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(71) Applicant(s)
3M Innovative Properties Company

(72) Inventor(s)
Sakurai, Aizoh;Mino, Yasuhiro;Nagata, Hiroyasu;Sugawa, Kosuke

(74) Agent / Attorney
Davies Collison Cave, Level 14 255 Elizabeth Street, Sydney, NSW, 2000

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(71) **Applicant** *(for all designated States except US)*: **3M INNOVATIVE PROPERTIES COMPANY** [US/US]; 3M Center, Post Office Box 33427, Saint Paul, MN 55133-3427 (US).

(72) **Inventors; and**
(75) **Inventors/Applicants** *(for US only)*: **SAKURAI, Aizoh** [JP/JP]; Sumitomo 3M Limited, 33-1, Tamagawadai, 2-Chome, Setagaya, Tokyo 158-8583 (JP). **MINO, Yasuhiro** [JP/JP]; Sumitomo 3M Limited, 33-1Tamagawadai, 2-Chome, Setagaya, Tokyo 158-8583 (JP). **NAGATA, Hiroyasu** [JP/JP]; Sumitomo 3M Limited, 33-1, Tamagawadai, 2-Chome, Setagaya, Tokyo 158-8583 (JP). **SUGAWA, Kosuke** [JP/JP]; Sumitomo 3M Limited, 33-1, Tamagawadai, 2-Chome, Setagaya, Tokyo 158-8583 (JP).

(74) **Agents**: **PATCHETT, David, B.** et al.; 3M CENTER, Office of Intellectual Property Counsel, Post Office Box 33427, Saint Paul, MN 55133-3427 (US).

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(54) **Title**: A PRESSURE SENSITIVE ADHESIVE AND A PRESSURE SENSITIVE ADHESIVE TAPE

(57) **Abstract**: A pressure sensitive adhesive is obtained by polymerizing a mixture containing: (1) 100 mass parts of (meth)acrylic monomer comprising 98-50 mass parts of a first monomer selected from an aliphatic (meth)alkyl acrylate having a carbon number of 4-6 and an aliphatic (meth)alkyl acrylate having a carbon number of 7-12, wherein the glass transition temperature of a homo-polymer thereof is -25 degrees C or less; and 2-50 mass parts of a second monomer comprising one or more selected from the group consisting of: an amide group-containing ethylenic unsaturated copolymerizing monomer, a carboxylic group-containing ethylenic unsaturated copolymerizing monomer, an amino group- containing ethylenic unsaturated copolymerizing monomer, a non-tertial alkyl(meth)acrylate wherein the glass transition temperature of a homo-polymer thereof is -25 degrees C or more; and a monomer represented by the chemical structural formula (I) $CH_{2=}CR^1COO(R_{2O})nR^3$ or $CH_2=CR^1COOR^4R^5$ (R^1methyl or H; R^2 and R^4 = linear or branched alkyl having a carbon number of 1-6; R^3 =methyl, ethyl, or substituted or non- substituted phenyl; R^5=substituted or non-substituted 4-membered or 5-membered ring containing oxygen; n=1-16); (2) 10-100 mass parts of a block copolymer; (3) 20-100 mass parts of hydrogenated tackifier; and (4) 0.05-1.0 mass parts of a photopolymerization initiator

A PRESSURE SENSITIVE ADHESIVE AND A PRESSURE SENSITIVE ADHESIVE TAPE

Background

The present disclosure relates to pressure sensitive adhesives. Specifically, the present disclosure relates to a pressure sensitive adhesive obtained by polymerization of an acrylic monomer, a block copolymer, a hydrogenated tackifier and a photopolymerization initiator. Moreover, the present disclosure relates to an adhesive tape comprising an adhesive layer comprising such a pressure sensitive adhesive.

Low surface energy (LSE) substrates are frequently used for products used under a variety of conditions such as automotive parts, building materials, electronic parts, and OA equipment. When those materials are bonded using adhesives, the adhesives may do not provide the desired level of adhesion. As a result, a primer tends to be coated on the material surface as a pretreatment agent.

However, the primer generally contains volatile organic solvent, so there are issues such as worsening of coating work conditions by solvent volatilization when or after the primer is coated, or worsening environment of the place where primer coated materials are used (e.g. inside a vehicle or in a confined space such as a room). There are further issues such as taking a certain work time for coating the primer, coating unevenness, forgetting to coat depending on a worker, and worsening of the coating surface appearance by contamination of primer.

Japanese Patent JP 2003-522249 relates to a pressure sensitive adhesive comprising a polymer blend containing a block copolymer, a tape comprising the pressure sensitive adhesive and an adhesive backing article comprising the pressure sensitive adhesive.

US Patent No. 4,243,500 relates to a pressure sensitive adhesive formed from a composition comprising mono-functional unsaturated acrylate ester monomer, tackifying resin polymer dissolved in the acrylate ester, non-crystallizing elastomeric material dissolved in the acrylate ester, and a UV initiator (5.80 parts with respect to 100 parts of monomers).

Summary

It would be desirable to have a pressure sensitive adhesive and an adhesive tape having sufficient adhesion to a LSE substrate surface under a wide range of conditions such as ambient temperature, high temperature and after aging with high temperature.

The present disclosure provides a pressure sensitive adhesive having a sufficient adhesion under a range of temperatures including a high temperature to the low surface energy materials such as polyolefins, and an adhesive tape comprising the pressure sensitive adhesive.

The present disclosure provides a pressure sensitive adhesive obtained by polymerizing a mixture containing:

1) 100 mass parts of (meth)acrylic monomer comprising

98-50 mass parts of a first monomer selected from an aliphatic (meth)alkyl acrylate having a carbon number of 4-6 and an aliphatic (meth)alkyl acrylate having a carbon number of 7-12, wherein the glass transition temperature of a homo-polymer thereof is -25 degrees C or less; and

2-50 mass parts of a second monomer comprising one or more selected from the group consisting of:

an amide group-containing ethylenic unsaturated copolymerizing monomer,

a carboxylic group-containing ethylenic unsaturated copolymerizing monomer,

an amino group-containing ethylenic unsaturated copolymerizing monomer,

non-tertial alkyl(meth)acrylate wherein the glass transition temperature of a homo-polymer thereof is -25 degrees C or more, and a monomer represented by the chemical structural formula (I) $CH_2=CR^1COO(R_2O)nR^3$ or $CH_2=CR^1COOR^4R^5$ (R^1=methyl or H; R^2 and R^4 = linear or branched alkyl having a carbon number of 1-6; R^3 =methyl, ethyl, or substituted or non-substituted phenyl; R^5=substituted or non-substituted 4-membered or 5-membered ring containing oxygen; n=1-16);

2) 10-100 mass parts of a block copolymer;

3) 20-100 mass parts of hydrogenated tackifier; and

4) 0.05-1.0 mass parts of a photopolymerization initiator.

The present disclosure also provides an adhesive sheet which comprises a substrate layer and an adhesive layer comprising the pressure sensitive adhesive.

Detailed Description

The present disclosure provides a pressure sensitive adhesive and an adhesive tape having sufficient adhesion to LSE substrates (such as polyolefins) under a wide range of conditions such as ambient temperature, high temperature, and after aging at high temperature.

A pressure sensitive adhesive of the present disclosure is a composition obtained by polymerization of a mixture containing

i) 100 mass parts of (meth)acrylic monomer comprising 98 to 50 mass parts of a first monomer and 2 to 50 mass parts of a second monomer,

ii) 10 to 100 mass parts of block copolymer,

iii) 0 to 100 mass parts of hydrogenated tackifier, and

iv) 0.05 to 1.0 mass parts of a photopolymerization initiator.

As used herein the term “(meth)acryl” refers to “acryl or methacryl.”

A first monomer can be selected from an aliphatic (meth)alkyl acrylate having a carbon number of 4-6 and an aliphatic (meth)alkyl acrylate having a carbon number of 7-12 and the first monomer includes about 98 to about 50 mass parts of the monomers having -25 degrees C or less of the glass transition temperature of a homo-polymer thereof.

The aliphatic (meth)alkyl acrylate having a carbon number of 4-6 represents an ester of acrylic acid or methacrylic acid and aliphatic alcohol having a carbon number of 4-6. The aliphatic (meth)alkyl acrylate having a carbon number of 7-12 refers to an ester of acrylic acid or methacrylic acid and aliphatic alcohol having a carbon number of 7-12.

In the present disclosure, the first monomer may be a homo-polymer having a glass transition temperature of -25 degrees C. The first monomer may include, but is not limited to, aliphatic (meth)alkyl acrylates having a carbon number of 4-6 such as n-butyl acrylate (BA), iso-butyl acrylate, pentyl acrylate, or hexyl acrylate; aliphatic (meth)alkyl acrylates having a carbon number of 7-12 such as 2-ethylhexyl acrylate (2EHA), iso-octyl acrylate (IOA), n-nonyl(meth)acrylate, iso-nonyl acrylate, decyl(meth)arylate, iso-decyl(meth)acrylate, lauryl(meth)acrylate, or iso-dodecyl(meth)acrylate.

The second monomer may include 2 to 50 mass parts of at least one from the group consisting of an amide group-containing ethylenic unsaturated copolymerizing monomer, a carboxylic group-containing ethylenic unsaturated copolymerizing monomer, an amino group-containing ethylenic unsaturated copolymerizing monomer, non-tertial alkyl(meth)acrylate wherein the glass transition temperature of a homo-polymer thereof is -25 degrees C or more, and a monomer represented by the chemical structural formula (I) $CH_2=CR^1COO(R_2O)nR^3$ or $CH_2=CR^1COOR^4R^5$ (R^1=methyl or H; R^2 and R^4 = linear or branched alkyl having a carbon number of 1-6; R^3 =methyl, ethyl, or substituted or non-substituted phenyl; R^5=substituted or non-substituted 4-membered or 5-membered ring containing oxygen; n=1-16).

As used herein the amide group-containing ethylenic unsaturated copolymerizing monomer refers to a monomer including -NC(O)- in the side chain of ethylenic unsaturated copolymerizing monomer. The ethylenic unsaturated copolymerizing monomer includes, for example, acrylamide, methacrylamide, N,N-dimethyl acrylamide (DMAA), N,N-diethyl acrylamide (nnDEA), N,N-dimethyl methacrylamide, acroyl morpholine (AcMO), N-vinyl caprolactam, or N-vinyl pyrrolidone (NVP).

As used herein, the carboxylic group-containing ethylenic unsaturated monomer represents a monomer having a carboxylic group in a side chain of the ethylenic unsaturated copolymerizing monomer. The carboxylic group-containing ethylenic unsaturated monomer having a carboxylic group includes, for example, unsaturated monocarboxylic acids such as acrylic acid, methacrylic acid or crotonic acid; or unsaturated dicarboxylic acids such as itaconic acid, fumaric acid, citraconic acid or maleic acid.

As used herein, the amino group-containing ethylenic unsaturated copolymerizing monomer refers to a monomer having an amino group in a side chain of the ethylenic unsaturated copolymerizing monomer. The amino group-containing ethylenic unsaturated copolymerizing monomer includes, for example, dialkylamino alkyl (meth)acrylates such as N,N- dimethylaminoethyl acrylate (DMAEA) or N,N-dimethylamino ethyl methacrylate (DMAEMA); dialkylamino alkyl (meth)acrylamides such as N,N-dimethylamino propyl acrylamide (DMAPAA) or N,N-dimethylamino propyl methacrylamide; dialkylamino alkyl vinyl ethers such as N,N-dimethylamino ethyl vinyl ether or N,N-diethylamino ethyl vinyl ether; or vinyl heterocyclic amines such as 1-vinylimidazole, 4-vinylpyridine or 2-vinylpyridine; or a mixture thereof.

As used herein, the non-tertial alkyl(meth)acrylate having the glass transition temperature of a homo-polymer thereof refers to -25 degrees C or more refers to an ester of acrylic acid or methacrylic acid and non-tertial, that is primary or secondary alcohol, which has the Tg of a homo-polymer thereof is -25 degrees C or more. The non-tertial alkyl(meth)acrylate having the glass transition temperature of a homo-polymer thereof refers to -25 degrees C or more includes, for example, benzyl acrylate (BzA), benzyl methacrylate, isobornyl acrylate (IBA), isobornyl methacrylate, cyclohexyl acrylate, cyclohexyl methacrylate, di-cyclo pentanyl methacrylate, or di-cyclo pentenyl methacrylate.

In a monomer represented by the chemical structural formula (I) $CH_2=CR^1COO(R_2O)nR^3$ or $CH_2=CR^1COOR^4R^5$ (R^1=methyl or H; R^2 and R^4 = linear or branched alkyl having a carbon number of 1-6; R^3 =methyl, ethyl, or substituted or non-substituted phenyl; R^5=substituted or non-substituted 4-membered or 5-membered ring containing oxygen; n=1-16), “substituted or non-substituted phenyl” refers to a phenyl group which may be substituted with any number of substitutions. The substitutions include, for example, halogen, alkyl group having a carbon number of 1 to 12, alkoxyl group, or hydroxyl group. The “substituted or non-substituted 5-membered or 6-membered ring containing oxygen” refers to 5-membered or 6-membered ring containing one or more oxygen atoms. The substitutions include the same as for the substituted or non-substituted phenyl. The monomer represented by the above chemical structural formula includes, for example, methoxy triethylene glycol methacrylate, methoxy dipropylene glycol acrylate, ethoxy dipropylene glycol acrylate, 3-methoxy butyl acrylate, 2-ethoxyethoxyethy acrylate, phenoxy ethyl acrylate(PEA), phenoxy ethyl methacrylate, or tetrahydro furyl methacrylate.

The glass transition temperature (Tg) was determined as peak top temperature of loss tangent curve at the glass transition region of the viscoelastic (meth)acrylic homo- and co-polymers, which was measured by dynamic mechanical analysis (Advanced Rheometric Expansion System (ARES) manufactured by Rheometric Scientific, Inc.). The measurement conditions were as follows: shear mode, applied frequency of 1 rad/sec, temperature ramp rate of 5 degrees C/min.

The first and second monomers can be added respectively 98 to 50 mass parts and 2 to 50 mass parts to be totally 100 mass parts. Alternatively, the first monomer can be 98 to 60 mass parts and the second monomer can be 2 to 40 mass parts. The amount of the first and second monomers can be selected properly depending on the combination of the first and second monomers, and the optimal range of each monomer content is variable depending on the combination.

The combination of the first and second monomers can be selected properly and are not limited.

In case, for example, the aliphatic (meth)alkyl acrylate having a carbon number of 4-6 as the first monomer and a single monomer as the second monomer are used, the second monomer can be preferably selected from an amide group-containing ethylenic unsaturated copolymerizing monomer, a carboxylic group-containing ethylenic unsaturated copolymerizing monomer, and non-tertial alkyl(meth)acrylate wherein the glass transition temperature of a homo-polymer thereof is -25 degrees C or more. Specific combination of the first and the second monomers includes, for example, n-butyl acrylate (BA) and one from N,N-dimethyl acrylamide (DMAA), acrylic acid(AA) and benzyl acrylate (BzA). Alternatively, in case an aliphatic (meth)alkyl acrylate having a carbon number of 7-12 as the first monomer and a single second monomer are used, an amide group-containing ethylenic unsaturated copolymerizing monomer can be used. Specifically, 2-ethylhexyl acrylate (2EHA) as the first monomer and N,N-dimethyl acrylamide as the second monomer can be used, respectively.

In case two or more of the second monomers are used, the second monomer includes an amide group-containing ethylenic unsaturated copolymerizing monomer and a carboxylic group-containing ethylenic unsaturated copolymerizing monomer, alternatively includes a carboxylic group-containing ethylenic unsaturated copolymerizing monomer and non-tertial alkyl(meth)acrylate, wherein the glass transition temperature of a homo-polymer thereof is -25 degrees C or more. In this instance, any monomers listed as the first monomers may be used. The specific combination in this instance includes, for example, the first monomer such as n-butyl acrylate or 2-ethylhexyl acrylate; and the second monomer such as a combination of N,N-dimethyl acrylamide and acrylic acid or a combination of acrylic acid and benzyl acrylate. In one aspect, the specific combination may include n-butyl acrylate as the first monomer. Further, the amino group-containing ethylenic unsaturated copolymerizing monomer, such as N,N-dimethyl aminoethyl acrylate or other monomers, can also be contained.

In each combination, it is preferred to contain about 15 mass parts to about 50 mass parts of the amide group-containing ethylenic unsaturated copolymerizing monomer as the second monomer when the aliphatic (meth)alkyl acrylates having a carbon number of 7-12 such as 2-ethylexyl acrylate is used as the first monomer. In this case, the aliphatic (meth)alkyl acrylates having a carbon number of 4-6 such as n-butyl acrylate can be combined further. Alternatively, the monomer represented by the formula (I) such as 3-methoxybutyl acrylate or 2-ethoxyethoxyethy acrylate can be combined further. When the first monomer comprises the aliphatic (meth)alkyl acrylates having a carbon number of 7-12 as a single monomer, it is more preferred to contain about 15 mass parts to about 50 mass parts or about 25 mass parts to about 50 mass of the amide group-containing ethylenic unsaturated copolymerizing monomer as the second monomer.

The combination of an amide group-containing ethylenic unsaturated copolymerizing monomer and an amino group-containing ethylenic unsaturated copolymerizing monomer as the second monomer may improve adhesion to an acid surface such as polyvinyl chloride. Such combination of the monomers includes, for example, 2-ethylhexyl acrylate as the first monomer; and (meth)acrylic monomer containing an amide group-containing ethylenic unsaturated copolymerizing monomer such as N,N-dimethyl acrylamide and an amino group-containing ethylenic unsaturated copolymerizing monomer such as N,N-dimethylamino ethylaclyrate as the second monomer.

Block copolymer

The pressure sensitive adhesive includes a block copolymer of about 10 mass parts to about 100 mass parts. That corresponds to about 10 parts to about

100 parts with respect to 100 parts of the (meth)acrylic monomer. If it is less than about 10 mass parts, a peel force at ambient temperature tends to be not sufficient, and if it is more than 100 mass parts, the block copolymer tends to be difficult to disperse sufficiently in the monomers.

A block copolymer generally includes type A-B block copolymer and type A-B-A block copolymer. A represents a hard segment such as polystyrene block and B represents a soft segment such as polyisoprene, polybutadiene or polyethylene/butylene. It is preferred that these block copolymers disperse in the acrylic monomer uniformly. The styrene block copolymer includes SIS (styrene-isoprene-styrene) block copolymer, SBS (styrene-butadiene-styrene) block copolymer, SB (styrene-butadiene) block copolymer, SBBS (styrene-butadiene/butylene-styrene) block copolymer, SEBS (styrene -ethylene/butylene-styrene) block copolymer, SEPS (styrene-ethylene/ propylene-styrene) block copolymer, and SEP (styrene-ethylene/propylene) block copolymer, having linear or radial structure. Preferred block copolymer includes SBS, SB and SEBS. A random copolymer such as SBR (styrene-butadiene random copolymer) can be used together. The styrene content in SBS or SB block copolymer may be about 25 mass % or more or about 29 mass % or more.

When the block copolymer is SIS, the aliphatic (meth)alkyl acrylate having a carbon number of 4-6 can be preferably used as the first monomer, and n-butylacrylate can be more preferable. Further, the aliphatic (meth)alkyl acrylate having a carbon number of 7-12 can be used as the first monomer combining with the aliphatic (meth)alkyl acrylate having a carbon number of 4-6 and SEBS.

Hydrogenated tackifier

The pressure sensitive adhesive of the present disclosure includes a hydrogenated tackifier of about 20 mass parts to about 100 mass parts. The hydrogenated tackifier does not inhibit radical polymerization of the (meth)acrylic monomer by UV and improves adhesive force of the pressure sensitive adhesive. When the amount of the tackifier is less than about 20 mass parts, the adhesive force of the pressure sensitive adhesive to the low surface energy substrate decreases and when the amount of the tackifier is more than about 100 mass parts, the pressure sensitive adhesive becomes difficult to dissolve in the monomer solution. The hydrogenated tackifier includes partially or fully hydrogenated resins such as hydrogenated rosin ester (e.g. Foral 85-E from Eastman Chemical Japan Limited), hydrogenated terpene resin, aliphatic hydrogenated petroleum resin (e.g. Arkon M (partially hydrogenated)) or Arkon P (fully hydrogenated) available from Arakawa Chemical Industries, Ltd.), or aromatic modified hydrogenated petroleum resin (e.g. Escorez 5600 available from Exxon Mobile).

Photopolymerization initiator

The pressure sensitive adhesive of the present disclosure includes a photopolymerization initiator of about 0.05 mass parts to about 1.0 mass parts. Such range of amount is preferred to have a large adhesive force, especially a peel force at high temperature and a peel force after aging at high temperature. Moreover the amount of the photopolymerization initiator may be about 0.05 mass parts to about 0.5 mass parts or about 0.05 mass parts to about 0.3 mass parts.

The photopolymerization initiators may be selected from known initiators. Such initiators include, for example, 1-hydroxy cyclohexyl phenylketon Irgacure(R)184 (available from Ciba Japan), 2,2-dimethoxy-2-phenylacetophenone (Irgacure(R)651available from Ciba Japan), 2-hydroxy2-methyl1-phenylpropane-1-one(Darocure(R)1173available from Ciba Japan), 2-methyl1-[4-(methylthio)phenyl]-2-morpholinopropane1-one (Irgacure(R)907 available from Ciba Japan), 2-benzyl2-dimethylamino1-(4-morpholinophenyl)-butane-1-one, 2-chlorothioxanthone, 2,4-dimethylthioxanthone, 2,4-

diisopropylthioxanthone, isopropylthioxanthone, 2,4,6-trimethylbenzoyl diphosphine oxide, or bis(2,6-dimethoxybenzoyl)-2,4,4-trimethylpentylphosphine oxide. Such photopolymerization initiators can be used alone or in combination.

The adhesive of the present disclosure may further include a crosslinker. Suitable crosslinkers includes, for example, multifunctional acrylates cross-linking agents, isocyanate cross-linking agents, epoxy cross-linking agents, oxazoline cross-linking agents, azirizine cross-linking agents, metal chelate cross-linking agents, melamine resin cross-linking agents or peroxide cross-linking agents.

The amount of the crosslinker is not limited, but may be from about 0.01 mass parts to about 1.0 mass parts with respect to 100 mass parts of the (meth)acrylic monomer.

The pressure sensitive adhesive of the present disclosure may further comprise additives usually used, such as a plasticizer (process oil, silicone oil, polyethylene glycol etc.), a filler, an anti-aging agent, an adhesive promoter (polyolefin chlorides), a UV absorbent, and/or a pigment.

Manufacturing Process

The pressure sensitive adhesive of the present disclosure may be obtained by UV polymerization of the components such as the first monomer, the second monomer, the block copolymer and the hydrogenated tackifier, and optionally with additives. Alternatively, the first monomer and the second monomer are mixed firstly, then part of the tackifier is added to the mixture and substituted with nitrogen gas, then cured with UV to obtain a pre-polymer having a viscosity of about 1000 cps to about 5000 cps. Subsequently, the photopolymerization initiator, the block copolymer, and the remaining hydrogenated tackifier are added, mixed and cured with UV to obtain the pressure sensitive adhesive.

Adhesive tape

The adhesive tape of the present disclosure comprises a substrate layer and an adhesive layer comprising the pressure sensitive adhesive described herein. The adhesive tape may be made by laminating the adhesive layer on one side or both side of the substrate. Other functional layers such as a surface protecting layer or a primer layer may be optionally laminated. Further, a liner may be laminated on the surface of the adhesive layer.

The substrate layer includes a sheet comprising a film or a foam material usually used. The sheet comprising the film may have an adhesion. Suitable film materials include, for example, polyethylene film, polypropylene film, polyester film, polycarbonate film, polyvinyl chloride film, poly vinylidene chloride film, poly styrene film or polyamide film. The sheet comprising the foam includes, for example, acrylic foam sheet, polyethylene foam sheet, chloroprene foam sheet or urethane foam sheet. Specifically, for example, acrylic foam tape (GT7108 available from Sumitomo 3M) can be used as the sheet comprising the foam. The thickness of the substrate layer is not limited, but can be selected depending on the use of the adhesive tape. In certain aspects, the thickness of the substrate layer may range from about 30 micrometers to about 4 millimeters.

The adhesive layer may include the pressure sensitive adhesive of the present disclosure. The thickness of the adhesive layer is not limited, but may be selected depending on the materials of the substrate layer or use of the adhesive tape. In certain aspect, the thickness of the adhesive layer may range from about 10 micrometers to about 500 micrometers.

The adhesive tape may be prepared by known methods. For example, the mixture of the first and the second monomers, the block copolymer, the hydrogenated tackifier and the photopolymerizaiton initiator is placed between films, then cured with UV to obtain the adhesive layer. The film is peeled off from one side of the obtained adhesive layer, and the substrate layer is laminated on the film peeled surface to obtain the adhesive tape. If a release-treated film is used, operation of peeling off the film from the adhesive layer and laminating to the substrate layer is easier. When the adhesive layer and the substrate layer are laminated, a primer may be applied on the surface of the adhesive layer. Further, a double -sided adhesive tape may be obtained if the adhesive layer is laminated to both sides of the substrate layer.

The pressure sensitive adhesive of the present disclosure can be used as an adhesive tape by laminating to the substrate layer. The pressure sensitive adhesive of the present disclosure has a sufficient adhesion to LSE substrates (such as polyolefins) surface under a wide range of conditions such as ambient temperature, high temperature, and after aging with high temperature, and the adhesive tape comprising the pressure sensitive adhesive can be used to adhere products used under a variety of conditions such as automotive parts, building material, electronic parts, and OA equipments.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as, an acknowledgement or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

In order that the invention described herein can be more fully understood, the following examples are set forth. It should be understood that these examples are for illustrative purposes only, and are not to be construed as limited the invention in any manner.

Examples

Description of ingredients used:

892LS : chlorinated polyolefin

Arkon M115 : partially hydrogenated petroleum resin

Arkon P125 : fully hydrogenated petroleum resin

Arkon M135 : partially hydrogenated petroleum resin

Arkon P100 : fully hydrogenated petroleum resin

HDDA : 1, 6-hexanediol diacrylate

Irgacure 651 : 2,2-dimethoxy-1,2-diphenylethane-1-one

Viscoat #158 : 3-methoxybutyl acrylate

Viscoat #190 : 2-ethoxyethoxyethy acrylate
I-marv P140 : fully hydrogenated petroleum resin
Piccolyte A-135 : a-pinene resin
Regalrez 6108 : hydrogenated hydrocarbon resin
Regalrez 1085 : hydrogenated hydrocarbon resin
CP343-1 : chlorinated polyolefin
ED-502S : mono-functional epoxy resin

Examples 1, 2, 5-12 and 14-55, Comparative Examples 7-16

The monomers shown in Tables 1-12 and the other components were mixed and dissolved with stirring in a container (65 degrees C for 24 hours). If the components included chlorinated polyolefin (892LS available from Nippon Paper Chemicals Co. LTD.), the monomers and the chlorinated polyolefin were mixed and stirred in the container (65 degrees C for 60 minutes), then the remaining components were added to the chlorinated polyolefin solution and dissolved with stirring.

The obtained mixture was placed between 50 micrometers thickness of the release-treated PET films (from Mitsubishi Chemical), then coated by knife coating. Subsequently, the sample was treated with UV irradiation (wavelength 300 to 400 nm, power 0.5 to 7 mW/cm2) for six minutes and cured, then the pressure sensitive adhesive was obtained. The thickness of the obtained sample was 100 micrometers.

One of the PET films of the obtained pressure sensitive adhesive was peeled off and a primer (Primer K500 available from Sumitomo 3M) was coated with a felt on the exposed adhesive surface. Next, an acrylic foam tape (GT7108 available from Sumitomo 3M) was laminated on the coated surface to obtain the adhesive tape. In Examples 9-12, the acrylic foam tape was laminated on the exposed adhesive surface without the primer to obtain the adhesive tape.

For shear test and static shear test, the obtained adhesive tape was used as a sample. For peel force test, a 50 micrometer thickness of PET film treated with Primer K500 laminated on the surface of the acrylic foam tape side of the obtained adhesive tape was used.

Comparative example 1

The components shown in Table 2 and toluene were added to a container and stirred for 24 hours at ambient temperature. The stirred solution was coated on 50 micrometer thickness of the release-treated PET film (from Mitsubishi Chemical) by knife coating, dried at 100 degrees C for 10 minutes to obtain a pressure sensitive adhesive. The thickness was 50 micrometers.

One of the PET films of the obtained pressure sensitive adhesive was peeled off, then primer (Primer K500 available from Sumitomo 3M) was coated on the exposed surface with a felt, and an acrylic foam tape (GT7108 available from Sumitomo 3M) was laminated on the surface to obtain a test sample.

Comparative example 2

Chlorinated polyolefin (892LS available from Nippon Paper Chemicals Co. LTD.) was added to toluene, heated to 60 degrees C and dissolved with stirring. Subsequently, to the obtained toluene solution, the block copolymer and the tackifier shown in Table 2 was added and dissolved with stirring for 24 hours at ambient temperature. 285.7 parts (100 parts in solid) of 35 mass % of acrylic polymer and 6.66 parts (0.2 parts in solid) of 3 mass % toluene solution of azirizine crosslinker (isophthaloylbis-2-methylaziridin) were added to the obtained toluene solution, well-stirred to give an adhesive solution.

The adhesive solution was coated on a separating material by knife coating, dried at 100 degrees C for 20 minutes to obtain an adhesive sheet. The thickness was 70 micrometers. A primer (Primer K500 available from Sumitomo 3M) was coated on the surface of the obtained adhesive sheet with a felt, then acrylic foam tape (GT7108 available from Sumitomo 3M) was laminated on the primer coated surface to obtain a test sample.

Preparation of acrylic polymer

71.11 parts of 2-ethylhexyl acrylate, 27.65 parts of N,N-dimethyl acrylamide, 1.235 parts of acrylic acid, 157.9 parts of ethyl acetate and 27.8 parts of toluene were poured into a pressure glass bottle. After adding 0.1481 parts of 2,2'-azobis(2,4-dimethylvaleronitrile) as a solvent polymerization initiator to the pressure glass bottle, the system was substituted by nitrogen gas with an inert gas injection tube for 10 minutes. Immediately after the gas substitution, the pressure glass bottle was closed with a lid, then cured in a constant-temperature bath at 50 degrees C for 20 hours to give an acrylic polymer solution.

Examples 3 and 4, Comparative examples 3-6

A photopolymerization initiator was added to the monomers listed in Tables 1 and 2 with the amount referred in the upper column, then substituted with nitrogen gas (deoxygenation), then cured with UV to obtain a pre-polymer having a viscosity of about 1000 cps to about 5000 cps. Then the photopolymerization initiator, the crosslinker, the block copolymer and the hydrogenated tackifier with the amount referred in the low column were added and dissolved with stirring in the container for 24 hours at 65 degrees C. Subsequently, the sample was obtained in the same manner as Example 1.

Measurement of peel force at ambient temperature to polyolefin

A panel made of polypropylene (PP) (5 mm x 35 mm x 75 mm, available from Japan Polypropylene Corporation) as an adherend was prepared, and washed with isopropyl alcohol (IPA). The samples (12 mm x 60 mm) prepared in the Examples and Comparative examples were adhered to the adherend with a

2 kg roller (back and forth one time) and aged for 24 hours at ambient temperature (25 degrees C), then 180°peel force (at ambient temperature, 50 mm/minute of tension rate) was measured with a tensile tester (Tensilon RTC-1325A available from Orientec Co., LTD.). The result is shown in Tables 1-12.

Measurement of peel force at 80 degrees C to polyolefin

A panel made of polypropylene (PP) (5 mm x 35 mm x 75 mm, available from Japan Polypropylene Corporation) as an adherend was prepared, and washed with isopropyl alcohol (IPA). The samples (12 mm x 60 mm) prepared in the Examples and Comparative examples were adhered to the adherend with a 2 kg roller (back and forth one time) and aged for 30 to 60 minutes at 80 degrees C, then 180°peel force (at 80 degrees C, 50 mm/minute of tension rate) was measured with a tensile tester (Tensilon RTC-1325A available from Orientec Co., LTD.). The result is shown in Tables 1-12.

Measurement of peel force after aging at 80 degrees C to polyolefin

A panel made of polypropylene (PP) (5 mm x 35 mm x 75 mm, available from Japan Polypropylene Corporation) as an adherend was prepared, and washed with isopropyl alcohol (IPA). The samples (12 mm x 60 mm) prepared in the Examples 1-12 and 14-42 and Comparative examples 1-14 were adhered to the adherend with a 2 kg roller (back and forth one time) and stored for two weeks at 80 degrees C, then 180°peel force (at ambient temperature, 50 mm/minute of tension rate) was measured with a tensile tester (Tensilon RTC-1325A available from Orientec Co., LTD.). The result is shown in Tables 1-9.

Measurement of shear force after aging at 80 degrees C to polyolefin

A panel made of polypropylene (PP) (5 mm x 35 mm x 75 mm, available from Japan Polypropylene Corporation) as an adherend was prepared, and washed with isopropyl alcohol (IPA). The samples (12 mm x 60 mm) prepared in the Examples 1-12 and 14-42 and Comparative examples 1-14 were adhered to the adherend with a 2 kg roller (back and forth one time) and a painted panel (cation electro-painting: JIS,G,3141(SPCC,SD)) which was coated by a primer (Primer K500 available from Sumitomo 3M) with a felt was laminated on the opposite surface (acrylic foam side surface) of the sample, then stored for 24 hours at ambient temperature (25 degrees C) and two weeks at 80 degrees C, shear force (Tensilon RTC-1325A available from Orientec Co., LTD., at ambient temperature, 50 mm/minute of tension rate) was measured with a tensile tester (Tensilon RTC-1325A available from Orientec Co., LTD.). The result is shown in Tables 1-9.

Static Shear test at 70 degrees C

As adherends, polyvinyl chloride panel (acid surface) (XP103 available from Mitsubishi Chemical, 2mm×25mm×100mm) and polypropylene (PP) panel (LSE surface) (available from Japan Polypropylene Corporation, 5mm×35mm×75mm) were prepared and washed with isopropyl alcohol (IPA). The adhesive surface of the test samples (12mm×25mm) prepared in the Examples 9 to 12 were adherend to the adherend and the opposite side (acrylic foam tape surface) of the test samples were adhered to cleaned SUS-304 panel (0.5mm×30mm×60mm), then pressed with a 5 kg roller (back and forth one time). The samples were placed in the oven for 30 minutes at 70 degrees C, then positioned 2 degrees from the vertical, a 1 kg of weight was hung on the free end of the samples and the time required for the weighted sample to fall off the panel was recorded. The result is shown in Table 3.

Static Shear test at 40 degrees C

The test samples (12mm×25mm) prepared in the Examples 49 to 52 were used for the test in the same manner as the Static Shear test at 70 degrees C except that the oven temperature was 40 degrees C and the adherends listed in

Table 13 were used. The result is shown in Table 13.

"Mode" in the Tables shows a state of the test samples after each test which are visually observed and shown in failure mode. The states of each failure mode used herein are the following.

FB (foam split break) : A state which a substrate layer (acrylic foam tape) had cohesion failure is shown. That is the state which the adhesive layer still adhered to the adherend and the substrate layer (acrylic foam tape) is destroyed.

POP: A state which a sample was peeled off from the adherend by interface failure of the adhesive layer is shown. The substrate layer (acrylic foam tape) still adhered to the adhesive layer and no adhesive remaining was observed visually on the adherend or the adherend surface was not sticky.

ACF (cohesion failure) : A marker of adhesive layer's cohesion failure. A state which an adhesive layer of the sample was destroyed and the adherend and the substrate layer were separated with the destroyed adhesive layer.

Anchor : A state which the sample separated at the interface of the adhesive layer and the substrate layer (acrylic foam tape).

Jerky : The state which the peel force was up and down domestically during peeling and showed the cycle of slip and stick with respect to the time axis. The peel force value in the Tables showed peak value.

"Not dispersed" shows that the block copolymer did not disperse in the monomers (dispersion failure).

Table 1

	Reagent	Supplier	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Ex. 7	Ex. 8
1st monomer	2EHA	Nippon Shokubai	71.11	71.11	71.11	71.11	71.11	71.11	64.6	64.5
2nd monomer	DMAA	KOHJIN Co., Ltd.	27.65	27.65	27.65	27.65	27.65	27.65		
	IBA	Osaka Organic Chemical Industry Ltd.							32.0	32
	AA	Toagosei Co., ltd.	1.235	1.235	1.235	1.235	1.235	1.235	3.4	3.5
Photopolymerization initiator	Irgacure 651	Ciba Japan	0.2370	0.2370	0.03951	0.03951	0.2370	0.2370	0.14	0.24
					0.1975	0.1975				
Closslinker	HDDA	Kyoeisha Chemical Co.,Ltd.	0.09877	0.09877	0.09877	0.09877	0.09877	0.09877	0.11	0.1
Block copolymer	D1118K (SBS)	Kraton Polymers	59.26	59.26	9.877	14.81	79.01	98.77		
	P1500 (SBBS)	Asahi Kasei Chemicals Co.							5.7	
	G1657 (SEBS)	Kraton Polymers							15.7	
	V9827 (SEBS)	KURARAY CO., LTD.								40
Tackifier	Arkon M135	Arakawa Chemical Industries, Ltd.	24.69	24.69	19.75	19.75	39.51	49.38		
	Arkon M115	Arakawa Chemical Industries, Ltd.	24.69	24.69			39.51	49.38		
	Arkon P100	Arakawa Chemical Industries, Ltd.								32
	I-marv P140	Idemitsu Kosan							21.4	
Additive	892LS	Nippon Paper Chemicals CO., LTD.	4.938							5
Peel force on PP at ambient temp. (N/12mm)		force	25	25	18.7	22.2	22.4	21.8	24	24
		mode	FB	FB	POP	POP	FB	FB	POP	POP
Peel force on PP at 80 degrees C (N/12mm)		force	10	11	9.6	9.4	11	11.1	4	5
		mode	POP	POP	POP	POP	POP	POP	POP	POP
Peel force after aging at 80 degrees C		force	25	25	20	23	24	24	24	24

Reagent	Supplier	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Ex. 7	Ex. 8
(N/12mm)									
	mode	FB	FB	POP	POP	FB	FB	POP	POP
Shear force after aging at 80 degrees C MPa)	force	1	1	0.8	0.8	0.9	0.9	0.9	0.9
	mode	FB	FB	POP	POP	FB	FB	POP	POP

Table 2

	Reagent	Supplier	Cex. 1	Cex. 2	Cex. 3	Cex. 4	Cex. 5	Cex. 6	Cex. 7
1st monomer	2EHA	Nippon Shokubai		71.11	76	69	71.11	71.11	71.11
2nd monomer	DMAA	KOHJIN Co., Ltd.		27.65			27.65	27.65	27.65
	IBA	Osaka Organic Chemical Industry Ltd.			19	28			
	AA	Mitsubishi Chemical Corporation		1.235	5	3	1.235	1.235	1.235
Photopolymerization initiator	Irgacure 651	Ciba Japan			0.06	0.04	0.03951	0.03951	0.237
					0.2	0.2	0.1975	0.1975	
Solvent polymerization initiator	2,2'-azobis(2,4-dimethylvaleronitrile)	Wako Pure Chemical Industries, Ltd.		0.1481					
Closslinker	HDDA	Kyoeisha Chemical Co.,Ltd.			0.08	0.08	0.09877	0.09877	0.09877
	isophthaloylbis-2-methylaziridin	-		0.1975					
Block copolymer	D1118K (SBS)	Kraton Polymers		59.26			4.938	9.877	108.6
	T-411 (SBS)	Asahi Kasei Chemicals Co.	13.45						
	＃1205（SBR)	Asahi Kasei Chemicals Co.	7.24						
Tackifier	Arkon M135	Arakawa Chemical Industries, Ltd.		24.69			19.75	9.877	54.32
	Arkon M115	Arakawa Chemical Industries, Ltd.		24.69					
	Piccolyte A-135	Rika Fine-Tech Inc.	20.69						54.32
	Regalrez6108	Eastman Chemical Japan			14				
	Regalrez1085	Eastman Chemical Japan				7			
Additive	892LS	Nippon Paper Chemicals CO., LTD.		4.938					
	CP343-1	Eastman Chemical Japan				2			
Solvent	toluene	Wako Pure Chemical Industries, Ltd.	58.2	206					
Peel force on PP at ambient temp. (N/12mm)		force	18	25	25	18	16.5	16.5	not dispersed
		mode	POP	FB	FB	POP	POP	POP	
Peel force on PP at 80 degrees C (N/12mm)		force	2	10	9	5	6	3.8	
		mode	POP	POP	ACF	POP	POP	POP	
Peel force after aging at 80 degrees C (N/12mm)		force	18	20	25	18	17	17	
		mode	POP	POP	FB	POP	POP	POP	
Shear force after aging at 80 degrees C（MPa)		force	0.2	0.5	0.8	0.3	0.5	0.5	
		mode	POP	POP	FB	POP	POP	POP	

Table 3

	Reagent	Supplier	Ex. 9	Ex. 10	Ex. 11	Ex. 12
1st monomer	2EHA	Nippon Shokubai	70.12	70.12	69.14	71.111
2nd monomer	DMAA	KOHJIN Co., Ltd.	26.67	26.67	25.68	27.65
	DMAEA	KOHJIN Co., Ltd.	1.975		3.951	
	AA	Mitsubishi Chemical Corporation	1.235	1.235	1.235	1.235
Photopolymerization initiator	Irgacure 651	Ciba Japan	0.1778	0.1778	0.237	0.237
Closslinker	HDDA	Kyoeisha Chemical Co.,Ltd.	0.0988	0.0988	0.0988	0.0988
Block copolymer	D1118K (SBS)	Kraton Polymers	39.51	39.51	59.26	59.26
Tackifier	Arkon M135	Arakawa Chemical Industries, Ltd.	29.63	29.63	23.7	24.69
	Arkon M115	Arakawa Chemical Industries, Ltd.	9.877	9.877	23.7	24.69
Additive	892LS	Nippon Paper Chemicals CO., LTD.	4.938	4.938	4.938	4.938
	ED-502S	ADEKA	0.4938	0.4938		
Peel force on PP at ambient temp. (N/12mm)		force	25	25	25	25
		mode	FB	FB	FB	FB
Peel force on PP at 80 degrees C (N/12mm)		force	11	10	12	12
		mode	POP	POP	POP	POP
Static shear at 70 degrees C on acid surface (minutes)		force	86	22	125	38
		mode	POP	POP	POP	POP
Static shear at 70 degrees C on olefin surface (minutes)		force	>10000	512	>10000	38
		mode	POP	Anchor	POP	Anchor

Table 4

	Reagent	Supplier	Cex. 8-1	Ex. 14	Ex. 15	Ex. 16	Ex. 17	Ex. 18	Ex. 19	Ex. 20	Cex. 8-2
1st monomer	BA	Mitsubishi Chemical Corporation	100	98	96	92	88	82	80	60	40
2nd monomer	AA	Toagosei co., Ltd.	0	2	4	8	12	18	20	40	60
Photopolymerization initiator	Irgacure 651	Ciba Japan	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Closslinker	HDDA	Kyoeisha Chemical Co.,Ltd.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Block copolymer	D1118K (SBS)	Kraton Polymers	60	60	60	60	60	60	40	40	30
Tackifier	Arkon M135	Arakawa Chemical Industries, Ltd.	25	25	25	25	25	25	20	20	15
	Arkon M115	Arakawa Chemical Industries, Ltd.	25	25	25	25	25	25	20	20	15
Additive	892LS	Nippon Paper Chemicals CO., LTD.	5	5	5	5					
Peel force at ambient temp. (N/12mm)/mode			1.9/POP	16/POP	22/POP	29/Jerky	27/FB	29/Jerky	27/POP	7.5/POP	not dispersed
Peel force at 80 degrees C (N/12mm)/mode			1.4/POP	6/POP	8/POP	10/POP	12/POP	12.5/POP	14/POP	17/POP	
Peel force after aging at 80 degrees C (N/12mm)/mode			-	-	26/FB	26/FB	22/POP	20/POP	8.8/POP	4.4/POP	
Shear force after aging at 80 degrees C (N/25x25mm)/mode			-	-	450/FB	454/FB	793/FB	474/FB	661/POP	620/POP	

Table 5

	Reagent	Supplier	Ex. 21	Ex. 22	Ex. 23	Ex. 24	Ex. 25	Ex. 26	Cex. 9	Cex. 10	Cex. 11
1st monomer	BA	Mitsubishi Chemical Corporation	90	80	70						
	2EHA	NIPPON SHOKUBAI				70	60	50	40	30	15
2nd monomer	DMAA	KOHJIN Co., Ltd.	10	20	30	30	40	50	60	70	85
Photopolymerization initiator	Irgacure 651	Ciba Japan	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Closslinker	HDDA	Kyoeisha Chemical Co.,Ltd.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Block copolymer	D1118K (SBS)	Kraton Polymers	60	60	60	60	60	60	60	30	30
Tackifier	Arkon M135	Arakawa Chemical Industries, Ltd.	25	25	25	25	25	25	25	15	15
	Arkon M115	Arakawa Chemical Industries, Ltd.	25	25	25	25	25	25	25	15	15
Peel force at ambient temp. (N/12mm)/mode			30/Jerky	24/FB	35/Jerky	23/POP	31/FB	24/FB	24/FB	not dispersed	not dispersed
Peel force at 80 degrees C (N/12mm)/mode			6.4/POP	8.4/POP	9.8/POP	8.9/POP	11.7/POP	12/POP	12/POP		
Peel force after aging at 80 degrees C (N/12mm)/mode			17/POP	17.5/POP	23/POP	30.5/POP	36/FB	6.0/POP	5.6/POP		
Shear force after aging at 80 degrees C (N/25x25mm)/mode			463/FB	594/FB	661/POP	534/FB	530/FB	-	-		

Table 6

	Reagent	Supplier	Cex. 12	Ex. 27	Ex. 28	Ex. 29
1st monomer	BA	Mitsubishi Chemical Corporation	100	95	90	65
2nd monomer	BzA	Osaka Organic Chemical Industry Ltd.	0	5	10	35
Photopolymerization initiator	Irgacure 651	Ciba Japan	0.24	0.24	0.24	0.24
Closslinker	HDDA	Kyoeisha Chemical Co.,Ltd.	0.1	0.1	0.1	0.1
Block copolymer	D1118K (SBS)	Kraton Polymers	60	60	60	60
Tackifier	Arkon M135	Arakawa Chemical Industries, Ltd.	25	25	25	25
	Arkon M115	Arakawa Chemical Industries, Ltd.	25	25	25	25
Additive	892LS	Nippon Paper Chemicals CO., LTD.	5	5	5	5
Peel force at ambient temp. (N/12mm)/mode			1.9/POP	18.0/POP	23.0/POP	24/FB
Peel force at 80 degrees C (N/12mm)/mode			1.4/POP	5.0/POP	7.9/POP	7.2/POP
Peel force after aging at 80 degrees C (N/12mm)/mode			-	26/FB	26/FB	26/FB
Shear force after aging at 80 degrees C（N/25x25mm)/mode			-	447/FB	516/FB	617/FB

Table 7

	Reagent	Supplier	Ex. 30	Ex. 31	Ex. 32	Ex. 33	Ex. 34
1st monomer	BA	Mitsubishi Chemical Corporation	90	90	90	90	94
2nd monomer	DMAA	KOHJIN Co., Ltd.	10			8	4
	AcMO	KOHJIN Co., Ltd.		10			
	NVP	Wako Pure Chemical Industries, Ltd.			10		
	DMAEA	KOHJIN Co., Ltd.				2	2
	AA	Mitsubishi Chemical Corporation	1.25	1.25	1.25	1.25	1.25
Photopolymerization initiator	Irgacure 651	Ciba Japan	0.24	0.24	0.24	0.24	0.24
Closslinker	HDDA	Kyoeisha Chemical Co.,Ltd.	0.1	0.1	0.1	0.1	0.1
Block copolymer	D1118K (SBS)	Kraton Polymers	60	60	60	60	60
Tackifier	Arkon M135	Arakawa Chemical Industries, Ltd.	25	25	25	25	25
	Arkon M115	Arakawa Chemical Industries, Ltd.	25	25	25	25	25
Additive	892LS	Nippon Paper Chemicals CO., LTD.	5	5	5	5	
Peel force at ambient temp. (N/12mm)/mode			29/FB	28/FB	28/FB	24/FB	24/FB
Peel force at 80 degrees C (N/12mm)/mode			9.2/POP	10.1/POP	8.3/POP	11.0/POP	7/POP
Peel force after aging at 80 degrees C (N/12mm)/mode			26/FB	26/FB	26/FB	26/FB	26/FB
Shear force after aging at 80 degrees C（N/25x25mm)/mode			728/FB	426/FB	466/FB	831/FB	821/FB

Table 8

	Reagent	Supplier	Ex. 35	Ex. 36	Ex. 37	Ex. 38	Ex. 39	Ex. 40	Ex. 41	Ex. 42
1st monomer	BA	Mitsubishi Chemical Corporation	65.5	65.5	65.5	65.5	65.5	65.5	65.5	65.5
2nd monomer	BzA	Osaka Organic Chemical Industry LTD.	30	30	30	30	30	30	30	30
	AA	Mitsubishi Chemical Corporation	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Photopolymerization initiator	Irgacure 651	Ciba Japan	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Closslinker	HDDA	Kyoeisha Chemical Co.,Ltd.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Block copolymer	D1118K, Sty 31% (SBS)	Kraton Polymers	60							
	D-KX415, Sty 35% (SB)	Kraton Polymers		60						
	D1102, Sty 30% (SBS)	Kraton Polymers			60					
	Asaprene(R) T-438, Sty 35% (SBS)	Asahi Kasei Chemicals Co.				60				
	Tafprene(R) 126, Sty 40% (SBS)	Asahi Kasei Chemicals Co.					60	50		
	Vector(R) 8508, Sty 29% (SBS)	Dexco Polymers LP							60	
	Vector(R) 4421, Sty 30% (SIS)	Dexco Polymers LP								60
	LBR-307 (BR, Mn=8xE3)	KURARAY CO., LTD.						10		
Tackifier	Arkon M135	Arakawa Chemical Industries, Ltd.	25	25	25	25	25	30	25	25
	Arkon M115	Arakawa Chemical Industries, Ltd.	25	25	25	25	25	30	25	25
Additive	892LS	Nippon Paper Chemicals CO., LTD.						5		
Peel force at ambient temp. (N/12mm)/mode			24/FB	23/Jerky	22.5/Jerky	22.0/Jerky	13/Jerky	27/POP	22.0/Jerky	21.0/Jerky
Peel force at 80 degrees C (N/12mm)/mode			9.0/POP	12.2/POP	12.5/POP	12.5/POP	10.2/POP	9.5/POP	10.8/POP	1.1/POP
Peel force after aging at 80 degrees C (N/12mm)/mode			18/POP	14/POP	25/POP	14/POP	14/POP	33/Jerky	25/POP	-
Shear force after aging at 80 degrees C（N/25x25mm)/mode			746/FB	661/FB	627/FB	785/FB	472/POP	470/POP	576/FB, POP	-

Table 9

Reagent	Supplier	Ex. 43	Cex. 13	Cex. 14
BA	Mitsubishi Chemical Corporation	65.5	65.5	
BzA	Osaka Organic Chemical Industry LTD.	30	30	100
AA	Mitsubishi Chemical Corporation	4.5	4.5	
Irgacure 651	Ciba Japan	0.24	5.8	5.8
HDDA	Kyoeisha Chemical Co.,Ltd.	0.1	0.1	
D1118K (SBS)	Kraton Polymers	60	60	
D1102, Sty 30% (SBS)	Kraton Polymers			50
Arkon M135	Arakawa Chemical Industries, Ltd.	25	25	
Arkon M115	Arakawa Chemical Industries, Ltd.	25	25	
Viscoat#300(pentaerythritol triacrylate)	Osaka Organic Chemical Industry LTD.			2
Irganox(R) 1010(Antioxidant)	Ciba Japan			0.25
Rikaester 8LJA(Glycerol ester of gum rosin)	Rika Fine-Tech Inc.			60
892LS	Nippon Paper Chemicals CO., LTD.	5		
Peel force at ambient temp. (N/12mm)/mode		24/FB	27.5/POP	30/Jerky
Peel force at 80 degrees C (N/12mm)/mode		9.0/POP	1.4/POP	2.3/POP
Peel force after aging at 80 degrees C (N/12mm)/mode		18/POP	-	-
Shear force after aging at 80 degrees C（N/25x25mm)/mode		746/FB	-	-

Table 10

	Reagent	Supplier	Cex. 15	Ex. 44	Ex. 45	Ex. 46	Ex. 47	Ex. 48	Cex. 16	Ex. 53
1st monomer	2EHA	Nippon shokubai co.,ltd.	81						71.11	41
	BA	Mitsubishi chemical co., ltd		81	81	81	81	71.11		32
2nd monomer	DMAA	Kohjin co., ltd.	16	16	16	16	16	27.65	27.65	24
	DMAEA	Kohjin co., ltd.	2	2	2	2	2			2
	AA	Toagosei co., ltd.	1	1	1	1	1	1.23	1.23	1
Photopolymerization initiator	Irgacure 651	Ciba Japan	0.18	0.18	0.18	0.18	0.18	0.178	0.237	0.3
Crosslinker	HDDA	Kyoeisha chemical co., ltd.	0.06	0.06	0.06	0.06	0.06	0.059	0.059	0.06
Block copolymer	D1118K (SBS)	Kraton Japan	40	40						
	D1119 (SIS)	Kraton Japan			40					20
	D1124 (SIS)	Kraton Japan				40				
	Q3460 (SIS)	Zeon Corporation					40	39.51	39.51	
	G1726 (SEBS)	Kraton Japan					40	39.51	39.51	20
Tackifier	Arkon M135	Arakawa chemical industries ltd.	20	20						
	Arkon M115	Arakawa chemical industries ltd.	20	20						
	Arkon P125	Arakawa chemical industries ltd.			40	40	40	39.51	39.51	
Additives	892LS	Nippon paper chemicals	5	5				4.94	4.94	40
Peel force on PP at ambient temp. (N/12mm)		force	17	24	24	25	25	28	26.3	25
		mode	POP	FB	FB	FB	FB	FB	POP	FB
Peel force on PP at 80 degrees C (N/12mm)		force	0.8	10.5	6.4	11.5	8.3	10.5	0.7	6.5
		mode	POP	POP	POP	POP	POP	POP	POP	POP

Table 11

	Reagent	Supplier	Ex. 49	Ex. 50	Ex. 51	Ex. 52
1st monomer	2EHA	Nippon shokubai co.,ltd.	31	31	31	70.12
	BA	Mitsubishi chemical co., ltd	50	46	42	
2nd monomer	DMAA	Kohjin co., ltd.	16	20	24	26.67
	DMAEA	Kohjin co., ltd.	2	2	2	1.98
	AA	Toagosei co., ltd.	1	1	1	1.23
Photopolymerization initiator	Irgacure 651	Ciba Japan	0.18	0.18	0.18	0.178
Crosslinker	HDDA	Kyoeisha chemical co., ltd.	0.06	0.06	0.06	0.059
Block copolymer	D1118K (SBS)	Kraton Japan	40	40	40	39.51
Tackifier	Arkon M135	Arakawa chemical industries ltd.	15	20	20	19.75
	Arkon M115	Arakawa chemical industries ltd.	25	20	20	19.75
Additives	892LS	Nippon paper chemicals	5	5	5	4.94
Peel force on PP at ambient temp. (N/12mm)		force	26	25	25	28
		mode	FB	FB	FB	FB
Peel force on PP at 80 degrees C (N/12mm)		force	11	12	13.5	10.5
		mode	POP	POP	POP	POP

Table12

	Reagent	Supplier	Ex. 54	Ex. 55
1st monomer	2EHA	Nippon shokubai co.,ltd.	81	81
2nd monomer	Viscoat #190	Osaka organic chemical industry ltd.	15	
	Viscoat #158	Osaka organic chemical industry ltd.		15
	DMAA	Kohjin co., ltd.	16	16
	DMAEA	Kohjin co., ltd.	2	2
	AA	Toagosei co., ltd.	1	1
Photopolymerization initiator	Irgacure 651	Ciba Japan	0.18	0.18
Crosslinker	HDDA	Kyoeisha chemical co., ltd.	0.06	0.06
Block copolymer	D1118K (SBS)	Kraton Japan	40	40
Tackifier	Arkon M135	Arakawa chemical industries ltd.	20	20
	Arkon M115	Arakawa chemical industries ltd.	20	20
Additives	Superchlon 892LS	Nippon paper chemicals	5	5
Peel force on PP at ambient temp. (N/12mm)		force	32	27
		mode	FB	POP
Peel force on PP at 80 degrees C (N/12mm)		force	13.0	13.0
		mode	POP	POP

Table 13

		Adherend					
		Birch	PMMA	ABS	PC	PP	SUS
Ex. 49	N=1	2 days	1 day	5 days	5 days	> 7 days	> 7 days
DMA 16%	N=2	4 days	1 day	6 days	> 7 days	> 7 days	> 7 days
Ex. 50	N=1	> 7 days	2 days	> 7 days	5 days	> 7 days	> 7 days
DMA 20%	N=2	> 7 days	3 days	> 7 days	> 7 days	> 7 days	> 7 days
Ex. 51	N=1	> 7 days	> 7 days	> 7 days	> 7 days	> 7 days	> 7 days
DMA 24%	N=2	> 7 days	> 7 days	> 7 days	> 7 days	> 7 days	> 7 days
Ex. 52	N=1	> 7 days	> 7 days	> 7 days	> 7 days	> 7 days	> 7 days
DMA 27%	N=2	> 7 days	> 7 days	> 7 days	> 7 days	> 7 days	> 7 days

Claims:

1. A pressure sensitive adhesive obtained by polymerizing a mixture containing:

1) 100 mass parts of (meth)acrylic monomer comprising

98-50 mass parts of a first monomer selected from an aliphatic (meth)alkyl acrylate having a carbon number of 4-6 and an aliphatic (meth)alkyl acrylate having a carbon number of 7-12, wherein the glass transition temperature of a homo-polymer thereof is -25 degrees C or less; and

2-50 mass parts of a second monomer comprising one or more selected from the group consisting of:

an amide group-containing ethylenic unsaturated copolymerizing monomer,

a carboxylic group-containing ethylenic unsaturated copolymerizing monomer,

an amino group-containing ethylenic unsaturated copolymerizing monomer,

a non-tertial alkyl(meth)acrylate wherein the glass transition temperature of a homo-polymer thereof is -25 degrees C or more, and

a monomer represented by the chemical structural formula (I) $CH_2=CR^1COO(R_2O)nR^3$ or $CH_2=CR^1COOR^4R^5$ (R^1=methyl or H; R^2 and R^4 = linear or branched alkyl having a carbon number of 1-6; R^3 =methyl, ethyl, or substituted or non-substituted phenyl; R^5=substituted or non-substituted 4-membered or 5-membered ring containing oxygen; n=1-16);

2) 10-100 mass parts of a block copolymer;

3) 20-100 mass parts of hydrogenated tackifier; and

4) 0.05-1.0 mass parts of a photopolymerization initiator.

2. The pressure sensitive adhesive according to claim 2, comprising 98-60 mass parts of the first monomer and 2-40 mass part of the second monomer.

3. The pressure sensitive adhesive according to claim 2, wherein the first monomer is an aliphatic (meth)alkyl acrylate having a carbon number of 4-6 and the second monomer is one selected from an amide group-containing ethylenic unsaturated

copolymerizing monomer, a carboxylic group-containing ethylenic unsaturated copolymerizing monomer and non-tertial alkyl(meth)acrylate wherein the glass transition temperature of a homo-polymer thereof is -25 degrees C or more.

4. The pressure sensitive adhesive according to claim 2, wherein the first monomer is an aliphatic (meth)alkyl acrylate having a carbon number of 7-12 and the second monomer is an amide group-containing ethylenic unsaturated copolymerizing monomer.

5. The pressure sensitive adhesive according to claim 2, wherein the second monomer is an amide group-containing ethylenic unsaturated copolymerizing monomer and a carboxylic group-containing ethylenic unsaturated copolymerizing monomer, or a carboxylic group-containing ethylenic unsaturated copolymerizing monomer and non-tertial alkyl(meth)acrylate wherein the glass transition temperature of a homo-polymer of the non-tertial alkyl(meth)acrylate is -25 degrees C or more.

6. The pressure sensitive adhesive according to claim 1, wherein the first monomer is n-butyl acrylate.

7. The pressure sensitive adhesive according to claim 1, wherein the first monomer is 2-ethylhexyl acrylate.

8. The pressure sensitive adhesive according to claim 1, wherein the block copolymer is selected from the group consisting of styrene-butadiene-styrene block copolymer, styrene-butadiene block copolymer, styrene-butadiene/butylene-styrene block copolymer, styrene-ethylene/butylene-styrene block copolymer, styrene ethylene/propylene-styrene block copolymer and styrene-ethylene/propylene block copolymer.

9. The pressure sensitive adhesive according to claim 8, wherein the first monomer is an aliphatic (meth)alkyl acrylate having a carbon number of 4-6.

10. The pressure sensitive adhesive according to claim 9, wherein the aliphatic (meth)alkyl acrylate having a carbon number of 4-6 is n-butyl acrylate.

11. The pressure sensitive adhesive according to claim 10 further comprising an aliphatic (meth)alkyl acrylate having a carbon number of 7-12.

12. The pressure sensitive adhesive according to claim 11, wherein the aliphatic (meth)alkyl acrylate having a carbon number of 7-12 is 2-ethylhexyl acrylate.

13. The pressure sensitive adhesive according to claim 1, wherein the first monomer is an aliphatic (meth)alkyl acrylate having a carbon number of 7-12 and the second monomer comprises is 25 mass parts to 50 mass parts of amide group-containing ethylenic unsaturated copolymerizing monomer.

14. The pressure sensitive adhesive according to claim 13, wherein the aliphatic (meth)alkyl acrylate having a carbon number of 7-12 is 2-ethylhexyl acrylate and the amide group-containing ethylenic unsaturated copolymerizing monomer is N,N-dimethyl acrylamide.

15. The pressure sensitive adhesive according to claim 1, wherein the block copolymer comprises styrene-isoprene-styrene block copolymer.

16. The pressure sensitive adhesive according to claim 15, wherein the first monomer comprises an aliphatic (meth)alkyl acrylate having a carbon number of 4-6.

17. The pressure sensitive adhesive according to claim 16, wherein the aliphatic (meth)alkyl acrylate having a carbon number of 4-6 is n-butyl acrylate.

18. A pressure sensitive adhesive tape comprising a substrate layer and a pressure sensitive adhesive layer comprising the pressure sensitive adhesive according to claim 1.

19. The pressure sensitive adhesive tape according to claim 18, wherein the substrate layer comprises an acrylic foam sheet.

20. A pressure sensitive adhesive substantially as hereinbefore described with reference to the non-comparative examples.