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DESCRIPTION

ADHESIVE TAPE FOR TEMPORARY-ATTACHMENT OF DEVICES

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TECHNICAL FIELD

The present invention relates to an adhesive tape for temporary attachment used in the field of electronic devices, semiconductor wafers, liquid crystal, etc., and
10 in particular relates to an adhesive tape for temporary attachment used in a cutting process of ceramic electronic devices, e.g., multilayer ceramic capacitors, multilayer ceramic inductors, resistors, ferrites, sensor elements, thermistors, varistors, or piezoelectric ceramics.

15

BACKGROUND ART

For example, a multilayer ceramic capacitor may be produced through the following steps.

20

A slurry of ceramic powder is thinly spread out with a doctor blade to make a ceramic green sheet. After a plurality of electrodes are printed on the surface of the green sheet, a number of such green sheets are laminated and integrated so as to form a green sheet

laminate. Next, after the laminate is initially heat-pressed, the laminate is cut in longitudinal and transverse directions with a cutting tool such as a dicer or a guillotine blade to obtain a number of ceramic
5 laminate chips. These chips (also referred to as "works") are then sintered, and external electrodes are formed on end faces of the resultant chips.

In the aforementioned step of obtaining an
10 integrated laminate and the step of cutting the laminate into green chips, a green sheet is temporarily fixed on a base for sheet stabilization by using an adhesive tape, and after the cutting, the works need to be peeled off the adhesive tape on the surface of the base. At the time
15 of peeling, it is necessary to reduce the adhesion strength between the works and the adhesive tape. If the adhesion strength cannot be adequately reduced, the following problems may occur.

20 (1) Since the laminate itself has not been sintered yet, the adhesion between the respective layers may be insufficient. Therefore, when the chips are peeled off the surface of the adhesive tape, interlayer peeling may occur within the laminate due to an excessively strong

adhesion strength of the adhesive tape.

(2) Even if interlayer peeling does not occur, the adhesive layer may be left as a contaminant on the bottom of a chip. As a result, when the chips are sent to a subsequent process, the contaminant may cause blocking. As the residue of the contaminant is also subjected to sintering, voids or cracks may occur due to the sintering of an organic material.

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Thus, the reliability and the yield of the product are unfavorably affected.

Accordingly, as disclosed in Japanese Publication for Opposition No. 6-79812, for example, an adhesive tape which includes an adhesive layer of a thermal foaming type is conventionally used. A foaming agent is contained in the adhesive layer of this adhesive tape. As a result, by heating the adhesive tape after the cutting of a laminate, the foaming agent acts to reduce the area of contact between the adhesive tape and the works, so that the works can be easily peeled off the adhesive tape surface.

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However, since the adhesive tape has a high foaming temperature, there are problems in that a binder within the laminate may evaporate to contaminate the works at the time of heating the adhesive tape, or that the laminate may fail to attain a predetermined hardness due to the evaporation of the binder prior to a preliminary sintering. Moreover, the adhesion strength may not be adequately reduced due to non-uniform foaming, so that the works may not be able to be peeled off the adhesive tape.

DISCLOSURE OF THE INVENTION

An adhesive tape for temporary attachment of a device according to the present invention comprises a substrate film and an adhesive layer provided on at least one face of the substrate film, wherein the adhesive layer comprises an adhesive composition, the adhesive composition containing a pressure-sensitive adhesive and a side-chain crystallizable polymer. The side-chain crystallizable polymer is obtained from a monomer mixture comprising: about 40 to about 70 wt.% of an acrylic acid alkyl ester and/or a methacrylic acid alkyl ester which has an alkyl group including 1 to 6 carbon atoms; about 2 to about 10 wt.% of a carboxyl group-containing

ethylenic unsaturated monomer; and about 20 to about 50 wt.% of an acrylic acid alkyl ester and/or a methacrylic acid alkyl ester which has an alkyl group including 16 or more (preferably 18 to 30) carbon atoms. The polymer
5 has a weight average molecular weight of about 3,000 to about 25,000.

In the case where adhesive layers are provided on both faces of the substrate film, the following
10 pressure-sensitive adhesives may be used as the pressure-sensitive adhesive constituting the second adhesive layer, for example:

natural rubber adhesives; synthetic rubber
15 adhesives; styrene/butadiene latex-base adhesives; block copolymer type thermoplastic rubbers; butyl rubbers; polyisobutylene; acrylic adhesives; and vinyl ether copolymer adhesive compositions.

20 In one embodiment, the adhesive composition comprises about 1 to about 30 wt.% of the side-chain crystallizable polymer on the basis of the adhesive composition.

In one embodiment, the adhesive composition is of such a nature that the adhesive composition easily peels off the device at about 35°C or above.

5 In one embodiment, the side-chain crystallizable polymer has a melting point occurring within a temperature range narrower than about 35°C.

10 In one embodiment, an adhesion strength of the adhesive composition with a stainless steel plate when heated to about 35°C or above is about 10% or less of an adhesion strength with the stainless steel plate at 23°C, or about 10 g/25 mm or less.

15 Since the adhesive tape has a good tackiness with respect to the device at a low temperature, the device can be processed (e.g., cut) or transferred by fixing the device on the adhesive tape at a low temperature. When peeling the device off the adhesive tape, the adhesive
20 tape is heated to a predetermined temperature or above so that the device can be easily peeled off the adhesive tape.

Specifically, since the tackiness of an adhesive

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composition composing the adhesive tape is highly sensitive to temperature, the polymer becomes crystalline or non-crystalline in a reversible manner by slightly varying the temperature from an arbitrarily selected
5 temperature, resulting in a substantial change in the tackiness with respect to a device.

Thus, for example, when using an adhesive tape as an adhesive tape for ceramic electronic devices, after
10 adhering a green sheet for ceramic electronic devices to the adhesive tape and performing a cutting process, the tape may be heated so as to greatly decrease its tackiness with respect to the green sheet for ceramic electronic devices, whereby the chips (ceramic electronic devices)
15 can be easily peeled off the tape.

In particular, since not very much residue is left on the device after peeling the device off the adhesive tape according to the present invention, the adhesive tape
20 is suitably used during the production of ceramic electronic devices, e.g., multilayer ceramic capacitors, multilayer ceramic inductors, resistors, ferrites, sensor elements, thermistors, varistors, or piezoelectric ceramics.

According to the present invention, the tackiness of an adhesive tape for temporary attachment with respect to a device can be controlled simply by changing the temperature of the adhesive tape. Thus, for example, a large adhesion strength can be obtained when temporarily attaching the green sheets for ceramic electronic devices; when a work is to be removed, peeling can easily occur simply by heating. Since the works will not be contaminated, it is possible to enhance the reliability of ceramic electronic devices.

BEST MODES FOR CARRYING OUT THE INVENTION

15 (substrate film)

Examples of substrate films which can be used for the adhesive tape for temporary attachment according to the present invention include sheets composed of a single layer or multiple layers of a synthetic resin film having a thickness of about 5 to about 500 μm , e.g., polyethylene, polypropylene, polyester, polyamide, polycarbonate, ethylene-vinyl acetate copolymer, ethylene-ethyl acrylate copolymer, ethylene-polypropylene copolymer, polyvinyl chloride. In order to enhance the adhesion

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with the adhesive layer, the surface of the substrate film may be subjected to a corona discharge treatment, a plasma treatment, a blast treatment, a chemical etching treatment, a primer treatment, or the like.

5

On at least one face of such a substrate film, an adhesive layer composed of an adhesive composition as described below is laminated.

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The adhesive composition may contain a side-chain crystallizable polymer having a melting point which occurs within a temperature range narrower than about 35°C, and a pressure-sensitive adhesive. The adhesive composition is of such a nature that it exhibits good
15 tackiness with respect to a device (e.g., a ceramic electronic device) or other materials to which it is adhered at temperature T1, while exhibiting a significantly reduced tackiness with respect to the device or other materials at temperature T2 which is
20 higher than temperature T1 by about 15°C or more.

(pressure-sensitive adhesive)

Examples of pressure-sensitive adhesives contained in the adhesive composition include the

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following pressure-sensitive adhesives, for example:

5 natural rubber adhesives; styrene/butadiene
 latex-base adhesives; ABA block copolymer type
 thermoplastic rubbers (where A represents a thermoplastic
 polystyrene end block; and B represents a rubber
 intermediate block such as polyisoprene, polybutadiene
 or poly(ethylene/butylene)); butyl rubbers;
 polyisobutylene; acrylic adhesives such as polyacrylate
10 and vinyl acetate/acryl ester copolymer; and vinylether
 copolymers such as polyvinylmethylether,
 polyvinylethylether, and polyvinylisobutylether.

 In particular, the use of acryl type pressure-
15 sensitive adhesives provides interaction with the polymer
 such that the polymer will be sufficiently dispersed at
 a predetermined temperature so as to exhibit tackiness,
 and yet the polymer will exhibit good releasability when
 heated to the predetermined temperature or above.
20 Preferable acryl type pressure-sensitive adhesives are
 composed essentially of ethylhexyl acrylate,
 hydroxyethyl acrylate, or the like. Examples thereof
 include a copolymer containing 80 to 95 parts by weight
 of 2-ethylhexyl acrylate and 5 to 20 parts by weight of

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2-hydroxyethyl acrylate.

(side-chain crystallizable polymer)

A side-chain crystallizable polymer to be
5 contained in the adhesive composition preferably has a
melting point which occurs within a temperature range
narrower than about 35°C.

As used herein, the term "melting point" means the
10 temperature at which an equilibrium process causes
certain portions of a polymer, initially aligned in an
ordered array, to become disordered.

In one embodiment, the melting point of the
15 polymer is preferably in the range of about 30°C to about
100°C, and more preferably in the range of about 35°C to
about 65°C. It is preferable that the melting occur
rapidly, i.e., over a relatively narrow temperature range
which is less than about 35°C and preferably less than
20 about 10 °C. It is preferable that the polymer
crystallizes rapidly. To this end, seeding agents, or
crystallization catalysts can be incorporated into the
polymer.

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After use, the adhesive layer can be easily peeled off the surface of a device by heating the adhesive layer to a temperature which is slightly higher than the use temperature. The heating temperature is usually about
5 40°C to about 100°C, preferably about 40°C to about 70°C, and more preferably about 50°C to about 70°C.

The side-chain crystallizable polymer contained in the adhesive composition is obtained from a monomer
10 mixture containing: about 40 to about 70 wt.% of an acrylic acid alkyl ester and/or a methacrylic acid alkyl ester which has an alkyl group including 1 to 6 carbon atoms; about 2 to about 10 wt.% of a carboxyl group-containing ethylenic unsaturated monomer; and about 20
15 to about 50 wt.% of an acrylic acid alkyl ester and/or a methacrylic acid alkyl ester which has an alkyl group including 16 or more carbon atoms.

As an acrylic acid ester and/or a methacrylic acid
20 ester (hereinafter also referred to as "(meth)acrylate") which has a straight-chain alkyl group including 16 or more carbon atoms as a side chain, a (meth)acrylate which has a straight-chain alkyl group including 16 to 30 carbon atoms may be preferably used, e.g., hexadecyl

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(meth)acrylate, stearyl (meth)acrylate, dococyl
(meth)acrylate, and triaconta (meth)acrylate.

Listed below are the melting points of side-chain
5 crystallizable polymers which are obtained from monomers
which have a straight-chain alkyl group including 16 to
30 carbon atoms:

	monomer used	melting point (°C)
10	C16 acrylate	36
	C16 methacrylate	26
	C18 acrylate	49
	C18 methacrylate	39
15	C20 acrylate	60
	C20 methacrylate	50
	C22 acrylate	71
	C22 methacrylate	62
	C30 acrylate	76
20	C30 methacrylate	68

Examples of (meth)acrylates which have an alkyl
group including 1 to 6 carbon atoms include
methyl(meth)acrylate, ethyl(meth)acrylate,

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butyl(meth)acrylate, isobutyl(meth)acrylate,
tertiary-butyl(meth)acrylate, hexyl(meth)acrylate,
cyclohexyl(meth)acrylate, and isoamyl(meth)acrylate.

5 As carboxyl group-containing ethylenic
unsaturated monomer, acrylic acid, methacrylic acid,
crotonic acid, itaconic acid, maleic acid, fumaric acid,
or the like may be used, with acrylic acid being
particularly preferable.

10

 The side-chain crystallizable polymer contains
the following components: about 40 to about 70 wt.% of
an (meth)acrylate which has an alkyl group including 1
to 6 carbon atoms; about 2 to about 10 wt.% of a carboxyl
15 group-containing ethylenic unsaturated monomer; and
about 20 to about 50 wt.% of an (meth)acrylate which has
an alkyl group including 16 or more carbon atoms.

 Preferably, the side-chain crystallizable
20 polymer contains the following components: about 45 to
about 60 wt.% of an (meth)acrylate which has an alkyl
group including 1 to 6 carbon atoms; about 3 to about 7 wt.%
of a carboxyl group-containing ethylenic unsaturated
monomer; and about 35 to about 50 wt.% of an

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(meth)acrylate which has an alkyl group including 18 to 30 carbon atoms.

The amount of the crystallizable polymer in the adhesive composition is preferably in the range of about 1 wt.% to about 30 wt.%, more preferably about 5 wt.% to about 20 wt.%, and particularly preferably about 5 wt.% to about 15 wt.%. The aforementioned effects provided by the polymer cannot be exhibited if the polymer is contained in an amount less than 1 wt.% or more than 30 wt.%.

When the side-chain crystallizable polymer contains as a component less than 25 wt.% of an (meth)acrylate which has an alkyl group including 1 to 6 carbon atoms, substantial residues are left on the material (device). On the contrary, when it is more than 70 wt.%, temperature sensitiveness tends to be reduced.

The specific molecular weight of the crystallizable polymer to be used is an important factor that determines the manner in which the adhesive composition used in the present invention exhibits temperature-dependent tackiness and/or adhesion binding

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strength. Specifically, a low molecular weight crystallizable polymer will lose bonding strength when heated. For example, the adhesion strength when heated at 60°C is decreased by 90% or more from the adhesion
5 strength (peeling force) at room temperature (23°C) (the detailed adhesion strength test conditions will be described later).

Accordingly, the weight average molecular weight
10 of the polymer is preferably about 3,000 to about 25,000, and more preferably about 4,000 to about 15,000. If the weight average molecular weight of the polymer exceeds about 25,000, there is an insufficient decrease in tackiness responsive to heating. If the weight average
15 molecular weight of the polymer is less than about 3,000, substantial residue is left after peeling, which is not preferable.

The adhesive composition according to the present
20 invention may be obtained by admixing a pressure-sensitive adhesive and a crystallizable polymer in a compatible solvent, and adding optional components thereto, e.g., plasticizers, tackifiers, fillers, cross-linking agents and the like. The solid contents

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are adjusted to a desired viscosity, and the mixture is blended until it is homogeneous. After blending, bubbles are removed from the mixture.

5 Examples of tackifiers include special rosin ester type tackifiers, terpene phenol type tackifiers, petroleum resin type tackifiers, high hydroxyl value rosin ester type tackifiers, hydrogenated rosin ester type tackifiers, and the like.

10

 Examples of cross-linking agents include: isocyanate-type compounds such as tetramethylenediisocyanate, hexamethylenediisocyanate, an adduct obtained by adding three tolylenediisocyanates
15 to trimethylolpropane, or polyisocyanate; epoxy-type compounds such as sorbitol polyglycidylether, polyglycerol polyglycidylether, pentaerythritol polyglycidylether, diglycerol polyglycidylether, glycerol polyglycidylether, neopentylglycol
20 diglycidylether, or resorcin diglycidylether; aziridine-type compounds such as trimethylolpropane-tri- β -aziridynyl propionate, tetramethylolmethane-tri- β -aziridynyl propionate, N,N'-hexamethylene-1,6-bis(1-aziridine carboxamide), N,N'-toluene-2,4-bis(1-

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aziridine carboxyamide), N,N'-diphenylmethane-4,4'-bis(1-aziridine carboxyamide), or trimethylolpropane-tri- β -(2-methylaziridine)propionate; and melamine-type compounds such as hexamethoxymethylol melamine. These
5 may be used alone, or two or more kinds of them may be used in combination. The cross-linking agent is contained preferably in an amount of 0.1 to 5 parts by weight, and more preferably 0.1 to 3 parts by weight, with respect to 100 parts by weight of the base polymer.

10

In order to provide a temperature-active adhesive composition on a substrate film, a knife coater, a roll coater, a calender coater, a comma coater, or the like is often used in general. Depending on the thickness of
15 the coating and the viscosity of the material, a gravure coater or a rod coater may be used. The adhesive composition may be applied by being transferred from a release sheet, as in the manner of transfer printing. The composition may be applied neat (i.e., without anything
20 else), or in a suitable solvent, or as an emulsion or latex. Thus, an adhesive layer is formed from the adhesive composition.

In terms of prevention of contamination during

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storage or commercial distribution, it is preferable to
adhesion-protect the adhesive layer with a separator
until the adhesive layer is adhered to the devices. The
separator can be made of paper, a plastic film such as
5 a polypropylene film or a polyester film, or a thin
flexible leaf of metal foil or the like. The separator
is subjected to a surface treatment with a release agent
as necessary so as to be rendered easy to peel.

10 Next, a method for producing a ceramic multilayer
capacitor as an example of a device will be described.

 First, a slurry of ceramic powder is thinly spread
out with a doctor blade to make a ceramic green sheet,
15 and electrodes are printed on the surface of the green
sheet. Then, a number of such green sheets are laminated
and integrated so as to form a green sheet laminate. Next,
the laminate is heated and affixed on a base via the
adhesive tape according to the present invention. Since
20 the temperature at this time is relatively low (e.g.,
about 20°C to about 40°C), the laminate adheres well to
the adhesive layer of the adhesive tape.

 Next, the laminate is heat-pressed and cut. At

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this time, the works do not peel off the adhesive layer or be transferred onto any green sheets that are yet to be cut. After a number of ceramic laminate chips are formed in this manner, the resultant works are removed
5 from the adhesive tape. Thereafter, the works are subjected to a preliminary sintering process, and a sintering process. At this time, the adhesive tape is heated at a predetermined temperature or above as mentioned above, whereby the work can be easily peeled
10 off the adhesive tape. Thereafter, the works are sintered, and external electrodes are formed on end faces of the works, whereby chip-type multilayer ceramic capacitors are obtained.

15 As for methods for heating the adhesive tape, the tape or a retention member (base) for the tape may be heated by the following methods, for example:

 placing the tape or the retention member on a hot
20 plate, blowing hot air over it (e.g., from an air heater or a drier), placing it in an oven, blowing steam over it, applying radiowaves to it for heating, or using a lamp (infrared or far-infrared).

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Specifically, it is preferable to attach a green sheet for ceramic electronic devices to the adhesive tape surface at a temperature which is below the melting point of the polymer used, and to peel the chip off the adhesive
5 tape surface at a temperature which is equal to or greater than the melting point of the polymer after the cutting.

Moreover, it is preferable to ensure that the peeling force is reduced to about 10% or less at a
10 temperature which is equal to or greater than the melting point of the side-chain crystallizable polymer. In other words, it is preferable that the adhesion strength of the adhesive composition with a stainless steel plate when heated to about 35°C or above is about 10% or less of the
15 adhesion strength with a stainless steel plate at about 23°C, or about 10 g/25 mm or less.

Although multilayer ceramic capacitors are illustrated above as devices, the present invention is
20 not limited thereto. The present invention is applicable to, for example, an adhesive tape for temporary attachment which is to be used in a step of cutting green sheets for ceramic electronic devices into a number of chips during the production of fine ceramic devices such as IC circuit

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boards, ferrites, sensor elements, or varistors.

(Examples)

Hereinafter, the present invention will be
5 specifically described by way of illustrative examples.
In the following description, any reference to "part(s)"
means "part(s) by weight".

A. Preparation of polymer

10

(Synthesis Example 1)

First, 45 parts of dococyl acrylate, 50 parts of
methyl acrylate, 5 parts of acrylic acid, 2.5 parts of
dodecylmercaptan, and 1 part of Trigonox 23-C70 (Kayaku
15 Akzo K.K.) were mixed in 200 parts of toluene. The
mixture was stirred at 70°C for 4 hours to polymerize these
monomers.

The resultant polymer had a weight average
20 molecular weight of about 18,000, and a melting point of
53°C.

(Synthesis Example 2)

First, 45 parts of dococyl acrylate, 50 parts of

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methy1 acrylate, 5 parts of acrylic acid, 5 parts of
dodecylmercaptan and 1 part of Trigonox 23-C70 (Kayaku
Akzo K.K.) were mixed in 200 parts of toluene. The
mixture was stirred at 70°C for 4 hours to polymerize these
5 monomers.

The resultant polymer had a weight average
molecular weight of about 10,000, and a melting point of
50°C.

10

(Synthesis Example 3)

First, 45 parts of dococyl acrylate, 50 parts of
methy1 acrylate, 5 parts of acrylic acid, 10 parts of
dodecylmercaptan and 1 part of Trigonox 23-C70 (Kayaku
15 Akzo K.K.) were mixed in 200 parts of toluene. The
mixture was stirred at 70°C for 4 hours to polymerize these
monomers.

The resultant polymer had a weight average
20 molecular weight of about 5,000, and a melting point of
47°C.

(Synthesis Example 4)

First, 45 parts of dococyl acrylate, 50 parts of

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methy1 acrylate, 5 parts of acrylic acid, 1.5 parts of
dodecylmercaptan and 1 part of Trigonox 23-C70 (Kayaku
Akzo K.K.) were mixed in 200 parts of toluene. The
mixture was stirred at 70°C for 4 hours to polymerize these
5 monomers.

The resultant polymer had a weight average
molecular weight of about 30,000, and a melting point of
54°C.

10

(Synthesis Example 5)

First, 45 parts of dococyl acrylate, 50 parts of
methy1 acrylate, 5 parts of acrylic acid, 7.5 parts of
propylmercaptan and 1 part of Trigonox 23-C70 (Kayaku
15 Akzo K.K.) were mixed in 200 parts of toluene. The
mixture was stirred at 70°C for 4 hours to polymerize these
monomers.

The resultant polymer had a weight average
20 molecular weight of about 2,500, and a melting point of
47°C.

(Synthesis Example 6)

First, 95 parts of stearyl acrylate, 5 parts of

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acrylic acid, 5 parts of dodecylmercaptan and 1 part of Kayaester HP-70 (Kayaku Akzo K.K.) were mixed. The mixture was stirred at 80°C for 5 hours to polymerize these monomers. The resultant polymer had a weight average
5 molecular weight of about 8,000, and a melting point of 50°C.

(Synthesis Example 7)

First, 92 parts of 2-ethylhexylacrylate, 8 parts
10 of 2-hydroxyethylacrylate, and 0.3 parts of Trigonox 23-C70 (Kayaku Akzo K.K.) were mixed in 150 parts of ethyl acetate/heptane (70/30). The mixture was stirred at 55°C for 3 hours, and thereafter heated to 80°C, and 0.5 parts of Kayaester HP-70 was added. The mixture was stirred
15 for 2 hours to polymerize these monomers. The resultant polymer had a weight average molecular weight of about 600,000.

B. Preparation of an adhesive tape for temporary
20 attachment of ceramic electronic devices.

(Example 1)

To the polymer solution which was obtained according to Synthesis Examples 1 and 7 above, Coronate

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L45 (Nippon Polyurethane Industry Co., Ltd.) was added as a cross-linking agent, so that 1.0 parts of Coronate L45 was present for 100 parts of the polymer. Then, the polymer solution was applied by using a roll coater on
5 a surface of a polyethylene terephthalate (PET) film (about 100 μ m) which had been subjected to a corona treatment. Thus, an adhesive tape for temporary attachment with a release sheet, having an acrylic-type adhesive layer (thickness: about 30 μ m) was obtained.

10

The following evaluation tests were performed for the resultant adhesive tape for temporary attachment.

(1) Peeling force

15 A 180° peeling force of the adhesive tape was measured with respect to SUS, according to JIS C2107. The measurements were taken at 23°C and 60°C, respectively.

(2) Residue after peeling

20 As a result of checking the residue after peeling using a Fourier transform infrared spectrophotometer, it was confirmed that the residue was mainly a side-chain crystallizable polymer. Therefore, the contaminating properties with respect to the work were evaluated

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according to the transmittance level. The measurements were taken by the following method:

MEASUREMENT DEVICE FT-IR-8200PC, manufactured by
5 SHIMADZU CORPORATION

MEASUREMENT METHODS AND CONDITIONS

I) Preparation of a test piece for IR measurement

10 i) Using a glass plate as a material, the adhesive tape was pressure-attached onto the glass plate by allowing a rubber roller (width: 45 mm; load: 2 kg) to reciprocate thereon four times at 23°C.

15 ii) After the attachment, the test piece was left intact for 20 minutes.

iii) The glass plate was then put on a hot plate which was pre-heated at 60°C, and left intact for another
20 20 minutes.

iv) The adhesive tape was peeled, and the glass plate was used as a test piece for IR measurement.

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II) Measurement of IR

i) Set the test piece, and measure its transmittance.

5 ii) From the measurement result, confirm that the residue after peeling is mainly a side-chain crystallizable polymer.

10 iii) Make a determination based on the transmittance of ν (CH_2) at 2920 cm^{-1} which derives from the side-chain crystallizable polymer.

Defining the residue of Comparative Example 3 as 100, each residue amount was subjected to a relative
15 evaluation.

(Example 2)

An adhesive tape for temporary attachment was obtained in a manner similar to Example 1 except that
20 instead of the polymer solution obtained according to Synthesis Example 1, the polymer solution obtained according to Synthesis Example 2 was used.

The peeling force of the resultant adhesive tape

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for temporary attachment and the residue after peeling were evaluated in a manner similar to Example 1.

(Example 3)

5 An adhesive tape for temporary attachment was obtained in a manner similar to Example 1 except that instead of the polymer solution obtained according to Synthesis Example 1, the polymer solution obtained according to Synthesis Example 3 was used.

10

The peeling force of the resultant adhesive tape for temporary attachment and the residue after peeling were evaluated in a manner similar to Example 1.

15 (Comparative Example 1)

 An adhesive tape for temporary attachment was obtained in a manner similar to Example 1 except that instead of the polymer solution obtained according to Synthesis Example 1, the polymer solution obtained
20 according to Synthesis Example 4 was used.

The peeling force of the resultant adhesive tape for temporary attachment and the residue after peeling were evaluated in a manner similar to Example 1.

(Comparative Example 2)

An adhesive tape for temporary attachment was obtained in a manner similar to Example 1 except that
5 instead of the polymer solution obtained according to Synthesis Example 1, the polymer solution obtained according to Synthesis Example 5 was used.

The peeling force of the resultant adhesive tape
10 for temporary attachment and the residue after peeling were evaluated in a manner similar to Example 1.

(Comparative Example 3)

Instead of the polymer solution obtained
15 according to Synthesis Example 1, the polymer solution obtained according to Synthesis Example 6 was used, and 0.3 parts of Coronate L45 (Nippon Polyurethane Industry Co., Ltd.) was added as a cross-linking agent to 100 parts of the polymer. This mixture was applied by using a roll
20 coater on a surface of a PET film (about 100 μ m) which had been subjected to a corona treatment. Thus, an adhesive tape for temporary attachment with a release sheet, having an acrylic-type adhesive layer (thickness: about 50 μ m) was obtained.

The peeling force of the resultant adhesive tape for temporary attachment and the residue after peeling were evaluated in a manner similar to Example 1.

5

These results are shown in Table 1.

Table 1

	Polymer composition	Polymer Molecular weight	Peeling force (g/25 mm)		Reduction rate of force	Residue after peeling
			23°C	60°C		
Ex.1	A=45/50/5/2.5	18,000	200 g	30 g	85%	10
Ex.2	A=45/50/5/5	10,000	160 g	10 g	94%	10
Ex.3	A=45/50/5/10	5,000	160 g	6 g	96%	10
Comp Ex.1	A=45/50/5/1.5	30,000	170 g	70 g	59%	10
Comp Ex.2	B=45/50/5/7.5	2,500	160 g	8 g	95%	80
Comp Ex.3	C=95/5/5	8,000	180 g	8 g	96%	100

Polymer composition

- 10 A=C22A/C1A/AA/C12SH
 B=C22A/C1A/AA/C3SH
 C=C18A/AA/C12SH

15 According to Comparative Example 1, due to low temperature sensitiveness, the reduction rate of force responsive to heating is low. Contamination on the work surface was also observed for Comparative Examples 2 and

3. In contrast, Examples 1 to 3 were excellent in terms of releasability as well as contaminating properties after heating (60°C), and yet the initial adhesion strength (23°C) was enhanced.

5

INDUSTRIAL APPLICABILITY

There is provided an adhesive tape for temporary attachment of devices, such that a sufficient adhesion strength for not causing scattering or dislocation of
10 chips is exhibited until a step of cutting the green sheets is performed and that a reduction in the adhesion strength is realized when peeling off the works so that interlayer destruction does not occur and no residues are left.

AMENDED CLAIMS

1. (Amended) An adhesive tape for temporary attachment comprising a substrate film and an adhesive layer provided on at least one face of the substrate film,

the adhesive layer comprising an adhesive composition, the adhesive composition containing a pressure-sensitive adhesive and a side-chain crystallizable polymer, wherein the side-chain crystallizable polymer is obtained from a monomer mixture comprising about 40 to about 70 wt.% of an acrylic acid alkyl ester and/or a methacrylic acid alkyl ester which has an alkyl group including 1 to 6 carbon atoms, about 2 to about 10 wt.% of a carboxyl group containing ethylenic unsaturated monomer, about 20 to about 50 wt.% of an acrylic acid alkyl ester and/or a methacrylic acid alkyl ester which has an alkyl group including 16 or more carbon atoms; the polymer has a weight average molecular weight of about 3,000 to about 25,000; and the adhesion strength of the adhesive composition with a stainless steel plate when heated to about 35°C or above is about 10% or less of an adhesion strength with the stainless steel plate at 23°C.

2. An adhesive tape for temporary attachment according to

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claim 1, wherein the adhesive composition contains about 1 to about 30 wt.% of the side-chain crystallizable polymer on the basis of the adhesive composition.

3. An adhesive tape for temporary attachment according to claim 1, wherein the adhesive composition is of such a nature that the adhesive composition easily peels off the device at about 35°C or above.

4. An adhesive tape for temporary attachment according to claim 1, wherein the side-chain crystallizable polymer has a melting point occurring within a temperature range narrower than about 35°C.

5. (Deleted)

TITLE : "ADHESIVE TAPE FOR TEMPORARY-ATTACHMENT
OF DEVICES"

An adhesive tape for temporary attachment of a device includes a substrate film and an adhesive layer provided on at least one face of the substrate film. The adhesive layer is composed of an adhesive composition, the adhesive composition containing a pressure-sensitive adhesive and a side-chain crystallizable polymer. The side-chain crystallizable polymer is obtained from a monomer mixture comprising: about 40 to about 70 wt.% of an acrylic acid alkyl ester and/or a methacrylic acid alkyl ester which has an alkyl group including 1 to 6 carbon atoms; about 2 to about 10 wt.% of a carboxyl group-containing ethylenic unsaturated monomer; and about 20 to about 50 wt.% of an acrylic acid alkyl ester and/or a methacrylic acid alkyl ester which has an alkyl group including 16 or more carbon atoms. The polymer has a weight average molecular weight of about 3,000 to about 25,000. Since the adhesive tape has a good tackiness with respect to the device at a low temperature, the device can be processed (e.g., cut) or transferred by fixing the device on the adhesive tape at a low temperature. When peeling the device off the adhesive tape, the adhesive tape is heated to a predetermined temperature or above

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so that the device can be easily peeled off the adhesive tape.