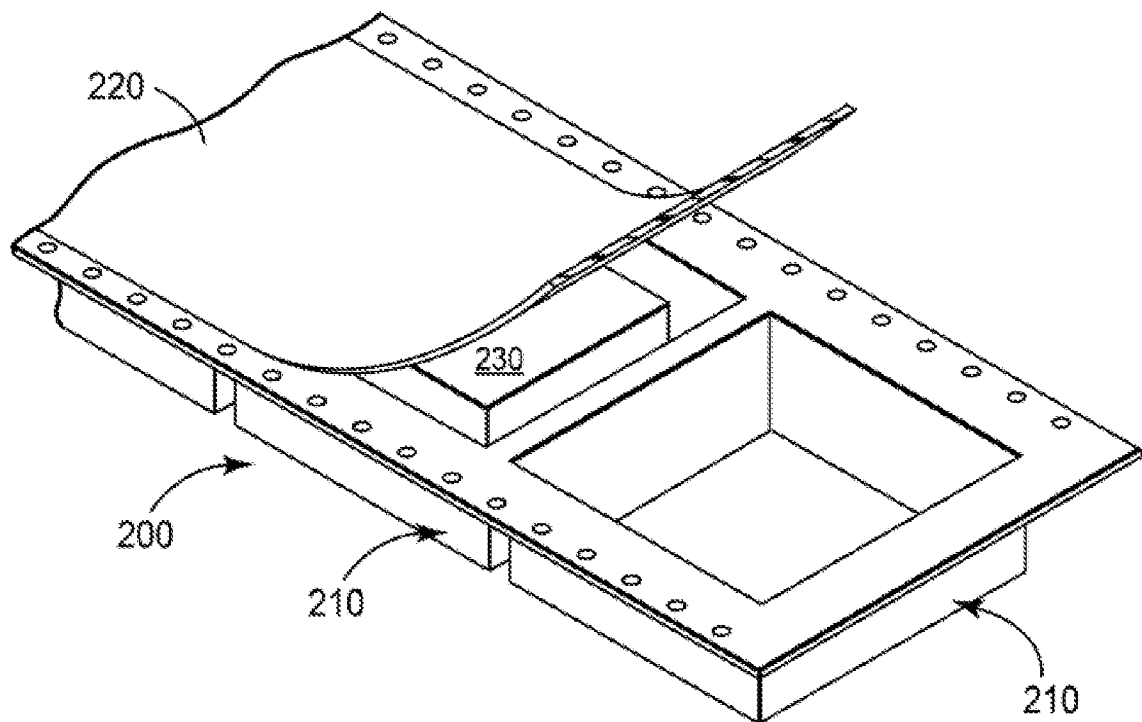
17. The article of claim 15, wherein the peel value of the cover tape from the carrier tape
sealed at a temperature of at least 135°C, ranges from 30-70 grams-force (gf).

18. The article of claim 15, wherein the article is heat sealed at a temperature of from 140-160°C, and the peel adhesion ranges from 30-70 grams-force (gf).

5 19. The article of claim 15, wherein the cover tape peel adhesion is maintained when exposed to conditions of 30 days aging, a temperature of up to 60°C, or a combination thereof.

10 20. The article of claim 15, wherein the cover tape peel adhesion is maintained when exposed to conditions of a temperature of up to 52°C and a relative humidity of up to 95%.

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*FIG. 1**FIG. 2*

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2019/055649

A. CLASSIFICATION OF SUBJECT MATTER

INV. C09J7/29 B32B27/18
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C09J B32B

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2014/329036 A1 (SUH KWANG SUCK [KR] ET AL) 6 November 2014 (2014-11-06) abstract paragraphs [0032], [0041]; claims 1,2,4-9,11; example 1	1-20
X,P	----- CN 208 963 722 U (3M INNOVATIVE PROPERTIES CO) 11 June 2019 (2019-06-11) abstract; claims	1-20
Y	----- US 2003/049437 A1 (DEVANEY LAURA C [US] ET AL) 13 March 2003 (2003-03-13) cited in the application abstract paragraph [0038]; claims 1,4 ----- -/-	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 2014/170414 A1 (ZHANG WEI XIANG [CN] ET AL) 19 June 2014 (2014-06-19) abstract paragraph [0030]; claims 1,15,16,19,20 -----	1-20

INTERNATIONAL SEARCH REPORT

Information on patent family members

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