[Description]

[Title of Invention]

Pressure-Sensitive Adhesive Sheet and Release-Lined Pressure-Sensitive Adhesive Sheet

[Technical Field]

[0001]

The present invention relates to a pressure-sensitive adhesive sheet and a release-lined pressure-sensitive adhesive sheet.

[Background Art]

[0002]

In general, pressure-sensitive adhesive (PSA) exists as a soft solid (a viscoelastic material) in a room temperature range and has a property to adhere easily to an adherend with some pressure applied. For such a property, PSA is widely used in a form of, for instance, an on-substrate PSA sheet having a PSA layer on a support substrate, for purposes such as bonding, fastening, protection and sealing in various applications including electronic devices. For instance, technical literatures related to PSA sheets that air-tightly seal internal spaces of magnetic disc devices include Patent Document 1.

[Citation List]

[Patent Literature]

[0003]

[Patent Document 1] Japanese Patent No. 6453799

[Summary of Invention]

[Technical Problem]

[0004]

The PSA sheet according to Patent Document 1 has a non-air-permeable substrate having an aluminum layer and shows excellent gas-blocking properties. Having the aluminum layer, even when bent along an adherend shape, the PSA sheet conforms well to the adherend shape without rebounding and readily maintains the highly tight adhesion to the adherend. Thus, for instance, when bent and applied to the upper and side surfaces of a magnetic disc device housing, it can air-tightly seal the internal space containing a magnetic disc such has a hard disc (HD) and has been preferably used in such applications.

[0005]

With respect to the thus-structured PSA sheet, however, when applied to a weld in a magnetic disc device and a surface having dents such as craters formed during magnetic disc device manufacturing, the aluminum layer of the PSA sheet may conform to the weld contours and the dents,

causing them to appear on the PSA sheet backside. The surface gloss of the aluminum layer may make the PSA sheet backside contours noticeable with reflection of light, degrading the appearance of a product having the PSA sheet applied thereon. Especially, during device assembly, adherend edges (e.g., corners of a housing of magnetic disc device) are more susceptible to dents upon contact with hard materials such as other parts, etc. As for the PSA sheet applied to cover adherend edges, with the great conformability including flexibility, it will adapt to adherend dents so well that shapes of adherend surface dents and like are likely to appear on the backside. Even when applied to a contoured adherend without impairing the properties required for certain applications such as air-tightness in the cover sealing application for magnetic disc devices, it is beneficial to provide a PSA sheet less susceptible to recognition of the adherend surface shape on its backside and capable of providing a good external appearance.

[0006]

The present invention has been made in view of these circumstances with an objective to provide a PSA sheet that even when applied to an adherend having a contoured surface, the surface structure of the adherend is less visible. Another objective of this invention is to provide a release-lined PSA sheet having the PSA sheet.

[Solution to Problem]

[0007]

The present description provides a PSA sheet comprising a PSA layer and a substrate supporting the PSA layer. The PSA sheet has an adhesive face formed of the PSA layer and a backside opposite to the adhesive face (i.e., the reverse side of the adhesive face). The backside of the PSA sheet has a gloss of 80 GU or lower and the PSA sheet has a total light transmittance of 75 % or lower. According to such an embodiment, even when the PSA sheet is applied to a contoured surface and the contours appear on the PSA sheet backside due to the conformability of the PSA sheet, because the gloss of the PSA sheet backside is 80 GU or lower, reflection of light on the PSA sheet backside is reduced, making the contours originating from the adherend less noticeable on the PSA sheet backside. In addition, because the total light transmittance of the PSA sheet is 75 % or lower, the PSA sheet has concealing properties and the contour pattern on the adherend becomes less visible through the PSA sheet regardless of whether or not the PSA sheet applied to the contoured surface conforms to the adherend surface shape. In summary, according to the PSA sheet having a backside gloss of 80 GU or lower and a total light transmittance of 75 % or lower, even when applied to a contoured adherend surface, it is possible to achieve adhesion where the adherend surface shape is less visible. According to such a PSA sheet, adherend surface contours are less visible; and even when contours based on the

adherend shape appear on the PSA sheet backside, they are so unnoticeable that they cannot be visually recognized. Thus, for instance, even when weld marks and dents are present on the adherend surface, they can be concealed to provide a good external appearance to the product having the PSA sheet applied thereon.

[0008]

In some preferable embodiments, the backside of the PSA sheet has an arithmetic average roughness in the range of 50 nm or greater and 3000 nm or less. With the arithmetic average roughness being 50 nm or greater, reflection of light on the backside is likely to be reduced and the contours on the backside is less noticeable. With the arithmetic average roughness being 3000 nm or less, the backside has good surface conditions. For instance, in an embodiment where the PSA sheet is printed on the backside, it tends to be highly printable, allowing easy recognition of printed letters.

[0009]

In some preferable embodiments, the backside of the PSA sheet has a haze value of 70 % or higher. A PSA sheet backside haze value of 70 % or higher tends to enhance the concealment of the adherend surface shape.

[0010]

In some preferable embodiments, the PSA sheet has a gas emission of 1.0 $\mu g/cm^2$ or less, determined at 130 °C for 30 minutes by gas chromatography/mass spectrometry (GC-MS). The PSA sheet having a gas emission of 1.0 $\mu g/cm^2$ or less as described above can be preferably used in applications such as precision instruments where gas emissions are not desired. For instance, the PSA sheet satisfying this property is suitable for an application to seal the internal space of a magnetic disc device in which a volatile gas such as siloxane gas can cause damage and malfunction.

[0011]

In some preferable embodiments, the PSA sheet has a siloxane gas emission of 0.1 $\mu g/cm^2$ or less, determined at 130 °C for 30 minutes by gas chromatography/mass spectrometry (GC-MS). The PSA sheet having a siloxane gas emission of 0.1 $\mu g/cm^2$ or less as described above can be preferably used in an application where the presence of siloxane gas is not desired. For instance, the PSA sheet satisfying this property is suitable for an application to seal the internal space of a magnetic disc device in which siloxane gas can cause damage and malfunction.

[0012]

In some embodiments, the substrate is formed of a single resin layer (a resin monolayer). According to the art disclosed herein, in form with a substrate having a resin monolayer structure, the PSA sheet backside can have a gloss of 80 GU or lower and the PSA sheet can have a total light

transmittance of 75 % or lower to obtain desirable effects.

[0013]

In the embodiment of the substrate formed of a resin monolayer, the substrate preferably has a total light transmittance of 20 % or lower. The substrate having 20 % or lower total light transmittance can reduce the total light transmittance of the PSA sheet as a whole and help conceal adherend surface contours.

[0014]

In the embodiment of the substrate formed of a resin monolayer, the PSA layer preferably has a total light transmittance of 20 % or lower. The PSA layer having 20 % or lower total light transmittance can also reduce the total light transmittance of the PSA sheet as a whole and help conceal adherend surface contours.

[0015]

The substrate may have a thickness of 20 μm or greater and 200 μm or less. When the substrate's thickness is 20 μm or greater, with the rigidity of the substrate, the PSA sheet can cover a contoured adherend surface while maintaining its flat backside and prevent contours on such an adherend surface from appearing on the PSA sheet backside. In an embodiment where the substrate's total light transmittance is limited, the low light transmission of the substrate can help obtain good concealment. With the substrate's thickness being 200 μm or less, the PSA sheet having the substrate conforms well to adherend shapes. For instance, even in an application where the PSA sheet is bent to cover two faces of an adherend, lifting and peeling are unlikely to occur. The substrate thickness above can be preferably employed in the embodiment of the substrate formed of a resin monolayer.

[0016]

In other embodiments, the substrate has one, two or more resin layers as well as a metal layer. According to the art disclosed herein, in form with a substrate having resin layers and a metal layer, the PSA sheet backside can have a gloss of 80 GU or lower and the PSA sheet can have a total light transmittance of 75 % or lower to obtain desirable effects. The embodiment having a metal layer helps obtain excellent gas-blocking properties; and even in an application where it is bent along the adherend shape, it helps maintain tight adhesion to the adherend. As used herein, the gas-blocking properties refer to abilities to block permeation of various gases and water (moisture), including moisture resistance.

[0017]

The metal layer preferably has a thickness of 2 μm or greater and 30 μm or less. When the metal layer's thickness is in this range, the adherend can be concealed. With respect to the PSA sheet having a metal layer of such a thickness, because the metal layer has the prescribed thickness, it has

suitably-limited conformability to contoured adherend surface and can prevent contours on such an adherend surface from appearing on the PSA sheet backside.

[0018]

The resin layer preferably has a thickness of 20 μm or greater and 200 μm or less. When the resin layer's thickness is 20 μm or greater, with the rigidity of the resin layer, the PSA sheet can cover a contoured adherend surface while maintaining its flat backside and prevent contours on such an adherend surface from appearing on the PSA sheet backside. With the resin layer's thickness being 200 μm or less, the PSA sheet having the resin layer conforms well to adherend shapes. For instance, even in an application where the PSA sheet is bent to cover two faces of an adherend, lifting and peeling are unlikely to occur. For two or more resin layers, the resin layer's thickness refers to the combined thickness of the two or more resin layers.

[0019]

The substrate has, as the resin layers, resin layers A and B placed to have the metal layer therebetween, wherein the resin layer A is placed on the side of the PSA sheet backside. The art disclosed herein is preferably implemented in an embodiment having a resin layer A, a metal layer and a resin layer B in this order. According to such an embodiment, it has excellent gas-blocking properties with the metal layer; and with the resin layers enclosing the metal layer, for instance, even when the metal layer (e.g., an aluminum layer) is thin, the metal layer can be effectively protected from bending, creasing, breaking, etc.

[0020]

This Description also provides a PSA sheet having a release liner (a release-lined PSA sheet). The release-lined PSA sheet has a PSA sheet disclosed herein, and a polyolefinic release liner protecting the adhesive face of the PSA sheet. Before used, the PSA sheet is stored with the adhesive face protected with the polyolefinic release liner. When used, it can be smoothly removed from the polyolefinic release liner.

[0021]

According to the PSA sheet disclosed herein, even when applied to a contoured adherend surface, it is possible to achieve adhesion where the adherend surface shape is less visible so as to provide a good external appearance to a product having the PSA sheet applied thereon. When applied to at least one face of the outer surface of a magnetic disc device such as a hard disc drive (HDD), even if the magnetic disc device has contours such as weld marks and dents, the PSA sheet can invisibly cover and hide the contours and provide a good external appearance to the magnetic disc device.

[0022]

The PSA sheet may have a size (sheet size) equivalent to at least 20 % up to 150 % of area of at least one face (adherend face) of the outer surface of the magnetic disc device housing. The PSA sheet in such a size can conceal only part of the adherend face or can provide coverage to conceal the entire adherend face. Furthermore, the PSA sheet can cover not only the one adherend face, but also an adjacent face. With respect to the PSA sheet applied in such an embodiment, even when a dent is formed on a corner of the outer housing surface, it can be applied over two faces including the corner; and therefore, it is possible to have concealment that makes the corner dent invisible. Such a PSA sheet applied over at least two faces can have a size larger than one of the adherend faces or a size smaller than the one face. For instance, it may be applied to the top cover's outer circumference in a magnetic disc device such as a hard disc drive. The PSA sheet used in such an application can cover adherend edges (e.g., corners of a magnetic disc device housing) susceptible to dents so as to conceal the adherend surface shape having the dents and provide a good external appearance.

[Brief Description of Drawings]

[0023]

Fig. 1 shows a cross-sectional diagram schematically illustrating a structural example of the PSA sheet.

Fig. 2 shows a cross-sectional diagram schematically illustrating another structural example of the PSA sheet.

Fig. 3 shows a cross-sectional diagram schematically illustrating a structural example of a magnetic disc device.

Fig. 4 shows a top view schematically illustrating the shape of the PSA sheet before applied to the magnetic disc device shown in Fig. 3.

Fig. 5 shows a schematic cross-sectional diagram illustrating a partial cross section of another structural example of the magnetic disc device.

Fig. 6 shows a schematic cross-sectional diagram illustrating a partial cross section of yet another structural example of the magnetic disc device.

[Description of Embodiments]

[0024]

Preferable embodiments of the present invention are described below. Matters necessary to practice this invention other than those specifically referred to in this description can be understood by a person skilled in the art based on the disclosure about implementing the invention in this description and common technical knowledge at the time the application was filed. The present invention can be practiced based on the contents disclosed in this description and common technical knowledge in the

subject field. In the drawings referenced below, a common reference numeral may be assigned to members or sites producing the same effects, and redundant descriptions are sometimes omitted or simplified. The embodiments described in the drawings are schematized for clear illustration of the present invention, and do not necessarily represent the accurate size or reduction scale of an actual product.

[0025]

As used herein, the term "PSA" refers to, as described earlier, a material that exists as a soft solid (a viscoelastic material) in a room temperature range and has a property to adhere easily to an adherend with some pressure applied. As defined in "Adhesion: Fundamental and Practice" by C. A. Dahlquist (McLaren & Sons (1966), P. 143), in general, PSA referred to herein can be a material that has a property satisfying complex tensile modulus E^* (1Hz) < 10^7 dyne/cm^2 (typically, a material that exhibits the described characteristics at 25 °C).

The concept of PSA sheet herein may encompass so-called PSA tape, PSA labels, PSA film, etc. The PSA sheet disclosed herein can be in a roll or in a flat sheet. Alternatively, the PSA sheet may be processed into various shapes.

[0026]

<Constitution of PSA sheet>

The PSA sheet disclosed herein can be, for instance, an adhesively single-faced PSA sheet having a cross-sectional structure as shown in Fig. 1. A PSA sheet 1 comprises a substrate 10 and a PSA layer 20 supported on a first face of substrate 10. PSA layer 20 constitutes an adhesive face 1A of PSA sheet 1. Substrate 10 is a layered body (laminate film) in which a resin layer A12, an inorganic layer 14 and a resin layer B16 are layered in this order. Resin layer A12 placed on the first face side of inorganic layer 14 forms the backside 1B (reverse side of adhesive face 1A) of PSA sheet 1. Resin layer B16 is placed on the second face side of inorganic layer 14, that is, the PSA layer 20 side. In other words, in substrate 10, resin layers A12 and B16 are arranged with inorganic layer 14 therebetween. In this embodiment, inorganic layer 14 is a metal layer. PSA sheet 1 prior to use (before applied to the adherend) may be in form of a release-lined PSA sheet 51 protected with a release liner 30 having a release face at least on the PSA layer 20 side surface.

[0027]

The PSA sheet may also have a cross-sectional structure as shown in Fig. 2. In having a substrate 10 and a PSA layer 20 supported on a first face of substrate 10, PSA sheet 2 has the same structure as the one shown in Fig. 1. However, with substrate 10 formed of a resin layer 12, it is different from the structure show in Fig. 1. PSA layer 20 forms an adhesive face 2A of PSA sheet 2. Resin layer

12 forms a backside 2B of PSA sheet 2. PSA sheet 2 prior to use (before applied to an adherend) may be in form of a release-lined PSA sheet 52 protected with release liner 30 having a release face at least on the PSA layer 20 side surface.

[0028]

It is noted that the substrate in the PSA sheet shown in Fig. 1 has a resin layer A, inorganic layer and resin layer B, but is not limited to this. The number of resin layers can be one as the structure shown in Fig. 2; or two, three or more. For instance, the substrate can be a laminate body of a single resin layer and an inorganic layer. In the laminate body, the resin layer is preferably placed on the side of the PSA sheet backside.

[0029]

The substrate backside may have an additional layer, for instance, on the backside of the resin layer. Such an additional layer forms the PSA sheet backside and it can be, for instance, a layer called a top coat layer or print layer. Between the respective layers forming the substrate, it may also have a bonding layer to bond the respective layers or a undercoat layer (or primer layer) to enhance the tightness of adhesion between the respective layers. Between the substrate and the PSA layer, it may further have a primer layer to enhance the tightness of adhesion between the two.

[0030]

<Properties of PSA sheet>

The PSA sheet disclosed herein is characterized by having a backside gloss (60° gloss) of 80 GU or lower. According to the PSA sheet satisfying this property, even when the PSA sheet is applied to a contoured surface with the contours appearing on the PSA sheet backside due to the conformability of the PSA sheet, because reflection of light is reduced on the PSA sheet backside, the contours originating from the adherend is less noticeable on the PSA sheet backside. In addition, with the PSA sheet backside having a gloss limited up to the prescribed value, for instance, when the PSA sheet backside is printed, it tends to be highly printable, allowing easy recognition of printed letters. In some preferable embodiments, the PSA sheet backside has a gloss of 60 GU or lower, possibly 50 GU or lower, 40 GU or lower, 30 GU or lower, 20 GU or lower, or even 15 GU or lower. The minimum gloss of the PSA sheet backside is 0 GU. For instance, from the standpoint of the balance with the exterior where the PSA sheet is applied, etc., it can be 1 GU or higher, 5 GU or higher, 12 GU or higher, 25 GU or higher, 35 GU or higher, or even 45 GU or higher. The gloss of the PSA sheet backside can be adjusted by, for instance, a selection of substrate material, a method for forming the substrate (typically a resin layer), placement of a backside layer (e.g., a lusterless layer including organic or inorganic particles), surface treatment (or mattifying treatment) such as roller embossing and sandblasting to the PSA sheet backside, etc. The

gloss (60° gloss) of the PSA sheet backside is determined by the method described later in Examples.

[0031]

The PSA sheet disclosed herein is also characterized by having a total light transmittance of 75 % or lower. The PSA sheet satisfying this property has concealing properties. When the PSA sheet is applied to a contoured surface, regardless of whether or not it conforms to the adherend surface shape, the contoured pattern on the adherend is less likely to be visible through the PSA sheet. The total light transmittance of the PSA sheet is preferably 60 % or lower, more preferably 40 % or lower, or yet more preferably 20 % or lower. In some preferable embodiments, the total light transmittance of the PSA sheet is 10 % or lower. From the standpoint of enhancing the adherend concealment, it can be 3 % or lower, below 1 %, or even below 0.1 %. The minimum total light transmittance of the PSA sheet is not particularly limited. It can be practically 0 %, that is, below detection limit; or it can be 0.01 % or higher, for instance, 0.1 % or higher, or also 1.0 % or higher. In some embodiments, the total light transmittance of the PSA sheet can be 5 % or higher, 9 % or higher, or even 12 % or higher (e.g., 15 % or higher). The total light transmittance of the PSA sheet can be adjusted by a selection of substrate material, a PSA layer component (e.g., colorant, etc.), lamination of a colored layer, etc. The total light transmittance of the PSA sheet is determined by the method described later in Examples.

[0032]

The haze value of the PSA sheet disclosed herein is not particularly limited. For instance, it can be 1 % or higher, 10 % or higher, 30 % or higher, or even 50 % or higher. With increasing haze of the PSA sheet, the adherend concealing properties tend to improve. The haze value of the PSA sheet is determined with respect to the PSA sheet backside. In other words, it is the haze value of the PSA sheet backside. In some preferable embodiments, the PSA sheet has a haze value of 70 % or higher, more preferably 80 % or higher, yet more preferably 90 % or higher, possibly 95 % or higher, or even 99 % or higher. The maximum haze value is 100 %. In some embodiments, the haze value can be 99 % or lower, 90 % or lower, or even 85 % or lower. The haze value of the PSA sheet can be adjusted by selections of substrate material and PSA layer components, surface treatment, etc.

[0033]

The “haze value” refers to the ratio of diffused light transmittance to total light transmittance when a measurement sample is irradiated with visible light. It is also called the cloudiness value. The haze value can be expressed by the next equation:

$$Th\ (\%) = Td/Tt \times 100$$

In the equation, Th is the haze value (%), Td is the diffused light transmittance (%), and Tt is the total light transmittance (%). The haze value of a PSA sheet can be determined by the method

described later in Examples.

[0034]

The arithmetic average roughness of the PSA sheet backside is not particularly limited. For instance, it can be 10000 nm or less. In some preferable embodiments, the PSA sheet backside has an arithmetic average roughness of 3000 nm or less, more preferably 1500 nm or less, yet more preferably 1000 nm or less, particularly preferably 800 nm or less, possibly 500 nm or less, or even 300 nm or less. With decreasing arithmetic average roughness, the PSA sheet backside has greater surface conditions. For instance, in an embodiment where the PSA sheet is printed on the backside, it tends to be highly printable, allowing easy recognition of printed letters. The PSA sheet backside has an arithmetic average roughness of, for instance, 10 nm or greater. In some preferable embodiments, the PSA sheet backside has an arithmetic average roughness of 50 nm or greater, more preferably 100 nm or greater, yet more preferably 150 nm or greater, or particularly preferably 200 nm or greater (e.g., 250 nm or greater). With increasing arithmetic average roughness, reflection of light on the backside is more likely to be reduced and the backside contours originating from the adherend surface shape tend to be less noticeable. In other embodiments, the PSA sheet backside can have an arithmetic average roughness of 350 nm or greater, 450 nm or greater, or even 550 nm or greater. The arithmetic average roughness of the PSA sheet backside can be adjusted by a selection of substrate material, method for forming the substrate (typically a resin layer) and surface treatment (roller embossing, sandblasting, etc.) to the PSA sheet backside. The arithmetic average roughness of the PSA sheet backside can be determined by the method described later in Examples.

[0035]

While no particular limitations are imposed, in some embodiments, the PSA sheet has a gas emission of 10 $\mu g/cm^2$ or less, determined at 130 °C for 30 minutes by GC-MS. The PSA sheet with such highly-limited thermal gas release can be preferably used in an application (typically a magnetic disc device) for which the presence of a volatile gas is undesirable. In some preferable embodiments, the gas emission of the PSA sheet is 1.0 $\mu g/cm^2$ or less, more preferably 0.5 $\mu g/cm^2$ or less, or even more preferably less than 0.3 $\mu g/cm^2$. When used as a sealing material to seal the internal space of a magnetic disc device in which a volatile gas such as siloxane gas can cause damage and malfunction, the PSA sheet satisfying this property can highly inhibit internal contamination with siloxane and other gas that badly affect the device. The minimum gas emission is not particularly limited and can be practically 0 $\mu g/cm^2$, that is, at or below detection limit. The gas emission can be determined by the method described later in Examples.

[0036]

While no particular limitations are imposed, in some embodiments, the PSA sheet has a siloxane gas emission of 1 μg/cm^2 or less, determined at 130 °C for 30 minutes by GC-MS. The PSA sheet satisfying this property can be preferably used in an application where the presence of siloxane gas is not desired. For instance, it is particularly suitable as a sealing material to seal the internal space of a magnetic disc device in which siloxane gas can cause damage and malfunction. In some preferable embodiments, the siloxane gas emission of the PSA sheet is 0.1 μg/cm^2 or less, more preferably 10 ng/cm^2 or less, yet more preferably 1 ng/cm^2 or less, or particularly preferably less than 0.4 ng/cm^2. The minimum siloxane gas emission is not particularly limited and can be practically 0 μg/cm^2, that is, at or below detection limit. The siloxane gas emission can be determined by the method described later in Examples.

[0037]

While no particular limitations are imposed, in some embodiments, the PSA sheet shows a moisture permeation of preferably 1 g/(m^2·24h) or less, more preferably 0.1 g/(m^2·24h) or less, or yet more preferably less than 0.01 g/(m^2·24h), determined by the method described below. The moisture permeation of the PSA sheet is determined based on JIS K7129B using a water vapor permeation analyzer PERMATRAN-W3/34G available from MOCON, Inc. In particular, the PSA sheet is placed between a dry chamber at 40 °C/0 %RH and a wet chamber at 40 °C/90 %RH for isolation. The relative humidity change in the dry chamber caused by water vapor allowed to permeate through the PSA sheet is detected by an infrared sensor to determine the water vapor permeation in g/(m^2·24h). In Examples described later, the same method is used for the analysis. The PSA sheet having such a limited moisture permeation can be preferably used as, for instance, a sealing material, in an application where the presence of moisture is not desirable or in an application requiring moisture resistance.

[0038]

While no particular limitations are imposed, in some embodiments, the PSA sheet preferably shows no lifting (i.e., a lifting height of 0 mm) in a flexible bonding test carried out by the following method: To the convex side of an L-shaped adherend made of a stainless steel plate (in particular, a SUS304 plate), a PSA sheet cut in a 10 mm × 40 mm size is applied and press-bonded with a 2 kg roller moved back and forth once so that its length direction vertically intersect the bent portion (bending line) of the L-shaped adherend. The resultant is stored in an oven at 60 °C for 72 hours. Subsequently, the lifting height of each edge of the PSA sheet is evaluated. In Examples described later, the same method is used for the measurement. The PSA sheet that does not lift in the flexible bonding test is likely to retain good bonding conditions less susceptible to lifting and peeling even when used in an application where the PSA sheet is bent to conform to the adherend shape.

[0039]

The total thickness of the PSA sheet disclosed herein is not particularly limited. It is suitably about 6 μm or greater. From the standpoint of the adherend concealment, etc., it is preferably 25 μm or greater, more preferably 40 μm or greater, yet more preferably 60 μm or greater, or particularly preferably 80 μm or greater. With increasing total thickness of the PSA sheet, the adherend-concealing properties tend to be superior. The total thickness is suitably about 1.2 mm or less. From the standpoint of the adherend conformability and of reducing the thickness and weight, it is preferably 200 μm or less, more preferably 150 μm or less, or yet more preferably 120 μm or less. The PSA sheet having such a total thickness tends to have excellent adherend conformability. It is noted that the total thickness of a PSA sheet here refers to the combined thickness of the substrate layer and the PSA layer, not including the thickness of the release liner described later.

[0040]

<Substrate>

The material forming the substrate of the PSA sheet is not particularly limited. As the substrate layer, a suitable species can be selected and used according to the intended purpose of the PSA sheet among, for instance, various resin films (plastic films); foam sheets made of foam such as polyurethane foam, polyethylene foam, and polychloroprene foam; woven fabrics and nonwoven fabrics (meaning to include paper such as Washi and high-grade paper) of a single species or a blend, etc., of various species of fibrous substances (which can be natural fibers such as hemp and cotton; synthetic fibers such as polyester and vinylon; and semi-synthetic fibers such as acetate); metal foil such as aluminum foil and copper foil; and composites of these.

[0041]

(Resin layer)

The substrate preferably includes a resin layer. In the resin layer, the backside gloss and total light transmittance are easily adjusted by a formation method, colorant addition, surface treatment, colored layer lamination, etc. A substrate having a resin layer helps obtain a PSA sheet having prescribed gloss and total light transmittance. By placing the resin layer, with the resin layer's rigidity, the PSA sheet can cover a contoured adherend surface while maintaining its flat backside and tends to help prevent contours on such an adherend surface from appearing on the PSA sheet backside. In some embodiments, the substrate can be formed of a resin layer. As the substrate, for instance, a substrate formed from a resin monolayer can be used. In other embodiments, the substrate can be a laminate body having a resin layer and an inorganic layer (favorably a metal layer). According to such an embodiment, the resin layer may serve as a protection layer to prevent the inorganic layer from getting damaged by

bending deformation and friction. In this embodiment, the resin layer is placed on the backside of the PSA sheet relative to the inorganic layer. Thus, the substrate including the resin layer in addition to the inorganic layer is preferable from the standpoint of the endurance and reliability of substrate properties such as gas-blocking properties and also from the standpoint of the ease of handling the substrate or the PSA sheet. By placing the resin layer on the PSA layer side surface of the substrate, the anchoring of the PSA layer can be enhanced. When the inorganic layer is formed by vapor deposition, spattering or like method, the resin layer can be used as the base for forming the inorganic layer.

[0042]

The structure of the resin layer is not particularly limited. For instance, the resin layer may include a void space as in fiber assemblies such as woven fabrics and non-woven fabrics or as in foam bodies such as polyethylene foam; or it can be a resin layer (resin film) essentially free of a void space. From the standpoint of reducing the thickness of the PSA sheet, it is preferable use a resin layer essentially free of a void space. As a favorable example of the resin layer, resin film (possibly plastic film) can be preferably used. The resin film here is typically a non-porous resin sheet and should be conceptually distinguished from, for instance, non-woven and woven fabrics (i.e. the concept excludes non-woven and woven fabrics). The resin film may be any of unstretched film, uniaxially stretched film and biaxially stretched film.

[0043]

As the resin material forming the resin layer, it is possible to use, for instance, polyester resins such as polyethylene terephthalate (PET), polybutylene terephthalate (PBT) and polyethylene naphthalate (PEN); polyolefin resins such as polyethylene (PE) and polypropylene (PP); polyimide (PI); polyetheretherketone (PEEK); chlorine-containing polymers such as polyvinyl chloride (PVC) and polyvinylidene chloride; polyamide-based resins such as nylon and aramid; polyurethane resin; polystyrene-based resin; acrylic resins; fluororesins; cellulose-based resins; and polycarbonate-based resins. Of these, solely one species or a combination of two or more species can be used. When two or more species of resin are used together, these resins can be used blended or separately. Both thermoplastic resins and thermosetting resins can be used. From the standpoint of the film formation, etc., a thermoplastic resin is preferably used.

[0044]

In some embodiments, a preferable resin layer is formed, using a resin material whose primary component is a polyester resin such as PET or a polyolefinic resin such as PE and PP. The resin layer (resin film layer) formed from the resin material has suitable rigidity with reduced conformability to contours on the adherend surface; and therefore, it tends to provide excellent concealment of adherend

shapes. The resin layer can have moisture impermeability or low moisture permeability. Thus, it is suitable for an application (sealing application) in which water permeation is undesirable. In some preferable embodiments, PET film can be preferably used as the resin layer. In other preferable embodiments, as the resin layer, it is possible to use BOPP (biaxially oriented polypropylene) film obtainable by forming film of a resin material that comprises PP as the primary component and biaxially stretching the film.

[0045]

The resin layer can be transparent, semi-transparent, or colored. The form of coloring the resin layer is not particularly limited. It can be colored (in particular, colored white) by forming voids such as air bubbles inside the layer or by using a colorant. In some embodiments, the resin layer includes a colorant. In an embodiment where the substrate has resin layers A and B, it is preferable that at least the resin layer A placed on the backside of the PSA sheet includes a colorant. The inclusion of the colorant in the resin layer can reduce the total light transmittance of the PSA sheet. By selecting a suitable colorant, it is possible to preferably combine low light transmittance and low glossiness. As the colorant, heretofore known pigments and dyes can be used. Examples of pigments include inorganic pigments and organic pigments. The colorant is not particularly limited. The colorant may have a color of, for instance, black, gray, white, red, blue, yellow, green, yellow-green, orange, purple, gold, silver and pearl. As the colorant, solely one species or a combination of two or more species can be used.

[0046]

Favorable examples of the colorant include white colorants. The use of a white colorant can reduce the total light transmittance and increase the haze. Specific examples of the white colorant include inorganic materials such as metal oxides including titanium oxides (titanium dioxides such as rutile titanium dioxide and anatase titanium dioxide), zinc oxide, cerium oxide, aluminum oxide, silicon oxide, zirconium oxide, magnesium oxide, calcium oxide, tin oxide, barium oxide, cesium oxide and yttrium oxide; carbonates including magnesium carbonate, calcium carbonate (light calcium carbonate, heavy calcium carbonate, etc.), barium carbonate and zinc carbonate; hydroxides including aluminum hydroxide, calcium hydroxide, magnesium hydroxide and zinc hydroxide; silicates including aluminum silicate, magnesium silicate and calcium silicate; barium sulfate, calcium sulfate, barium stearate, zinc flower, zinc sulfide, talc, clay, kaolin, titanium phosphate, mica, gypsum, white carbon, diatomaceous earth, bentonite, lithopone, zeolite, sericite and hydrated halloysite; as well as organic materials such as acrylic resins, polystyrene-based resins, polyurethane-based resins, amide-based resins, polycarbonate-based resins, silicone-based resins, urea-formaldehyde-based resins and melamine resins. As the white colorant, solely one species or a combination of two or more species can be used.

[0047]

Other favorable examples of the colorant include black colorants. The use of a black colorant can reduce the glossiness of the PSA layer's backside to a low level while effectively reducing the total light transmittance of the PSA sheet. Specific examples of the black colorant include carbon black, graphite, aniline black, perylene black, cyanine black, titanium black, inorganic pigment hematite, activated carbon, molybdenum disulfide, chromium complexes, and anthraquinone-based colorants. Among them, carbon blacks are particularly preferable. As the carbon black, those generally called carbon black (furnace black, channel black, acetylene black, thermal black, lamp black, turpentine soot, etc.) can be used without particular limitations. For the black colorant, solely one species or a suitable combination of two or more species can be used. As for the carbon black, it is also possible to use surface-modified carbon black particles having a functional group such as carboxy group, amino group, sulfonate group and silicon-containing group (e.g., alkoxysilyl group, alkylsilyl group). Such surface-modified carbon black particles are also called self-dispersible carbon black with which addition of dispersant may be unnecessary or the amount added can be reduced. For the carbon black particles, solely one species or a combination of two or more species can be used.

[0048]

As the colorant, a particulate colorant (pigment) can be preferably used. In some preferable embodiments, a colorant (e.g., a particulate black colorant such as carbon black) having a mean particle diameter of about 1 nm or greater (e.g., about 10 nm or greater) can be used. The mean particle diameter is, for instance, about 50 nm or greater, possibly about 100 nm or greater, or even about 300 nm or greater. The maximum mean particle diameter of the colorant is not particularly limited and can be, for instance, about 5000 nm or less, or even about 3000 nm or less. From the standpoint of reducing the total light transmittance, the colorant has a mean particle diameter of suitably about 1000 nm or less, or preferably about 500 nm or less.

[0049]

Here, the mean particle diameter of a colorant refers to the median volume diameter, in particular, the particle diameter at the 50th percentile (the 50th-percentile particle diameter, which may be abbreviated as D_{50} hereinafter) in its size distribution obtained by a particle size meter based on laser scattering/diffraction. As the analyzer, for instance, product name MICROTRAC MT3000II available from MicrotracBEL Corporation or a comparable product can be used.

[0050]

The colorant content is not particularly limited and can be in a known range. For instance, the colorant content can be at least 0.1 % by weight of the resin layer. From the standpoint of obtaining

greater effect of addition of colorant, it is suitably 1 % by weight or higher, or preferably 5 % by weight or higher. The colorant content of the resin layer can be, for instance, about 30 % by weight or lower, 25 % by weight or lower, 20 % by weight or lower, or even 15 % by weight or lower (e.g., 10 % by weight or lower).

[0051]

The resin layer may include, as necessary, various additives such as fillers (inorganic fillers, organic fillers, etc.), anti-aging agent, antioxidant, UV absorber, anti-static agent, slip agent and plasticizer. The ratio of the various additives included is below about 30 % by weight (e.g., below 20 % by weight, typically below 10 % by weight).

[0052]

The number of resin layers in the substrate is not particularly limited and it can be one, two or more (e.g., about two to five). From the standpoint of the productivity and availability, the number of resin layers in the substrate is preferably one to three, or more preferably one or two. When the substrate includes several resin layers, the materials and structures (thicknesses, inclusion of a void space, etc.) of these resin layers can be the same with or different from one another.

[0053]

The method for forming the resin layer is not particularly limited. A heretofore known general resin film molding method can be suitably employed to form the resin layer, for instance, extrusion molding, inflation molding, T-die casting, calender roll molding and wet casting. The resin layer may a non-stretched kind or may be subjected to a stretching process such as uniaxial stretching and biaxial stretching.

[0054]

The thickness of the resin layer is not particularly limited. From the standpoint of the film formation, etc., it is suitably 1 μm or greater, preferably 5 μm or greater, or possibly even 10 μm or greater. In some preferable embodiments, the substrate has one resin layer having a thickness of 20 μm or greater, more preferably 25 μm or greater, or yet more preferably 30 μm or greater. When the resin layer has a large thickness, with the rigidity of the resin layer, the PSA sheet can cover a contoured adherend surface while maintaining its flat backside and can lessen the appearance of contours on such an adherend surface behind the PSA sheet backside. In an embodiment where the resin layer has a limited total light transmittance, good concealment is likely to be obtained with the low light transmission of the resin layer. In some embodiments, the substrate may have one resin layer having a thickness of 40 μm or greater (e.g., 50 μm or greater). In a substrate formed of a single resin layer and a substrate having one resin layer and an inorganic layer, a resin layer having such a thickness can be

preferably used. When the substrate includes several resin layers, while each of the several resin layers may have a thickness in these ranges, it is preferable that one of the several resin layers has a thickness in these ranges.

[0055]

The maximum thickness of the resin layer is not particularly limited. For instance, it can be 300 μm or less. From the standpoint of reducing the thickness and weight of the PSA sheet, it is preferably 200 μm or less, or more preferably 100 μm or less. By suitably limiting the resin layer's thickness, the PSA sheet having the resin layer conforms well to adherend shapes. For instance, even in an application where the PSA sheet is bent to cover two faces of an adherend, lifting and peeling are unlikely to occur. This is significant in the following viewpoint: When a dent is formed on an edge (typically a corner) of an adherend, the PSA sheet is applied to cover two faces including the edge to enable concealment to make the corner dent invisible. The resin layer can have a thickness of 80 μm or less, 70 μm or less, 55 μm or less, or even 45 μm or less. When the substrate includes several resin layers, at least one resin layer among them may have a thickness in these ranges; or the combined thickness of the several resin layers can be in these ranges. The maximum thickness is preferably the combined thickness of the several resin layers.

[0056]

The resin layer may be subjected to common surface treatment, for instance, chemical or physical treatment, such as mattifying treatment, corona discharge treatment, crosslinking treatment, chromic acid treatment, ozone exposure, flame exposure, high-voltage electric shock exposure, and ionized radiation treatment.

[0057]

(Inorganic layer)

In some preferable embodiments, the substrate includes an inorganic layer. With the substrate having an inorganic layer, the total light transmittance of the PSA sheet decreases and the adherend can be concealed. The material or structure of the inorganic layer is not particularly limited and can be selected in accordance with the purpose and usage. In an application requiring gas-blocking properties, it is advantageous that the inorganic layer is essentially non-porous. A preferable inorganic layer is essentially formed of an inorganic material. For instance, an inorganic layer formed of at least 95 % (by weight) inorganic material is preferable (more preferably at least 98 % by weight, or yet more preferably at least 99 % by weight). The number of inorganic layers in the substrate is not particularly limited; it can be one, two or more (e.g., about two to five). From the standpoint of the productivity and availability, the number of inorganic layers in the substrate is preferably about 1 to 3, or more preferably

one or two. When the substrate includes several inorganic layers, the materials and structures (thicknesses, etc.) of these inorganic layers can be the same with or different from one another.

[0058]

As the inorganic material forming the inorganic layer, it is possible to use, for instance, metal materials including elemental metals such as aluminum, copper, silver, iron, tin, nickel, cobalt, and chromium as well as alloys of these; and inorganic compounds such as oxides, nitrides and fluorides of metals and metalloids including silicon, aluminum, titanium, zirconium, tin and magnesium. Specific examples of the inorganic compounds include silicon oxides (SiO_x, typically SiO_2), aluminum oxide (Al_2O_3), silicon nitride (Si_3N_4), silicon oxide nitride (SiO_xN_y), titanium oxide (TiO_2), and indium tin oxide (ITO).

[0059]

The metal materials can be used as the inorganic layers as metal foils (e.g., aluminum foil) formed by a known method such as rolling by a rolling mill, etc. Alternatively, for instance, a metal material formed in a layer by a known film-forming method such as vacuum vapor deposition, spattering and plating.

[0060]

The inorganic compound can be typically used as the inorganic layer in a form of thin film formed by a known method. As the method for forming thin film of the inorganic compound, various vapor deposition methods can be used. For instance, physical vapor deposition methods (PVD) such as vacuum vapor deposition, spattering and ion plating, chemical vapor deposition methods (CVD) and like method can be used. The substrate may further have a resin layer on top of the vapor deposition layer. For instance, the resin layer may be a topcoat layer provided for purposes such as protecting the vapor deposition layer.

[0061]

From the standpoint of the productivity, availability, etc., as the inorganic layer, a metal layer essentially formed of a metal material is preferably used. The metal layer also shows excellent gas-blocking properties. For instance, even when bent along the adherend shape, it readily maintains the bent state and shows excellent conformability to the adherend shape. As the inorganic layer formed of a metal material, it is preferable to use an inorganic layer formed of, for instance, aluminum or an aluminum alloy.

[0062]

The maximum thickness of the inorganic layer is not particularly limited. From the standpoint of obtaining conformability to adherend shapes, the inorganic layer advantageously has a thickness of 50

μm or less (favorably 30 μm or less). From the standpoint of reducing the thickness and weight of the PSA sheet, the thickness of the inorganic layer is, for instance, 20 μm or less, suitably 15 μm or less, preferably 13 μm or less, more preferably 11 μm or less, or yet more preferably 9 μm or less. When the substrate includes several inorganic layers, the combined thickness of these inorganic layers is preferably in these ranges. From the standpoint of the gas-blocking properties, productivity, availability, etc., the thickness of the inorganic layer (e.g., a metal layer such as aluminum foil) is suitably 1 μm or greater, preferably 2 μm or greater, or more preferably 5 μm or greater. In an embodiment where the inorganic layer is formed by vapor deposition of an inorganic compound, the inorganic layer's thickness is suitably in the range between 1 nm and 1000 nm, preferably in the range between 2 nm and 300 nm, or more preferably in the range between 5 nm and less than 100 nm.

[0063]

In some preferable embodiments, as the substrate, it is preferable to use a laminate body having one, two or more resin layers and an inorganic layer. With the inorganic layer, the total light transmittance of the PSA sheet decreases and the adherend can be concealed well. The presence of the inorganic layer also helps conform to adherend shapes. On the other hand, when the adherend surface has contours such as weld marks and dents, the PSA sheet may adapt to the adherend contours to make them apparent on the PSA sheet backside; and as a result, the adherend surface shape may not be concealed. However, by using the resin layer/inorganic layer laminate as the substrate, while having advantages of the inorganic layer, the PSA sheet can benefit from the rigidity of the resin layer to maintain its flat backside and can also simultaneously cover the contoured adherend surface, keeping the adherend surface contours from appearing on the PSA sheet backside. The placement of the resin layer helps obtain a backside with low glossiness.

[0064]

In the substrate having the resin layer and inorganic layer, the resin layer and the inorganic layer are preferably bonded. The bonding method is not particularly limited. A method known in the pertinent field can be suitably employed. For instance, it is possible to employ a method (extrusion lamination) where a resin material for forming the resin layer is melted and extruded along with a pre-molded inorganic layer (typically metal foil), a method where a solution or dispersion of the resin material for forming the resin layer is applied to a pre-molded inorganic layer and allowed to dry, and like method. Alternatively, it is also possible to employ a method where an inorganic layer is vapor-deposited on a pre-molded resin layer, a method where an inorganic layer is bonded to a separately-molded resin layer, and like method. For instance, the bonding can be achieved by hot pressing. The resin layer and the inorganic layer can be bonded via an adhesive layer or a PSA layer.

[0065]

The adhesive layer to bond the resin layer and the inorganic layer can be an undercoat layer formed by applying an undercoat such as primer to the resin layer. As the undercoat, those known in the pertinent field can be used, such as urethane-based undercoat, ester-based undercoat, acrylic undercoat, and isocyanate-based undercoat. From the standpoint of reducing the thickness and weight of the PSA sheet, the thickness of the undercoat layer is suitably 7 μm or less, or preferably 5 μm or less. The minimum thickness of the undercoat layer is not particularly limited. For instance, it can be 0.01 μm or greater (typically 0.1 μm or greater).

[0066]

Favorable examples of the substrate used in the PSA sheet disclosed herein include a substrate formed of a laminate body having an inorganic layer as well as resin layers A and B placed to have the inorganic layer therebetween. According to such an embodiment, it has excellent gas-blocking properties with the inorganic layer; and with the resin layers enclosing the inorganic layer, for instance, even when the inorganic layer (e.g., an aluminum layer) is thin, the inorganic layer can be effectively protected from bending, creasing, breaking, etc. By this, even when the PSA sheet is exposed to various stressors in the manufacturing process, etc., or even when it is exposed to a harsh environment for a long period while in use, it can maintain the properties such as gas-blocking properties for long. The resin layers A and B forming the substrate may be in direct contact with the inorganic layer; or to obtain tight inter-layer bonding, undercoat layers as described above can be included between the respective layers. The resin layer A refers to the resin layer placed on the backside (the front face of the substrate) of the PSA sheet relative to the inorganic layer and the resin layer B refers to the resin layer placed on the PSA layer side.

[0067]

The inorganic layer can be a metal layer formed of an aforementioned metal material. For instance, an aluminum layer is preferable. The resin layers A and B can be formed from the same material. For instance, thermoplastic resins exemplified above can be used. Of these materials, solely one species or a combination of two or more species can be used. Each of the resin layers A and B may have a layered structure with two or more layers, but is preferably a monolayer. In particular, preferable materials forming the resin layers A and B include PET, PP and polystyrene. PP is more preferable and PET is yet more preferable.

[0068]

The resin layers A and B have thicknesses T_A and T_B, respectively; and their ratio (T_A/T_B) is not particularly limited, but is suitably 0.5 or higher, preferably 1 or higher, more preferably 1.5 or

higher, yet more preferably 2.0 or higher, possibly 3.0 or higher, 4.0 or higher, or even 5.0 or higher. With increasing ratio of the resin layer A, greater adherend concealment is likely to be obtained. The T_A/T_B ratio is suitably about 10 or lower, possibly 8.0 or lower, 7.0 or lower, or even 5.0 or lower. When the T_A/T_B ratio is in these ranges, adherend conformability and adherend concealment can be preferably combined. The thickness T_A of resin layer A is suitably about 10 μm or greater, preferably 20 μm or greater, more preferably 25 μm or greater, yet more preferably 30 μm or greater (e.g., 35 μm or greater), or possibly even 40 μm or greater (e.g., 45 μm or greater). T_A is suitably about 100 μm or less, preferably 70 μm or less, more preferably 60 μm or less, possibly 50 μm or less, or even 45 μm or less. The thickness T_B of resin layer B is suitably about 1 μm or greater, preferably 3 μm or greater, more preferably 5 μm or greater, or yet more preferably 7 μm or greater. T_B is suitably about 25 μm or less, preferably 20 μm or less, more preferably 15 μm or less, or yet more preferably 12 μm or less (e.g., 10 μm or less).

[0069]

The inorganic layer has a thickness T_I and the resin layers A and B have a combined thickness T_R ($= T_A + T_B$); and their ratio (T_R/T_I) is not particularly limited. From the standpoint of adherend concealment, etc., the ratio is suitably 1 or higher, possibly 3 or higher, 4 or higher, or even 5 or higher (e.g., 7 or higher). When it is bent and applied to accommodate the adherend shape, in view of the adherend conformability, the T_R/T_I ratio is suitably 15 or lower, preferably 10 or lower, possibly 8 or lower, or even below 5. The total (T_R) of the resin layer A's thickness T_A and B's thickness T_B is suitably about 15 μm or greater, preferably 25 μm or greater, more preferably 35 μm or greater, yet more preferably 40 μm or greater, possibly 45 μm or greater, or even 55 μm or greater. T_R is suitably about 100 μm or less, preferably 80 μm or less, more preferably 70 μm or less, or possibly 60 μm or less (e.g., 50 μm or less). The substrate in this embodiment can preferably combine conformability to adherend shapes based on the presence of the inorganic layer with adherend concealment with the rigidity and glossiness of the resin layers.

[0070]

As the method for forming a laminate body having the inorganic layer, resin layer A and resin layer B, it is possible to employ various methods as described earlier, such as a method where the respective layers are formed as films by a known method and they are laminated dry by forming undercoat layers described above, a method where the inorganic layer is formed on the resin layer A in a tightly bonded manner and the resin layer B is laminated dry or extrusion-laminated on top of it, and like method.

[0071]

(Colored layer)

The substrate surface may be at least partially colored with a colored layer (possibly a print layer such as printed letters). The PSA sheet having such a colored layer is preferably used as a PSA label such as a printing label. The colored layer can be placed on at least one face of the substrate.

[0072]

The colored layer can be typically formed by applying a colored layer-forming composition to a base film, the composition comprising a colorant and a binder. As the colorant, heretofore known pigments and dyes can be used, similar to the colorants that can be included in the resin layer. As the binder, materials known in the paint or printing field can be used without particular limitations. Examples include polyurethane, phenol resin, epoxy resin, urea-melamine resin and polymethyl methacrylate. The colored layer-forming composition can be, for instance, a solvent-based type, UV-curable type, heat-curable type, etc. The colored layer can be formed by a method conventionally used to form a colored layer without particular limitations. For instance, it is preferable to use a method where the colored layer (print layer) is formed by gravure printing, flexographic printing, offset printing, etc.

[0073]

The colored layer may have a monolayer structure formed entirely of a single layer or a multilayer structure including two, three or more colored sublayers. For instance, a colored layer having a multilayer structure with two or more colored sublayers can be formed by repeated applications (e.g., printing) of a colored layer-forming composition. The respective colored sublayers may be the same or different in color and amount of colorant. In a colored layer to provide concealing properties, from the standpoint of preventing formation of pinholes, it is particularly significant to have a multilayer structure.

[0074]

The colored layer has a total thickness of suitably about 1 μm to 10 μm, preferably about 1 μm to 7 μm, or possibly, for instance, about 1 μm to 5 μm. In the colored layer including two or more colored sublayers, each sublayer preferably has a thickness of about 1 μm to 2 μm.

[0075]

The number of substrate-forming layers is not particularly limited. For instance, it can have a resin monolayer structure; or like the resin layer/inorganic layer laminate, it can have a laminate structure with two, three or more layers. It may further have a surface layer called a top coat layer, print layer, etc.; or a bonding layer or primer layer to enhance the tightness of adhesion between the respective layers.

[0076]

(Properties of substrate)

A preferable substrate has a gloss (60° gloss) of 80 GU or lower on one face (e.g., the resin

layer surface). By using a substrate having the surface with limited gloss, the adherend surface shape becomes less noticeable. When the substrate surface is printed, it tends to be highly printable, allowing easy recognition of printed letters. In some preferable embodiments, the substrate surface has a gloss of 60 GU or lower, possibly 50 GU or lower, 40 GU or lower, 30 GU or lower, 20 GU or lower, or even 15 GU or lower. The minimum gloss of the substrate surface is 0 GU. For instance, from the standpoint of the balance with the exterior where the PSA sheet is applied, etc., it can be 1 GU or higher, 5 GU or higher, 12 GU or higher, 25 GU or higher, 35 GU or higher, or even 45 GU or higher. A substrate having a low GU can be obtained by, for instance, selecting a certain resin layer (resin film) material for use as the substrate; using a commercially-available substrate material (e.g., resin film) having a low GU; placing a matt layer (e.g., a lusterless layer including organic or inorganic particles) on the substrate surface; or subjecting the substrate surface (e.g., the resin layer surface) to surface treatment (or mattifying treatment) such as roller embossing and sandblasting; and so on. The gloss (60° gloss) of the substrate surface is determined by the method described later in Examples.

[0077]

In some embodiments, the substrate preferably has a total light transmittance of 75 % or lower. When a substrate satisfying this property is used, the PSA sheet will have concealing properties to make adherend contours less visible through the PSA sheet. The substrate's total light transmittance is preferably 60 % or lower, more preferably 40 % or lower, or yet more preferably 20 % or lower. In some preferable embodiments, the substrate's total light transmittance is 10 % or lower. From the standpoint of enhancing the adherend concealment, it can be 3 % or lower, below 1 %, or even below 0.1 %. The substrate's minimum total light transmittance is not particularly limited. It can be practically 0 %, that is, below detection limit; or it can be 0.01 % or higher, for instance, 0.1 % or higher, or also 1.0 % or higher. In some embodiments, the substrate's total light transmittance can be 5 % or higher, 9 % or higher, or even 12 % or higher (e.g., 15 % or higher). The substrate's total light transmittance can be reduced by placing an inorganic layer, including a colorant in a resin layer, forming voids, etc. In other embodiments, the substrate's total light transmittance can be above 75 %, for instance, 90 % or higher. For instance, when the PSA layer has a lower total light transmittance, the substrate may have such a relatively high total light transmittance. The substrate's total light transmittance is determined by the method described later in Examples.

[0078]

In some preferable embodiments, the substrate has a haze value of 70 % or higher, more preferably 80 % or higher, yet more preferably 90 % or higher, possibly 95 % or higher, or even 99 % or higher. With increasing haze of the substrate, the adherend concealing properties tend to improve. The

substrate's haze is determined with respect to one face (in particular, the surface on the side of the PSA sheet backside). The maximum haze value is 100 %. In some embodiments, the haze value can be 99 % or lower, 90 % or lower, or even 85 % or lower. In other embodiments, the substrate's haze value can be, for instance, 1 % or higher, 10 % or higher, 30 % or higher, or even 50 % or higher. A substrate having a high haze value can be obtained by, for instance, selecting a certain resin layer (resin film) material for use as the substrate; using a commercially-available substrate material (e.g., resin film) having a high haze value; placing a surface layer (e.g., a layer including organic or inorganic particles) on the substrate surface; or subjecting the substrate surface (e.g., the resin layer surface) to the sort of surface treatment such as roller embossing and sandblasting. The substrate's haze value is determined by the method described later in Examples.

[0079]

The arithmetic average roughness of the substrate surface is not particularly limited. For instance, it can be 10000 nm or less. In some preferable embodiments, the substrate surface has an arithmetic average roughness of 3000 nm or less, more preferably 1500 nm or less, yet more preferably 1000 nm or less, particularly preferably 800 nm or less, possibly 500 nm or less, or even 300 nm or less. With decreasing arithmetic average roughness, the substrate surface has greater surface conditions. For instance, in an embodiment where the substrate surface is printed, it tends to be highly printable, allowing easy recognition of printed letters. The substrate surface has an arithmetic average roughness of, for instance, 10 nm or greater. In some preferable embodiments, the substrate surface has an arithmetic average roughness of 50 nm or greater, more preferably 100 nm or greater, yet more preferably 150 nm or greater, or particularly preferably 200 nm or greater (e.g., 250 nm or greater). By placing the surface having such an arithmetic average roughness on the side of the PSA sheet backside, reflection of light on the PSA sheet backside is likely to be reduced and the backside contours originating from the adherend surface shape tend to be less noticeable. In other embodiments, the substrate surface can have an arithmetic average roughness of 350 nm or greater, 450 nm or greater, or even 550 nm or greater. The arithmetic average roughness of the substrate surface can be adjusted by a selection of substrate material, a method for forming the substrate (typically a resin layer), use of a commercially-available substrate material having the prescribed arithmetic average roughness, surface treatment (roller embossing, sandblasting, etc.) to the substrate surface (e.g., the resin layer surface), etc. The arithmetic average roughness of the substrate surface can be determined by the method described later in Examples.

[0080]

(Thickness of substrate)

The thickness of the substrate is not particularly limited. From the standpoint of the

productivity and handling properties of the PSA sheet, the thickness of the substrate is about 3 μm or greater, or suitably about 5 μm or greater (e.g., 10 μm or greater). The thickness of the substrate is preferably 20 μm or greater, more preferably 40 μm or greater, yet more preferably 60 μm or greater, or particularly preferably 70 μm or greater. With increasing thickness of the substrate, it tends to show superior adherend surface shape concealment and gas-blocking properties. The maximum thickness of the substrate is, for instance, about 1 mm or less, possibly about 300 μm or less, or suitably about 200 μm or less (e.g., 150 μm or less). From the standpoint of the adherend conformability of the PSA sheet and of reducing its thickness and weight, the thickness of the substrate is preferably 100 μm or less, more preferably 80 μm or less, or possibly, for instance, 70 μm or less.

[0081]

The PSA layer-side surface of the substrate may be subjected to common surface treatment, chemical or physical treatment, for instance, mattifying treatment, corona discharge treatment, crosslinking treatment, chromic acid treatment, ozone exposure, flame exposure, high-voltage electric shock exposure, and ionized radiation treatment. On the PSA layer-side surface of the substrate, an undercoat layer may be placed, which is formed by applying an undercoat such as primer to the resin layer. As the undercoat, those known in the pertinent field can be used, such as urethane-based, ester-based, acrylic, and isocyanate-based kinds. From the standpoint of reducing the thickness and weight of the PSA sheet, the thickness of the undercoat layer is suitably 7 μm or less, preferably 5 μm or less, or more preferably 3 μm or less.

[0082]

<PSA layer>

(Base polymer)

In the art disclosed herein, the type of PSA forming the PSA layer is not particularly limited. The PSA may comprise, as its base polymer, one, two or more species of various rubber-like polymers such as rubber-based polymers, acrylic polymers, polyester-based polymers, urethane-based polymers, polyether-based polymers, silicone-based polymers, polyamide-based polymer and fluorine-based polymers that are known in the PSA field. From the standpoint of the gas-blocking properties and reduction of gas emission, it is preferable to use a rubber-based PSA comprising a rubber-based polymer as the base polymer or a PSA comprising an acrylic polymer as the base polymer. Other examples include a PSA comprising a rubber-based polymer and an acrylic polymer as the base polymer. When the PSA sheet disclosed herein is used in a magnetic disc device, it is desirable that the PSA is essentially free of a silicone-based polymer which may form siloxane gas.

The PSA sheet having an acrylic PSA layer and the PSA sheet having a rubber-based PSA

layer are primarily discussed below; however, the PSA layer of the PSA sheet disclosed herein is not limited to a layer formed of an acrylic PSA or a rubber-based PSA.

As used herein, the “base polymer” of PSA refers to the primary component among rubber-like polymers (i.e. a component accounting for more than 50 % by weight of the rubber-like polymers) in the PSA. A rubber-like polymer is a polymer that shows rubber elasticity in a room temperature range.

[0083]

(Acrylic polymer)

In some embodiments of the art disclosed herein, the PSA layer is an acrylic PSA layer comprising an acrylic polymer as a base polymer. The acrylic polymer is preferably a polymer of a starting monomer mixture that comprises an alkyl (meth)acrylate as the primary monomer and may further comprise a secondary monomer copolymerizable with the primary monomer. Here, the primary monomer refers to a component accounting for more than 50 % by weight of the starting monomer mixture.

As used herein, the term "(meth)acryloyl" comprehensively refers to acryloyl and methacryloyl. Similarly, the term "(meth)acrylate" comprehensively refers to acrylate and methacrylate, and the term “(meth)acryl” comprehensively refers to acryl and methacryl.

[0084]

As the alkyl (meth)acrylate, for instance, a compound represented by the following formula (1) can preferably be used:

$CH_2=C(R^1)COOR^2$ (1)

Here, R^1 in the formula (1) is a hydrogen atom or a methyl group. R^2 is an acyclic alkyl group having 1 to 20 carbon atoms (hereinafter, such a range of the number of carbon atoms may be indicated as “C_{1-20}”). From the standpoint of the PSA’s storage modulus, adhesive properties, etc., an alkyl (meth)acrylate in which R^2 is a C_{1-18} acyclic alkyl group is preferable; an alkyl (meth)acrylate in which R^2 is a C_{2-14} acyclic alkyl group is more preferable; an alkyl (meth)acrylate in which R^2 is a C_{4-12} acyclic alkyl group is even more preferable. In particular, it is preferable to use an alkyl acrylate as the primary monomer. The acyclic alkyl group includes linear and branched alkyl groups.

[0085]

Examples of an alkyl (meth)acrylate having a C_{1-20} acyclic alkyl group for R^2 include methyl (meth)acrylate, ethyl (meth)acrylate, propyl (meth)acrylate, isopropyl (meth)acrylate, n-butyl (meth)acrylate, isobutyl (meth)acrylate, s-butyl (meth)acrylate, pentyl (meth)acrylate, isopentyl (meth)acrylate, hexyl (meth)acrylate, heptyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, octyl (meth)acrylate, isooctyl (meth)acrylate, nonyl (meth)acrylate, isononyl (meth)acrylate, decyl

(meth)acrylate, isodecyl (meth)acrylate, undecyl (meth)acrylate, dodecyl (meth)acrylate, tridecyl (meth)acrylate, tetradecyl (meth)acrylate, pentadecyl (meth)acrylate, hexadecyl (meth)acrylate, heptadecyl (meth)acrylate, octadecyl (meth)acrylate, nonadecyl (meth)acrylate, and eicosyl (meth)acrylate. Among these alkyl (meth)acrylates, solely one species or a combination of two or more species can be used.

[0086]

From the standpoint of increasing the conversion in the synthesis of the acrylic polymer to facilitate reduction of thermally released gas, as the primary monomer forming the acrylic polymer, an alkyl acrylate having an acyclic alkyl group with 9 or fewer carbon atoms can be preferably used. For instance, it is preferable to use at least either 2-ethylhexyl acrylate (2EHA) or n-butyl acrylate (BA). In the acrylic polymer, BA may be used solely or 2EHA may be used solely as the primary monomer, or just BA and 2EHA may be used as the primary monomer. A favorable example is an acrylic polymer in which BA is used alone as the primary monomer. In some embodiments, the BA content in all monomers forming the acrylic polymer can be, for instance, 50 % by weight or higher, 70 % by weight or higher, 85 % by weight or higher, or even 90 % by weight or higher.

[0087]

The ratio of alkyl (meth)acrylate as the primary monomer in all the monomers forming the acrylic polymer is preferably 60 % by weight or higher, more preferably 70 % by weight or higher, or yet more preferably 75 % by weight or higher, for instance, 85 % by weight or higher. The maximum ratio of alkyl (meth)acrylate is not particularly limited. From the standpoint of greater cohesive strength, repulsion resistance, etc., the ratio of alkyl (meth)acrylate is usually suitably lower than 98 % by weight, or preferably lower than 96 % by weight.

[0088]

Secondary monomers capable of introducing possible crosslinking points into the acrylic polymer or enhancing the adhesive strength include carboxy group-containing monomers, hydroxy group-containing monomers, acid anhydride group-containing monomers, amide group-containing monomers, amino group-containing monomers, imide group-containing monomers, epoxy group-containing monomers, (meth)acryloylmorpholine, and vinyl ethers. Among them, hydroxy group-containing monomers and carboxy group-containing monomers are preferable.

[0089]

A favorable example of the acrylic polymer in the art disclosed herein is an acrylic polymer in which a carboxy group-containing monomer is copolymerized as the secondary monomer. Examples of the carboxy group-containing monomer include acrylic acid (AA), methacrylic acid (MAA),

carboxyethyl (meth)acrylate, carboxypentyl (meth)acrylate, itaconic acid, maleic acid, fumaric acid, crotonic acid, and isocrotonic acid. Among them, AA and MAA are preferable.

The carboxy group-containing monomer content in all monomers can be, for instance, above about 1 % by weight, above 3 % by weight, above 5 % by weight, or even above 6 % by weight; it is usually suitably below 15 % by weight, below 12 % by weight, below 10 % by weight, or even below 8 % by weight.

[0090]

In the acrylic polymer in the art disclosed herein, a hydroxy group-containing monomer may be copolymerized as the secondary monomer. Examples of the hydroxy group-containing monomer include hydroxyalkyl (meth)acrylates such as 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 3-hydroxyprpyl (meth)acrylate, 2-hydroxybutyl (meth)acrylate, and 4-hydroxybutyl (meth)acrylate; polypropylene glycol mono(meth)acrylate; and N-hydroxyethyl(meth)acrylamide. Particularly preferably hydroxy group-containing monomers include hydroxyalkyl (meth)acrylates having linear alkyl groups with 2 to 4 carbon atoms. For instance, 2-hydroxyethyl acrylate (HEA) and 4-hydroxybutyl acrylate (4HBA) can be preferably used.

The hydroxy group-containing monomer content in all monomers can be, for instance, 0.01 % by weight or higher, 0.03 % by weight or higher, or even 0.05 % by weight or higher; it can be, for instance, 10 % by weight or lower, 5 % by weight or lower, 1 % by weight or lower, 0.5 % by weight or lower, or even 0.2 % by weight or lower.

[0091]

For the secondary monomer, solely one species or a combination of two or more species can be used. From the standpoint of the cohesive strength, etc., the secondary monomer content in all monomers is usually suitably higher than 1 % by weight, preferably higher than 2 % by weight, more preferably higher than 5 % by weight, or possibly higher than 6 % by weight. The upper limit is preferably 30 % by weight or lower (e.g., 25 % by weight or lower), 15 % by weight or lower, or even 10 % by weight or lower.

[0092]

A favorable example of the acrylic polymer in the art disclosed herein is an acrylic polymer using both a hydroxy group-containing monomer and a carboxy group-containing monomer as the secondary monomers. When these are used together, the ratio (by weight) of carboxy group-containing monomer to hydroxy group-containing monomer can be, for instance, above 3 times, above 10 times, above 30 times, or even above 50 times. With the combined use of the hydroxy group-containing monomer in a small amount relative to the carboxy group-containing monomer, the PSA sheet can be

favorably made, better combining adhesive strength and cohesive strength. Such a PSA sheet may exhibit good repulsion resistance in an application where it is bent along the adherend shape. While no particular limitations are imposed, the ratio can be, for instance, 1000 times or lower, 500 times or lower, 300 times or lower, or even 100 times or lower.

[0093]

As the monomers forming the acrylic polymer, for a purpose such as increasing the cohesive strength of the acrylic polymer and adjusting the Tg value, other comonomers can be used besides the aforementioned secondary monomers. Examples of the comonomers include vinyl ester-based monomers such as vinyl acetate; aromatic vinyl compounds such as styrene; cycloalkyl (meth)acrylates such as cyclohexyl (meth)acrylate; aromatic ring-containing (meth)acrylates such as aryl (meth)acrylates; olefinic monomers such as ethylene, propylene, isoprene, butadiene and isobutylene; polyfunctional monomers such as 1,6-hexanediol di(meth)acrylate, having two or more (e.g., three or more) polymerizable functional groups (e.g., (meth)acryloyl groups) per molecule. The amount of the other comonomers can be suitably selected in accordance to the purpose and application and is not particularly limited. It is usually preferably 10 % by weight or less (e.g., 1 % by weight or less) of all monomers.

[0094]

The composition of monomers forming the acrylic polymer is suitably designed so that the acrylic polymer has a glass transition temperature (Tg) of about -5 °C or lower (e.g., about -75 °C or higher and -5 °C or lower). Here, the Tg of an acrylic polymer refers to the value determined by the Fox equation based on the composition of the monomers. As shown below, the Fox equation is a relational expression between the Tg of a copolymer and glass transition temperatures Tgi of homopolymers of the respective monomers constituting the copolymer.

$$1/Tg = \Sigma(Wi/Tgi)$$

In the Fox equation, Tg represents the glass transition temperature (unit: K) of the copolymer, Wi the weight fraction (copolymerization ratio by weight) of a monomer i in the copolymer, and Tgi the glass transition temperature (unit: K) of homopolymer of the monomer i.

[0095]

As the glass transition temperatures of homopolymers used for determining the Tg value, values found in publicly known documents are used. For example, with respect to the monomers listed below, as the glass transition temperatures of homopolymers of the monomers, the following values are used:

2-ethylhexyl acrylate -70 °C

n-butyl acrylate	-55 °C
ethyl acrylate	-22 °C
lauryl acrylate	0 °C
2-hydroxyethyl acrylate	-15 °C
4-hydroxybutyl acrylate	-40 °C
acrylic acid	106 °C
methacrylic acid	228 °C

[0096]

With respect to the glass transition temperatures of homopolymers of monomers other than those listed above, values given in "*Polymer Handbook*" (3rd edition, John Wiley & Sons, Inc., Year 1989) are used. When the literature provides two or more values, the highest value is used.

[0097]

While no particular limitations are imposed, from the standpoint of the adhesion, the acrylic polymer's Tg is advantageously about -10 °C or lower, or preferably about -15 °C or lower, more preferably -20 °C or lower, or yet more preferably -35 °C or lower. From the standpoint of the PSA layer's cohesive strength, the acrylic polymer's Tg is advantageously about -75 °C or higher, preferably about -70 °C or higher, more preferably about -55 °C or higher, or possibly even higher than -50 °C. The acrylic polymer's Tg can be adjusted by suitably changing the monomer composition (i.e. the monomer species used for synthesizing the polymer and their ratio).

[0098]

The acrylic polymer's Mw is not particularly limited. For instance, it can be about 10×10^4 or higher and 500×10^4 or lower. From the standpoint of the cohesive strength and reduction of gas emissions, the Mw is advantageously about 30×10^4 or higher and preferably about 50×10^4 or higher (e.g., about 70×10^4 or higher). In some preferable embodiments, the acrylic polymer's Mw is about 90×10^4 or higher, more preferably about 120×10^4 or higher, or yet more preferably about 140×10^4 or higher. With PSA having such a Mw, good repulsion resistance can be obtained in an application where the PSA sheet is bent along the adherend shape. From the standpoint of the adhesion, the Mw is usually suitably about 300×10^4 or lower, preferably about 200×10^4 or lower, or more preferably about 170×10^4 or lower.

[0099]

It is noted that Mw is determined from a value obtained based on polystyrene standards by gel permeation chromatography (GPC). As the GPC analyzer, for instance, model name HLC-8320 GPC (columns: TSKgel GMH-H(S) available from Tosoh Corporation) can be used.

[0100]

The method for obtaining the acrylic polymer is not particularly limited. Various polymerization methods known as synthetic methods of acrylic polymers may be appropriately employed, such as solution polymerization, emulsion polymerization, bulk polymerization, suspension polymerization and photopolymerization. For instance, solution polymerization may be preferably employed. As the method for supplying the monomers when solution polymerization is carried out, all-at-once supply by which all starting monomers are supplied at once, continuous supply (addition), portion-wise supply (addition) and like method can be suitably employed. From the standpoint of making it easier to form a PSA layer with a low level of thermally released gas, it is preferable to set the polymerization conditions (polymerization time, polymerization temperature, etc.) so as to obtain a polymerization reaction mixture with less unreacted monomers.

[0101]

The polymerization temperature can be appropriately selected according to the species of monomers, solvent, and polymerization initiator used, etc. It can be, for instance, about 20 °C to 170 °C (typically about 40 °C to 140 °C). In some embodiments, the polymerization temperature can be about 75 °C or lower (more preferably about 65 °C or lower, e.g., about 45 °C to 65 °C). After polymerization is carried out at such a polymerization temperature, the internal temperature of the system can be maintained at a higher temperature (e.g., a temperature higher by about 5 °C to 35 °C or by about 10 °C to 20 °C) for, for instance, about 15 minutes to 6 hours or preferably about 30 minutes to 3 hours to reduce unreacted monomers.

[0102]

For the solvent (polymerization solvent) used for solution polymerization, a suitable species can be selected among heretofore known organic solvents. For instance, it is possible to use one species of solvent or a solvent mixture of two or more species, selected among aromatic compounds (typically aromatic hydrocarbons) such as toluene and xylene; acetic acid esters such as ethyl acetate; and aliphatic or alicyclic hydrocarbons such as hexane and cyclohexane; lower alcohols such as methanol, ethanol and isopropanol; and ketones such as methyl ethyl ketone. From the standpoint of readily obtaining a PSA sheet with a low amount of thermally released gas, it is preferable to use a polymerization solvent that can be easily removed by volatilization. For instance, it is preferable to use one solvent species (ethyl acetate, etc.) having a boiling point below 100 °C, below 90 °C or below 80 °C, or a solvent mixture having a composition that gives such a boiling point.

[0103]

The initiator used for the polymerization may be suitably selected according to the

polymerization method from heretofore known polymerization initiators. Examples include azo-based polymerization initiators such as 2,2'-azobisisobutyronitrile, 2,2'-azobis-2-methylbutyronitrile, dimethyl 2,2'-azobis(2-methylpropionate), 4,4'-azobis-4-cyanovalerianic acid, azobis isovaleronitrile, 2,2'-azobis(2-amidinopropane) dihydrochloride, 2,2'-azobis[2-(5-methyl-2-imidazolin-2-yl)propane] dihydrochloride, 2,2'-azobis(2-methylpropionamidine) disulfate, and 2,2'-azobis(N,N'-dimethyleneisobutylamidine) dihydrochloride; persulfates such as potassium persulfate; peroxide-based polymerization initiators such as dibenzoyl peroxide; substituted ethane-based initiators such as phenyl-substituted ethane; aromatic carbonyl compounds; and redox-based initiators by a combination of a peroxide and a reducing agent. For the polymerization initiator, solely one species or a combination of two or more species can be used. The polymerization initiator can be used in a typical amount selected from a range of, for instance, about 0.005 part to 1 part (typically about 0.01 part to 1 part) by weight to 100 parts by weight of the monomers.

[0104]

The art disclosed herein, as the polymerization initiator, an azo-based polymerization initiator can be preferably used. In radical polymerization, as compared to organic peroxides and other radial polymerization initiators, it is advantageous to use an azo-based polymerization initiator as its degradation products are unlikely to remain in the resulting PSA composition as components that can be thermally released gas and gas emission is likely to be inhibited. As the polymerization initiator, it is particularly desirable to avoid the use of an organic peroxide. It is preferable to synthesize the acrylic polymer in the art disclosed herein, for instance, using only one, two or more species of azo-based initiators as the polymerization initiator.

[0105]

(Rubber-based polymer)

In some embodiments, the PSA layer is preferably a rubber-based PSA layer formed from a PSA composition that comprises a rubber-based polymer as the base polymer. Examples of the base polymer include various rubber-based polymers such as natural rubber; styrene-butadiene rubber (SBR); polyisoprene; a butene-based polymer comprising butene (referring to 1-butene as well as cis- or trans-2-butene) and/or 2-methylpropene (isobutylene) as the primary monomer(s); A-B-A block copolymer rubber and a hydrogenation product thereof, for instance, styrene-butadiene-styrene block copolymer rubber (SBS), styrene-isoprene-styrene block copolymer rubber (SIS), styrene-isobutylene-styrene block copolymer rubber (SIBS), styrene-vinyl isoprene-styrene block copolymer rubber (SVIS), styrene-ethylene-butylene-styrene block copolymer rubber (SEBS) which is a hydrogenation product of SBS, styrene-ethylene-propylene-styrene block copolymer rubber (SEPS) which is a hydrogenation product of

SIS, and styrene-isoprene-propylene-styrene block copolymer (SIPS). Among these rubber-based polymers, solely one species or a combination of two or more species can be used.

[0106]

A favorable example of the butene-based polymer is an isobutylene-based polymer. Due to its molecular structure, the isobutylene-based polymer's main chain has low motility. Thus, a PSA layer (isobutylene-based PSA layer) whose base polymer is an isobutylene-based polymer may itself show a relatively low level of gas diffusion. This is advantageous from the standpoint of preventing entry of moisture (water vapor) into electronic devices through the PSA layer, preventing gas leakage from an electronic device filled with a gas (e.g., a magnetic disc device having a housing base internally filled with helium gas), etc. Such a PSA layer tends to have a good elastic modulus and excellent removability. Specific examples of the isobutylene-based polymer include polyisobutylene and isobutylene-isoprene copolymer (butyl rubber).

[0107]

The monomers (monomer mixture) to form the rubber-based polymer disclosed herein comprises one, two or more species of monomers selected among butene, isobutylene, isoprene, butadiene, styrene, ethylene and propylene. The rubber-based polymer can be a polymer obtainable by polymerizing the one, two or more species of monomers exemplified above. The monomer mixture for forming the rubber-based polymer disclosed herein typically comprises the one, two or more species of monomers at a ratio of at least 50 % (e.g., 50 % to 100 %) by weight, preferably at least 75 % by weight, more preferably at least 85 % by weight, or yet more preferably at least 90 % (e.g., at least 95 %) by weight. The ratio of these monomers in the entire monomer content can also be 99 % by weight or higher. The rubber-based polymer according to some preferable embodiments is a polymer obtainable by polymerizing one, two or more species of monomers selected among isobutylene, isoprene and butene. It is noted that from the standpoint of reduction of gas emission (in particular, reduction of gas emissions that may degrade the durability, reliability or accurate operation of electronic devices including magnetic disc devices), the styrene content of the monomer mixture is preferably lower than 10 % by weight, or more preferably lower than 1 % by weight. The art disclosed herein can be preferably implemented in an embodiment where the monomer mixture is essentially free of styrene.

[0108]

In some preferable embodiments, the isobutylene-based polymer accounts for more than 50 % (e.g., 70 % or more, or even 85 % or more) by weight of the polymer(s) in the PSA. The PSA may be essentially free of other polymers besides the isobutylene-based polymer. In the PSA, for instance, the ratio of non-isobutylene-based polymer content in the polymer content can be 1 % by weight or lower, or

at or below the minimum detectable level.

[0109]

As used herein, the "isobutylene-based polymer" is not limited to isobutylene homopolymer (homopolyisobutylene) and the term encompasses a copolymer whose primary monomer is isobutylene. The copolymer includes a copolymer in which isobutylene corresponds to the highest content of the monomers forming the isobutylene-based polymer. In typical, it can be a copolymer in which isobutylene accounts for more than 50 % by weight of the monomers, or even 70 % by weight or more thereof. Examples of the copolymer include a copolymer of isobutylene and butene (normal butylene), a copolymer (butyl rubber) of isobutylene and isoprene, vulcanized products and modified products of these. Examples of the copolymers include butyl rubbers such as regular butyl rubber, chlorinated butyl rubber, iodinated butyl rubber, and partially crosslinked butyl rubber. Examples of the vulcanized and modified products include those modified with functional groups such as hydroxy group, carboxy group, amino group, and epoxy group. The isobutylene-based polymer that can be preferably used from the standpoint of the gas-blocking properties, reduction of gas emission, adhesive strength, etc., includes polyisobutylene and isobutylene-isoprene copolymer (butyl rubber). The copolymer can be a copolymer (e.g., an isobutylene-isoprene copolymer) of which the other monomers (isoprene, etc.) excluding isobutylene has a copolymerization ratio lower than 30 % by mol.

As used herein, the "polyisobutylene" refers to a polyisobutylene in which the copolymerization ratio of monomers excluding isobutylene is 10 % or lower (preferably 5 % or lower) by weight. In particular, homopolyisobutylene is preferable.

[0110]

The molecular weight of the isobutylene-based polymer is not particularly limited. For instance, it is possible to suitably select and use a species having a weight average molecular weight (Mw) of about 5×10^4 or higher (preferably about 15×10^4 or higher, e.g., about 30×10^4 or higher). The maximum Mw is not particularly limited and can be about 150×10^4 or lower (preferably about 100×10^4 or lower, e.g., about 80×10^4 or lower). Several species of isobutylene-based polymer varying in Mw can be used together as well. Having a Mw in these ranges, the PSA can be easily adjusted to have an elasticity in a preferable range and is likely to show good cohesive strength.

[0111]

While no particular limitations are imposed, as the polyisobutylene, it is possible to preferably use a species having a dispersity (Mw/Mn) (which is indicated as a ratio of weight average molecular weight (Mw) to number average molecular weight (Mn)) in a range of 3 to 7 (more preferably 3 to 6, e.g., 3.5 to 5.5). Several species of polyisobutylene varying in Mw/Mn can be used together as well.

[0112]

The Mw and Mn values of an isobutylene-based polymer here refer to values based on standard polystyrene that are determined by gel permeation chromatography (GPC) analysis. As the GPC analyzer, for instance, model name HLC-8120 GPC available from Tosoh Corporation can be used.

[0113]

When using a butyl rubber, its molecular weight is not particularly limited. For instance, a species having a Mw in a range of 5×10^4 to 100×10^4 can be suitably selected and used. In view of the balance between the PSA layer's formation and tightness of bonding to adherend (adhesive strength), the butyl rubber's Mw is preferably 10×10^4 or higher, or more preferably 15×10^4 or higher; it is preferably 100×10^4 or lower, or more preferably 80×10^4 or lower. Several species of butyl rubber varying in Mw can be used together as well.

While no particular limitations are imposed, the butyl rubber has a dispersity (Mw/Mn) in a range of preferably 3 to 8 or more preferably in a range of 4 to 7. Several species of butyl rubber varying in Mw/Mn can be used together as well. The butyl rubber's Mw and Mn can be determined by GPC analysis, similarly to the polyisobutylene.

[0114]

The Mooney viscosity of the butyl rubber is not particularly limited. For instance, a butyl rubber having a Mooney viscosity ML_{1+8}(125°C) between 10 and 100 can be used. In view of the balance between the PSA layer's formation and tightness of bonding to adherend (adhesive strength), a butyl rubber having a Mooney viscosity ML_{1+8}(125°C) of 15 to 80 (more preferably 30 to 70, e.g., 40 to 60) is preferable.

[0115]

The rubber-based PSA layer according to some preferable embodiments comprises a rubber-based polymer A and a rubber-based polymer B as its base polymers. The rubber-based polymers A and B are preferably both isobutylene-based polymers. The rubber-based polymer A is more preferably an isobutylene-based polymer in which isobutylene is polymerized at a ratio of at least 50 % (e.g., at least 70 %, preferably at least 80 %, or yet more preferably at least 90 %) by weight; it is typically polyisobutylene. The rubber-based polymer B is an isobutylene-based polymer in which isobutylene and isoprene are copolymerized (i.e. an isobutylene-based copolymer); it is typically an isobutylene-isoprene copolymer. In the copolymer, the combined amount of isobutylene and isoprene as monomers accounts for typically at least 50 % (e.g., at least 70 %, preferably at least 80 %, or yet more preferably at least 90 %) by weight of the entire monomers. The use of rubber-based polymers A and B can bring the PSA layer's elastic modulus in a preferable range, whereby greater gas-blocking properties tend to be

obtained.

[0116]

When rubber-based polymers A and B are used, their blend ratio can be suitably selected so as to obtain desired properties disclosed herein. The weight ratio (P_A/P_B) of rubber-based polymer A (P_A) to rubber-based polymer B (P_B) can be, for instance, 95/5 to 5/95, preferably 90/10 to 10/90, more preferably 80/20 to 20/80, yet more preferably 70/30 to 30/70, or particularly preferably 60/40 to 40/60.

[0117]

In some preferable embodiments, the dispersity (Mw/Mn) of the aforementioned base polymers at large is 3 or higher, or more preferably 4 or higher. According to the PSA comprising such base polymers, adhesive strength can be easily combined with resistance to leftover adhesive residue. It also brings the PSA layer's elastic modulus in a favorable range and good gas-blocking properties tend to be obtained. At or above a certain Mw/Mn value, the PSA can be obtained with a low solution viscosity for its Mw. The dispersity of the base polymers at large can also be 5 or higher, 6 or higher, or even 7 or higher. The maximum dispersity of the base polymers at large is not particularly limited; it is preferably 10 or lower (e.g., 8 or lower).

[0118]

The art disclosed herein can be preferably implemented in an embodiment having a PSA layer (e.g., a rubber-based PSA layer) formed of a PSA (a non-crosslinked PSA) in which the based polymers are not crosslinked. Here, the term "PSA layer formed of a non-crosslinked PSA" refers to a PSA layer that has not been subjected to an intentional treatment (i.e. crosslinking treatment, e.g., addition of a crosslinking agent, etc.) for forming chemical bonds among the base polymers.

[0119]

The rubber-based PSA layer in the art disclosed herein comprises an aforementioned rubber-based polymer A as the base polymer and may further comprise a polymer C having a lower molecular weight than the polymer A. In terms of the molecular weight, Mw is used for comparison to the polymer A. The polymer C preferably has a Mn of 1000 or higher. By this, the gas emission can be limited while obtaining the effect of using the polymer C. In addition, the cohesive strength can be maintained at a practical level. The polymer C's Mn is preferably 2000 or higher, or more preferably 2500 or higher. The maximum molecular weight of the polymer C is not particularly limited as long as it is lower than that of the polymer A, but the Mw is typically lower than 5×10^4. The polymer C's Mw can be lower than about 1×10^4, or even about 5000 or lower. The polymer C according to some embodiments is a liquid or a viscous fluid at room temperature (e.g., 25 °C).

[0120]

For the Mn of polymer C, the value determined by vapor pressure osmometry is used. The Mw of polymer C refers to the value based on polystyrene standards determined by gel permeation chromatography (GPC) analysis. As the GPC analyzer, for instance, model name HLC-8120 GPC available from Tosoh Corporation can be used.

[0121]

The species of polymer C is not particularly limited and a suitable species is selected in accordance with the species of polymer A, etc. As the polymer C, one, two or more species can be used among, for instance, rubber-based polymers (typically diene-based polymers), olefinic polymers, acrylic polymers, polyester-based polymers, urethane-based polymers, polyether-based polymers, silicone-based polymers, polyamide-based polymers, and fluoropolymers. In the PSA sheet for use in a magnetic disc, it is desirable to avoid the use of a silicone-based polymer.

[0122]

The polymer C according to a preferable embodiment is selected among olefinic polymers and diene-based polymers. Presumably, these polymers are likely to block passage of water molecules because they generally have low polarity with short side chains. In addition, they tend to readily dissolve or disperse in the PSA layer that includes the polymer A. In particular, olefinic polymers are more preferable as they are thermally stable and highly weather resistant. The monomers for forming the polymer C can be one, two or more species of monomers selected among ethylene, propylene, butene, isobutylene, isoprene and butadiene. Here, the butene encompasses 1-butene as well as cis- and trans-2-butenes. The polymer C is preferably a polymer formed from a monomer mixture that includes one, two or more species of the monomers exemplified above at a ratio of at least 50 % by weight. Specific examples include ethylene-butene copolymer, ethylene-propylene-butene copolymer, propylene-butene copolymer, ethylene-butene-unconjugated diene copolymer, and ethylene-propylene-butene-unconjugated diene copolymer. Examples of these polymers include so-called ethylene propylene rubber.

[0123]

In a more preferable embodiment, the polymer C is preferably a polymer formed from a monomer mixture that includes at least one species of monomer at a ratio of at least 50 % by weight, selected from the group consisting of butene, isobutylene and isoprene. The polymer obtained from these monomers is hydrophobic and non-polar; and therefore, having excellent properties to block polar substances such as moisture in the air, it is likely to bring about excellent gas-blocking properties. The monomer mixture to form the polymer C includes one, two or more species of the monomers at a ratio of more preferably at least 75 % by weight, yet more preferably at least 85 % by weight, or particularly

preferably at least 90 % (e.g., at least 95 %) by weight. The ratio of these monomers in the entire monomers can also be 99 % by weight or more. The polymer C may be obtained by copolymerizing one, two or more species of other monomers (e.g., butadiene, styrene, ethylene, and propylene) copolymerizable with the monomers exemplified above.

[0124]

The polymer C is particularly preferably a polybutene, that is, a polymer formed from a monomer mixture that includes a monomer selected among butene (1-butene, cis- or trans-2-butene) and isobutene (isobutylene) at a ratio of at least 50 % by weight. The polymerization ratio of butene and isobutene combined in the polybutene as the polymer C is preferably about 75 % by weight or higher, more preferably about 85 % by weight or higher, or yet more preferably about 90 % by weight or higher (e.g., about 95 % by weight or higher). The butene and isobutene content in the entire monomers can also be 99 % by weight or higher.

[0125]

The polybutene is a polymer formed from a monomer mixture that includes isobutene as the primary component and may arbitrarily include a certain amount of normal butene (1-butene, cis- or trans-2-butene). Polybutene is thermally stable and highly weather resistant because, unlike diene-based rubber, its molecular chain is free of a double bond. In addition, because of its molecular structure, the main chain is poorly mobile and tends to have excellent gas-blocking properties. The copolymerization ratio of isobutene in the polybutene is preferably about 50 % by weight or higher, more preferably about 70 % by weight or higher, or possibly about 80 % by weight or higher (e.g., about 90 % by weight or higher).

[0126]

The polymer C can be obtained by a method suitably selected from various known polymerization methods. Alternatively, a commercial product corresponding to the polymer C can be obtained and used. For instance, a polybutene can be obtained by polymerizing a monomer mixture that includes butene and isobutene with the use of a Lewis acid catalyst (e.g., aluminum chloride, boron trifluoride), etc. Alternatively, a species corresponding to the polymer C can be selected and used among commercial products such as the NISSEKI POLYBUTENE series available from JXTG Nippon Oil & Energy Corporation and the NICHIYU POLYBUTENE series available from NOF Corporation.

[0127]

In the PSA layer disclosed herein, the ratio (C_C/C_A) of polymer C content (C_C) to polymer A content (C_A) is suitably about 0.1 or higher. From the standpoint of the gas-blocking properties, the C_C/C_A ratio is preferably about 0.3 or higher, more preferably about 0.5 or higher, or yet more preferably

about 0.7 or higher (e.g., about 0.9 or higher). The C_C/C_A ratio is suitably about 2 or lower. From the standpoint of inhibiting a decrease in holding power, the C_C/C_A ratio is preferably about 1.5 or lower, or more preferably about 1.2 or lower (e.g., about 1.1 or lower).

[0128]

The polymer C content in the PSA layer is suitably selected in view of the effect of polymer C. From the standpoint of the gas-blocking properties, the polymer C content in the PSA layer can be, for instance, about 1 % by weight or higher, 5 % by weight or higher, 15 % by weight or higher, 25 % by weight or higher, or even 35 % by weight or higher. From the standpoint of the cohesive strength, the polymer C content in the PSA layer is suitably about 70 % by weight or lower, or preferably about 60 % by weight or lower (e.g., about 55 % by weight or lower). In some embodiments, the polymer C content in the PSA layer can be, for instance, 50 % by weight or less, less than 30 % by weight, less than 20 % by weight, or even less than 10 % by weight.

[0129]

(Blend of acrylic polymer and rubber-based polymer)

In some embodiments, the PSA layer according to an embodiment of the art disclosed herein is a rubber-acrylic blend PSA layer comprising a rubber-based polymer and an acrylic polymer as the base polymer. As the rubber-based polymer, one, two or more species can be used among the aforementioned rubber-based polymers. As the acrylic polymer, one, two or more species can be used among the aforementioned acrylic polymers. The rubber-based polymer and acrylic polymer can be suitably mixed together to preferably combine the rubber-based polymer's advantage (gas-blocking properties, etc.) and acrylic polymer's advantage (low gas emission, adhesive properties, etc.). When a rubber-based polymer and an acrylic polymer are used together as the base polymer, the weight ratio of rubber-based polymer (R) to acrylic polymer (A), R/A, can be, for instance, 95/5 to 20/80; it is preferably 90/10 to 30/70, more preferably 80/20 to 40/60, or yet more preferably 70/30 to 50/50.

[0130]

In some preferable embodiments, the PSA layer may have a composition in which the total amount of the base polymer accounts for more than 50 % by weight of the total weight of the PSA layer (i.e., the weight of the PSA layer formed of this particular PSA). For instance, the total amount of the base polymer is preferably about 75 % by weight or more of the total weight of the PSA layer, more preferably about 85 % by weight or more, or yet more preferably about 90 % by weight or more (e.g., 95 % by weight or more).

[0131]

(Crosslinking agent)

The PSA composition (preferably a solvent-based PSA composition) used for forming the PSA layer preferably comprises a crosslinking agent as an optional component. The PSA layer (e.g., an acrylic PSA layer) in the art disclosed herein may include the crosslinking agent in a post-crosslinking-reaction form, a pre-crosslinking-reaction form, a partially-crosslinked form, an intermediate or combined form of these, etc. In typical, the crosslinking agent is mostly included in the PSA layer in the post-crosslinking-reaction form.

[0132]

The type of crosslinking agent is not particularly limited. A suitable species can be selected and used among heretofore known crosslinking agents. Examples of the crosslinking agent include isocyanate-based crosslinking agents, epoxy-based crosslinking agents, oxazoline-based crosslinking agents, aziridine-based crosslinking agents, melamine-based crosslinking agents, carbodiimide-based crosslinking agents, hydrazine-based crosslinking agents, amine-based crosslinking agents, peroxide-based crosslinking agents, metal chelate-based crosslinking agents, metal alkoxide-based crosslinking agents, and metal salt-based crosslinking agents. For the crosslinking agent, solely one species or a combination of two or more species can be used. From the standpoint of reducing gas emission, it is desirable to select the crosslinking agent from non-peroxide compounds. Examples of the crosslinking agent that can be preferably used in the art disclosed herein include isocyanate-based crosslinking agents and epoxy-based crosslinking agents. In particular, isocyanate-based crosslinking agents are more preferable.

[0133]

As the isocyanate-based crosslinking agent, a polyfunctional isocyanate (which refers to a compound having an average of two or more isocyanate groups per molecule, including a compound having an isocyanurate structure) can be preferably used. For the isocyanate-based crosslinking agent, solely one species or a combination of two or more species can be used. A preferable example of the polyfunctional isocyanate has an average of three or more isocyanate groups per molecule. Such a tri-functional or higher polyfunctional isocyanate can be a multimer (e.g., a dimer or a trimer), a derivative (e.g., an addition product of a polyol and two or more polyfunctional isocyanate molecules), a polymer or the like of a di-functional, tri-functional, or higher polyfunctional isocyanate. Examples include polyfunctional isocyanates such as a dimer and a trimer of a diphenylmethane diisocyanate, an isocyanurate (a cyclic trimer) of a hexamethylene diisocyanate, a reaction product of trimethylol propane and a tolylene diisocyanate, a reaction product of trimethylol propane and a hexamethylene diisocyanate, polymethylene polyphenyl isocyanate, polyether polyisocyanate, and polyester polyisocyanate.

[0134]

As the epoxy-based crosslinking agent, a compound having at least two epoxy groups per molecule can be used without particular limitations. A preferable epoxy-based crosslinking agent has three to five epoxy groups per molecule. For the epoxy-based crosslinking agent, solely one species or a combination of two or more species can be used. While no particular limitations are imposed, specific examples of the epoxy-based crosslinking agent include N,N,N′,N′-tetraglycidyl-m-xylenediamine, 1,3-bis(N,N-diglycidylaminomethyl)cyclohexane, 1,6-hexanediol diglycidyl ether, polyethylene glycol diglycidyl ether, and polyglycerol polyglycidyl ether.

[0135]

The crosslinking agent content in the PSA composition disclosed herein is not particularly limited. From the standpoint of the cohesion, to 100 parts by weight of the base polymer (e.g., acrylic polymer), it is suitably about 0.001 part by weight or more, preferably about 0.002 part by weight or more, more preferably about 0.005 part by weight or more, or yet more preferably about 0.01 part by weight or more. From the standpoint of the adhesive strength and elastic modulus, the crosslinking agent content in the PSA composition is, to 100 parts by weight of the base polymer (e.g., acrylic polymer), about 20 parts by weight or less, suitably about 15 parts by weight or less, or preferably about 10 parts by weight or less (e.g., about 5 parts by weight or less). By suitably setting the amount of crosslinking agent, the PSA can show good cohesive strength.

[0136]

In an embodiment using an isocyanate-based crosslinking agent, its amount used is not particularly limited. The isocyanate-based crosslinking agent can be used in an amount of, for instance, about 0.5 part by weight or greater and about 10 parts by weight or less to 100 parts by weight of the base polymer (e.g., acrylic polymer). From the standpoint of the cohesion, the amount of isocyanate-based crosslinking agent used to 100 parts by weight of the base polymer (e.g., acrylic polymer) is suitably about 1 part by weight or greater, or preferably about 1.5 parts by weight or greater. The amount of isocyanate-based crosslinking agent used to 100 parts by weight of the base polymer (e.g., acrylic polymer) is suitably about 8 parts by weight or less, or preferably about 5 parts by weight or less (e.g., less than about 4 parts by weight). By suitably setting the amount of isocyanate-based crosslinking agent used, it is possible to increase the cohesive strength and obtain good repulsion resistance.

[0137]

(Colorant)

The PSA layer may be transparent or colored. With a colored PSA layer, even when the substrate is transparent or semi-transparent, the PSA layer as a whole may have adherend-concealing properties. The form of coloring the PSA layer is not particularly limited. It can be colored (in particular,

colored white) by forming voids such as air bubbles inside the layer or by using a colorant. In some embodiments, the PSA layer may include a colorant. For the colorant, solely one species or a combination of two or more species can be used.

[0138]

As the colorant, similar to the colorant possible used in the substrate, heretofore known pigments and dyes can be used. The colorant is not particularly limited. The colorant may have a color of, for instance, black, gray, white, red, blue, yellow, green, yellow-green, orange, purple, gold, silver and pearl. In some embodiments, the PSA layer includes a black colorant. As the black colorant, among the examples of black colorant used in the substrate, solely one species or a combination of two or more species can be used without particular limitations. As a favorable example of black colorant, carbon black can be used. In other embodiments, the PSA layer includes a white colorant. As the white colorant, among the examples of white colorant used in the substrate, solely one species or a combination of two or more species can be used without particular limitations.

[0139]

In an embodiment where the PSA layer includes a colorant, the colorant content (total amount, total amount included) of the PSA layer is suitably selected in view of the aimed light transmittance, required adhesive properties, etc. The colorant content in the PSA layer is suitably 0.1 % by weight or higher. From the standpoint of reducing the total light transmittance, it is preferably 0.5 % by weight or higher, more preferably 1 % by weight or higher, or yet more preferably 2 % by weight or higher. From the standpoint of the light transmittance, dispersibility in PSA, retention of adhesive properties such as adhesive strength and impact resistance, etc., the colorant content in the PSA layer is possibly 30 % by weight or lower, suitably 20 % by weight or lower, preferably 10 % by weight or lower, or possibly even 5 % by weight or lower. The art disclosed herein can also be preferably implemented in an embodiment where the PSA layer is essentially free of a colorant.

[0140]

(Other additives)

Besides the components described above, the PSA composition may comprise, as necessary, various additives generally known in the field of PSA, such as tackifier (tackifier resin), leveling agent, defoaming agent, crosslinking accelerator, plasticizer, filler, softener, anti-static agent, anti-aging agent, UV absorber, antioxidant and photo-stabilizer. With respect to these various additives, heretofore known species can be used by typical methods. In a PSA sheet for a purpose that unwelcomes siloxane gas (e.g., a PSA sheet applied to the interior of a magnetic disc device or to an area in contact with the interior), it is desirable to avoid the use of a silicone-based additive (e.g., silicone-based leveling agent

and defoaming agent).

[0141]

From the standpoint of limiting gas emissions from the PSA sheet, it is desirable to avoid the use of a low molecular weight component that may cause gas emission. From such a standpoint, the other additive content (e.g., tackifier resin, anti-aging agent, UV absorber, antioxidant, photo-stabilizer) in the PSA layer is preferably limited to below about 30 % (preferably below 10 %, typically below 3 %, e.g., below 1 %) by weight. The art disclosed herein can be preferably implemented in an embodiment where the PSA layer is essentially free of a tackifier resin. The art disclosed herein can also be preferably implemented in an embodiment where the PSA layer is essentially free of UV absorber, antioxidant, and photo-stabilizer such as hindered amine-based photo-stabilizer and hindered phenolic antioxidant.

[0142]

(Formation of PSA layer)

The PSA layer can be formed based on a method for forming a PSA layer in a known PSA sheet. For example, it is preferable to use a method (direct method) where a PSA composition having PSA-layer-forming materials dissolved or dispersed in a suitable solvent is directly provided (typically applied) to a substrate and allowed to dry to form a PSA layer. In another method (transfer method) that can be employed, the PSA composition is provided to a highly-releasable surface (e.g., a surface of a release liner, a substrate's backside that has been treated with release agent, etc.) and allowed to dry to form a PSA layer on the surface, and the PSA layer is transferred to a substrate. As the release face, a release liner surface, a substrate's backside that is highly releasable, and the like can be used. From the standpoint of reducing the amount of silicone in adhesive face, the amount of silicone in release face is preferably at or below a certain level (e.g., at or below 20 ng/cm^2) like the release liner forming the release-lined PSA sheet described later.

[0143]

The form of the PSA composition is not particularly limited. For instance, it can be in various forms, such as a PSA composition (a solvent-based PSA composition) that comprises PSA-layer-forming materials as described above in an organic solvent, a PSA composition (water-dispersed PSA composition, typically an aqueous emulsion-based PSA composition) in which the PSA is dispersed in an aqueous solvent, a PSA composition that is curable by an active energy ray (e.g., UV ray), and a hot-melt PSA composition. From the standpoint of the ease of application and the adhesive properties, a solvent-based PSA composition can be preferably used. As the solvent, it is possible to use one species of solvent or a mixture of two or more species, selected among aromatic compounds (typically aromatic hydrocarbons) such as toluene and xylene; acetic acid esters such as ethyl acetate and butyl acetate; and

aliphatic or alicyclic hydrocarbons such as hexane, cyclohexane, heptane and methyl cyclohexane. While no particular limitations are imposed, it is usually suitable to adjust the solvent-based PSA composition to include 5 % to 45 % non-volatiles (NV) by weight. Too low an NV tends to result in higher production costs while too high an NV may degrade the handling properties such as the ease of application. It can be advantageous to adjust the NV of the solvent-based PSA composition to or below a certain level (preferably to or below 35 % by weight, more preferably to or below 30 % by weight, e.g., to or below 28 % by weight) also in view of facilitating removal of other possible volatiles included besides the solvent by volatilization along with the solvent while the composition is allowed to dry and reducing the amount of thermally released gas of the PSA layer.

[0144]

The PSA composition can be applied, for instance, with a known or commonly used coater such as gravure roll coater, reverse roll coater, kiss roll coater, dip roll coater, bar coater, knife coater, and spray coater. The PSA layer disclosed herein is typically formed in a continuous form, but not limited to such a form. For instance, the PSA layer may be formed in a regular or random pattern of dots, stripes, etc.

From the standpoints of accelerating the crosslinking reaction, improving production efficiency, and the like, it is preferable to dry the PSA composition under heating. The drying temperature can be, for example, about 40 °C to 150 °C, and preferably about 60 °C to 130 °C. After dried, the PSA composition can be subjected to aging to adjust the distribution or migration of components within the PSA layer, to allow the crosslinking reaction to proceed, to reduce distortion possibly present in the PSA layer, etc.

[0145]

(Properties of PSA layer)

The total light transmittance of the PSA layer is not particularly limited. In some embodiments, the PSA layer preferably has a total light transmittance of 75 % or lower. For instance, when the substrate is transparent or semi-transparent, a decrease in total light transmittance of the PSA layer lowers the total light transmittance of the PSA sheet as a whole, whereby the PSA sheet can have adherend-concealing properties at large. The PSA layer has a total light transmittance of preferably 60 % or lower, more preferably 40 % or lower, or yet more preferably 20 % or lower. In some embodiments, the PSA layer has a total light transmittance of 10 % or lower, 3 % or lower, or even lower than 1 %. The minimum total light transmittance of the PSA layer is not particularly limited. It can be essentially 0 %, that is, below detection limit; or 0.01 % or higher, for instance, 0.1 % or higher, or even 1.0 % or higher. In some embodiments, the PSA layer can have a total light transmittance of 5 % or higher, 9 %

or higher, or even 12 % or higher (e.g., 15 % or higher). The total light transmittance of the PSA layer can be reduced by PSA components and like such as use of a colorant, etc. In other embodiments, the PSA layer can have a total light transmittance of higher than 75 %, for instance, 90 % or higher. For instance, when the substrate has a low total light transmittance, the PSA layer may have a relatively high total light transmittance as described above. It is advantageous to use the PSA layer having a high total light transmittance in view of retaining adhesive properties such as adhesive strength, cohesive strength and repulsion resistance. The total light transmittance of the PSA layer is determined by the method described later in Examples.

[0146]

(Thickness of PSA layer)

In the art disclosed herein, the thickness of the PSA layer forming the adhesive face is not particularly limited. The PSA layer usually has a thickness of suitably 3 μm or greater, preferably 10 μm or greater, or more preferably 20 μm or greater. With increasing thickness of the PSA layer, the adhesive strength to adherend tends to increase. Having at least a certain thickness, the PSA layer absorbs the adherend's surface roughness to form tight adhesion. When the PSA layer has a thickness of 10 μm or greater, for instance, it can provide good, tight adhesion to an adherend having a surface whose arithmetic mean surface roughness Ra is about 1 μm to 5 μm (e.g., 3 μm). The thickness of the PSA layer forming the adhesive face can be, for instance, 150 μm or less; it is suitably 100 μm or less, or preferably 70 μm or less. By decreasing the thickness of the PSA layer, the gas emissions from the PSA layer can be reduced. A smaller thickness of the PSA layer is also advantageous from the standpoint of reducing the thickness and weight of the PSA sheet. In some embodiments, the thickness of the PSA layer can be, for instance, 50 μm or less, 35 μm or less, or even 30 μm or less.

[0147]

<Release liner>

In the art disclosed herein, a release liner can be used during formation of the PSA layer; fabrication of the PSA sheet; storage, distribution and shape machining of the PSA sheet prior to use, etc. The release liner is not particularly limited. For example, it is possible to use a release liner having a release layer on the surface of a liner substrate such as resin film and paper; a release liner formed from a low adhesive material such as a fluoropolymer (polytetrafluoroethylene, polychlorotrifluoroethylene, polyvinyl fluoride, polyvinylidene fluoride, tetrafluoroethylene-hexafluoropropylene copolymer, chlorofluoroethylene-vinylidene fluoride copolymer, etc.) or a polyolefinic resin (PE, PP, etc.); or the like. The release layer can be formed, for instance, by subjecting the liner substrate to a surface treatment with a release agent such as a silicone-based, long-chain alkyl-based, fluorine-based, or molybdenum

disulfide-based release agent. When the PSA sheet disclosed herein is applied to a magnetic disc device (e.g., to the interior of the magnetic disc device, or to an area facing the interior), it is particularly preferable to use a non-silicone-based release liner free of a silicone-based release agent which may produce siloxane gas. A particularly preferable release liner is a polyolefinic release liner that is monolayered or multilayered with two or more layers, having a polyolefinic resin layer forming the PSA layer-facing side. A polyethylene-based release liner in which the layer forming the PSA layer-facing side is formed of polyethylene is particularly preferable. In the polyolefinic release liner, at least the layer forming the PSA layer-facing side should be formed of a polyolefinic resin; it can be, for instance, a laminate film of a polyolefinic resin and a non-polyolefinic resin.

[0148]

The thickness of release liner is not particularly limited; it can be, for instance, 20 μm or greater, 40 μm or greater, or even 60 μm or greater. In some embodiments, the release liner may have a thickness of, for instance, 180 μm or less, 150 μm or less, 120 μm or less, or even 100 μm or less. From the standpoint of reducing the total thickness of the release-lined PSA sheet, it is preferable that the release liner is not excessively thick.

[0149]

<Applications>

The PSA sheet disclosed herein provides excellent concealment of adherend surface shapes; and therefore, it is suited for various applications requiring or desiring good appearances. For instance, when applied to a surface susceptible to formation of contours such as weld marks and dents, it enables concealment by which the presence of the contours cannot be visually recognized. For instance, the PSA sheet disclosed herein is preferably used for various electronic devices. More specifically, it is preferably used as a wrapping material (e.g., a sealing material to seal its internal space) in the electronic devices. In some preferable embodiments, for instance, the PSA sheet is preferably used for sealing the internal space of a magnetic disc device such as HDD. In this application, an included gas such as siloxane may cause damage to the device; and therefore, it is important to prevent such gas contamination. The PSA sheet according to some preferable embodiments shows excellent gas-blocking properties, which can be an advantageous property in the application. In particular, for instance, in a magnetic disc device employing HAMR (heat assist magnetic recording), it is important to prevent entrance of water which badly affects the recording life. In simple terms, the HAMR technology uses laser beam to increase surface recording density. By using the PSA sheet disclosed herein for such a purpose (i.e., for use as a sealing material (or a cover seal) for HAMR magnetic disc device), a magnetic recording device having a higher density can be obtained. Other favorable applications include use as a printing label applied to

outer faces of products such as the magnetic disc device. When the PSA sheet disclosed herein is used as a printing label, in addition to providing product information and like with the printing label, it can conceal contours such as weld marks and dents present on the product outer face to which the printing label is applied.

[0150]

Fig. 3 shows a structural example of the magnetic disc device as a favorable example to which the art disclosed herein can be applied. Fig. 3 shows a cross-sectional diagram schematically illustrating the magnetic disc device. A magnetic disc device 100 comprises a data-recording magnetic disc 110, a spindle motor 112 that rotates magnetic disc 110, a magnetic head 114 that reads and writes data on magnetic disc 110, and an actuator 116 that supplies power to magnetic head 114. Actuator 116 has a built-in linear motor not shown in the drawing. In this embodiment, two magnetic discs 110 are included, but it is not limited to this and three or more magnetic discs may be included.

[0151]

These components of magnetic disc device 100 are placed in a housing (also called a casing)120 which serves as a casing for magnetic disc device 100. In particular, the components of magnetic disc device 100 are contained in a box-shaped housing base member (a support structure) 122 having a top opening and the top opening of housing base member 122 is covered with a rigid cover member (also called a top cover) 124. More specifically, the top opening of housing base member 122 has a recessed portion around the inner circumference and the outer rim of cover member 124 is placed on the bottom of recessed portion 126, with cover member 124 covering the opening. A PSA sheet 101 is applied from the top face of cover member 124 so as to entirely cover the cover member 124 and the top face (outer circumference of the opening) of housing 120, that is, the entire top face of housing 120, altogether. This seals a space present between housing base member 122 and cover member 124 as well as other holes and void spaces that communicate from the inside to the outside of magnetic disc device 100, thereby keeping the inside of the device air-tight. Such a sealing structure using PSA sheet 101 as the sealing material (cover seal) can be made thinner than a conventional counterpart that uses a cover member and a gasket to obtain air-tight properties. In addition, because it does not require the use of a liquid gasket, gas emission from the gasket can be eliminated as well.

[0152]

As shown in the drawing, PSA sheet 101 is applied not only to cover the top face of housing 120, but also to cover part of the adjacent side face, further extending beyond the top face and bending at an edge (corner) of the top face. By this, even when a dent is formed at a corner of the outer surface of housing 120, it can be applied to cover two faces including the corner to enable concealment to make the

corner dent invisible. In this structural example, in magnetic disc device 100, PSA sheet 101 is applied, at least partially covering the top and side faces of housing 120 in a U shape. More specifically, PSA sheet 101 covers cover member 124 and the top face (outer circumference of the opening) of housing base member 122 altogether (covering with main body 101a of PSA sheet 101) and further has a margin (or an extending portion 101b) that further extends to the side of housing 120. In particular, extending portion 101b is bent from the top face over the corner of top rim to the side of housing base member 122. Such an extending portion 101b may be provided entirely or partially at each side forming the outer circumference of the top face of housing 120.

[0153]

In these embodiments, cover members 124 and 224 cover magnetic discs 110 and 210 as well as actuators 116 and 216 altogether, respectively, in one piece. However, they are not limited to these. They may cover magnetic discs 110 and 210, actuators 116 and 216, and other components, separately; or they may not cover actuators 116 or 216 while covering magnetic discs 110 and 210. Even in these embodiments, by applying the PSA sheet over the cover member, the inside of the device can be made air-tight. In a magnetic disc device having such an embodiment, the air-tight properties are obtained with the thin PSA sheet, thereby achieving a thin sealing structure. This can increase the capacity for housing magnetic discs, bringing about a magnetic disc device having a higher density and a larger capacity.

[0154]

Fig. 4 shows a top view schematically illustrating the shape of PSA sheet 101 before applied to magnetic disc device 100. PSA sheet 101 has a rectangular main body 101a applied to the top face of the magnetic disc device, and four margins 101b extending from the respective sides (four sides) of main body 101a. Each margin 101b has a rectangular shape having a width equal to the length of the adjacent side of main body 101a, but is not limited to this. It may have various shapes such as a trapezoidal shape narrowing in the direction that extends from main body 101a, or having an R corner.

[0155]

Fig. 5 and Fig. 6 show other structural examples of the magnetic disc device to which the art disclosed herein can be applied. Fig. 5 and Fig. 6 show cross-sectional views corresponding to Fig. 3. In these drawings, housings 120 of magnetic disc devices 200 and 300 are simplified and only PSA sheets 201 and 301 are schematically shown in cross-sectional views. In magnetic disc device 200 shown in Fig. 5, PSA sheet 201 is applied to part of the top face of housing 120 of magnetic disc device 200. Such a PSA sheet 201 can be used as a sealing material (cover seal) for magnetic disc device 200 or can also be used as a print label. In magnetic disc device 300 shown in Fig. 6, PSA sheet 301 is circularly applied to the outer circumference of the top face (top cover 124) of housing 120 of the magnetic disc device.

More specifically, PSA sheet 301 covers corners located at edges of the top face of housing 120, bent to cover the top and side faces of housing 120 and applied along the top face outer circumference in housing 120. With respect to other features of the structures shown in Fig. 5 and Fig. 6, the same is basically true as the structure shown in Fig. 3. Thus, redundant description is omitted.

[0156]

While no particular limitations are imposed, the PSA sheet may have a size equivalent to at least 20 % up to 150 % of area of at least one face (adherend face, typically the housing top face) of the outer housing surface in the magnetic disc device. The PSA sheet in such a size can conceal only part of the adherend face or can also conceal the entire adherend face. Furthermore, the PSA sheet can cover not only the one adherend face, but also an adjacent face. With respect to the PSA sheet applied in such an embodiment, even when a dent such as a hit mark is formed on a corner of the outer housing surface of the magnetic disc device, it can be applied over two faces including the corner to invisibly conceal the corner dent. Such a PSA sheet applied over at least two faces can have a size larger than one of the adherend faces or a size smaller than the one face. For instance, it may be applied to the top cover outer circumference in a magnetic disc device such as HDD.

[0157]

In some preferable embodiments, the PSA sheet size is larger than 100 % of the adherend face (typically the housing top face) of the outer housing surface in the magnetic disc device, possibly 110 % or greater, 120 % or greater. The maximum value can be, for instance, 150 % or less, 140 % or less, or even 125 % or less. The PSA sheet in such a size is preferably used as a cover seal applied over the top and side faces of a magnetic disc device to cover the corner there. In other embodiments, the PSA sheet size is up to 100 % of the adherend face (typically the housing top face) of the outer housing surface in the magnetic disc device, possibly 80 % or less, or even 60 % or less. The minimum value can be, for instance, 30 % or greater, or even 50 % or greater. The PSA sheet in such a size is preferably used as a cover seal for a magnetic disc device or as a print label. For instance, on an adherend surface, it can be applied to only a dented area to conceal the adherend shape. Such an application may extend over two faces forming the adherend outer surface, partially covering each of the two faces.

[0158]

Matters disclosed by this description include the following:

(1) A magnetic disc device comprising

at least one data-recording magnetic disc,

a motor that rotates the magnetic disc,

a magnetic head that at least either reads or writes data on the magnetic disc,

an actuator that moves the magnetic head, and

a housing that houses the magnetic disc, the motor, the magnetic head and the actuator; wherein

the housing is provided with a cover seal, the cover seal being a PSA sheet comprising a PSA layer and a substrate supporting the PSA layer,

the PSA sheet has an adhesive face formed of the PSA layer and a backside opposite to the adhesive face (i.e., the reverse side of the adhesive face), and

the backside of the PSA sheet has a gloss of 80 GU or lower and the PSA sheet has a total light transmittance of 75 % or lower.

(2) The magnetic disc device according to (1) above, wherein the housing comprises a box-shaped housing base member having a top opening and a cover member covering the opening.

(3) The magnetic disc device according to (2) above, wherein the housing base member has a recessed portion around the inner circumference of the top opening and the outer rim of the cover member is placed on the bottom of the recessed portion.

(4) The magnetic disc device according to any of (1) to (3) above, wherein the cover member has a hole.

(5) The magnetic disc device according to any of (1) to (4) above, wherein the PSA sheet seals the internal space of the magnetic disc device.

(6) The magnetic disc device according to any of (1) to (5) above, wherein the PSA sheet covers and seals the top face of the housing base member of the magnetic disc device.

(7) The magnetic disc device according to any of (1) to (6) above, capable of heat-assisted magnetic recording.

(8) The magnetic disc device according to any of (1) to (7) above, wherein the backside of the PSA sheet has an arithmetic average roughness in the range of 50 nm or greater and 3000 nm or less.

(9) The magnetic disc device according to any of (1) to (8) above, wherein

the PSA sheet is applied to at least one face of the outer housing surface of the magnetic disc device (e.g., a hard disc drive), and

the PSA sheet has a size equivalent to at least 20 % up to 150 % of the area of the one face.

(10) The magnetic disc device according to any of (1) to (9) above, wherein the PSA sheet is applied to the top cover outer circumference in the magnetic disc device (e.g., a hard disc drive).

[0159]

(11) A PSA sheet having a PSA layer and a substrate supporting the PSA layer, wherein

the PSA sheet has an adhesive face formed of the PSA layer and a backside opposite to the

adhesive face (i.e., the reverse side of the adhesive face), and

the backside of the PSA sheet has a gloss of 80 GU or lower and the PSA sheet has a total light transmittance of 75 % or lower.

(12) The PSA sheet according to (11) above, wherein the backside of the PSA sheet has an arithmetic average roughness in the range of 50 nm or greater and 3000 nm or less.

(13) The PSA sheet according to (11) or (12) above, wherein the backside of the PSA sheet has a haze value of 70 % or higher.

(14) The PSA sheet according to any of (11) to (13) above, having a gas emission of 1.0 μg/cm^2 or less, determined at 130 °C for 30 minutes by GC-MS.

(15) The PSA sheet according to any of (11) to (14) above, having a siloxane gas emission of 0.1 μg/cm^2 or less, determined at 130 °C for 30 minutes by GC-MS.

(16) The PSA sheet according to any of (11) to (15) above, wherein the substrate is formed of a resin monolayer.

(17) The PSA sheet according to (16) above, wherein the substrate has a total light transmittance of 20 % or lower.

(18) The PSA sheet according to (16) or (17) above, wherein the PSA layer has a total light transmittance of 20 % or lower.

(19) The PSA sheet according to any of (11) to (18) above, wherein the substrate has a thickness of 20 μm or greater and 200 μm or less.

(20) The PSA sheet according to any of (11) to (15) above, wherein the substrate has one, two or more resin layers as well as a metal layer.

(21) The PSA sheet according to (20) above, wherein the metal layer has a thickness of 2 μm or greater and 30 μm or less.

(22) The PSA sheet according to (20) or (21) above, wherein the resin layer has a thickness of 20 μm or greater and 200 μm or less.

(23) The PSA sheet according to any of (20) to (22) above, wherein the substrate has, as the resin layers, resin layers A and B placed to have the metal layer therebetween, and the resin layer A is placed on the side of the PSA sheet backside.

(24) A release-lined PSA sheet having the PSA sheet according to any of (11) to (23) above, and a polyolefinic release liner protecting the adhesive face of the PSA sheet.

(25) The PSA sheet according to any of (11) to (23) above, that is for application to at least one face of the outer housing surface of a hard disc drive, and the PSA sheet has a size equivalent to at least 20 % up to 150 % of the area of the one face.

(26) The PSA sheet according to any of (11) to (23) above, that is for application to the top cover outer circumference in a hard disc drive.

[0160]

(27) A magnetic disc device comprising the PSA sheet according to any of (11) to (23) above.

(28) The magnetic disc device according to (27) above, wherein the PSA sheet seals the internal space of the magnetic disc device.

(29) The magnetic disc device according to (27) or (28) above, wherein the magnetic disc device has a housing base member and the PSA sheet is a cover seal that covers and seals the top face of the housing base member.

(30) The magnetic disc device according to any of (27) to (29) above, wherein

the PSA sheet is applied to at least one face of the outer housing surface of a magnetic disc drive (e.g., a hard disc drive), and

the PSA sheet has a size equivalent to at least 20 % up to 150 % of the area of the one face.

(31) The magnetic disc device according to any of (27) to (30) above, wherein the PSA sheet is applied to the top cover outer circumference in the magnetic disc device (e.g., a hard disc drive).

[0161]

Several working examples related to the present invention are described below, but the present invention is not intended to be limited to these examples. In the description below, "parts" and "%" are by weight unless otherwise specified.

[0162]

<Test Methods>

[Backside 60° gloss]

The 60° gloss (GU) of PSA sheet backside is determined at a measurement angel of 60°, using a commercial gloss meter (e.g., product name Cat. No. 4563 micro-TRI-gloss available from BYK). The 60° gloss (GU) of substrate surface is also determined by the same method.

[0163]

[Total light transmittance and haze value]

The total light transmittance (%) and haze value (%) of a PSA sheet refer to the total light transmittance and haze value in the thickness direction of the PSA sheet peeled from the release liner, and are determined based on JIS K 7136:2000, using a commercial haze meter. The haze value of the PSA sheet is the haze value of the PSA sheet backside and can be the haze value of the substrate by itself excluding the PSA layer from the PSA sheet. As the haze meter, product name HAZEMETER HZ-V3 available from Suga Test Instruments Co., Ltd. or a comparable product is used. The total light

transmittance (%) of a substrate is also determined by the same method. As for the total light transmittance of a PSA layer, a measurement sample obtained by adhering the PSA monolayer to PET film having a high total light transmittance (93 % in particular) (product name LUMIRROR #38-U48 available from Toray Industries, Inc.) is subjected to measurement and the resulting value is used as the PSA layer's total light transmittance. Besides this, the measurement is carried out in the same manner as the above. For instance, a PSA monolayer (double-faced PSA sheet) with each face protected with a release liner is adhered to the aforementioned PET film upon removal of the light-peel-side release liner; and using the resultant, the total light transmittance of the PSA layer can be determined.

[0164]

[Backside arithmetic average roughness Ra]

The arithmetic average roughness Ra (nm) of PSA sheet backside is determined, using a general surface roughness analyzer (e.g., non-contact three-dimensional surface shape analyzer Wyko NT-3300 available from Veeco). The arithmetic average roughness (nm) of substrate surface is also determined by the same method.

[0165]

[Gas emission and siloxane gas emission]

The gas emission of PSA sheet is determined based on the dynamic headspace method. In particular, a PSA sheet subject to measurement is cut out to a 7 cm^2 size to obtain a measurement sample. The measurement sample is sealed in a 50 mL vial and heated at 130 °C for 30 minutes, using a headspace autosampler. As the headspace autosampler, a commercial product can be used without particular limitations. For instance, product name EQ-12031HSA available from JEOL Ltd., or a comparable product can be used. The total gas emission (total amount of gas) and the siloxane gas emission (cyclic siloxane emission including trimer, tetramer, pentamer and hexamer) from the measurement sample are determined by gas chromatography/mass spectrometry (GC-MS). A commercial GC-MS can be used. These gas emissions are the amounts of gas released per unit surface area of PSA sheet (in $\mu g/cm^2$ or ng/cm^2).

[0166]

[Adherend surface shape concealment test]

The concealment of adherend surface shape by a PSA sheet is evaluated, using a surface shape analyzer (product name Optimap PSD) available from Rhopoint Instruments. By using such a surface shape analyzer, visual evaluation of concealing properties can be made with an objective numerical value. In particular, the level of concealment (in visual inspection) of adherend surface shape by the PSA sheet can be numerically expressed (curvature (m^{-1})), including not only detection of contours, but also

the image clarity (contour pattern, etc.) of adherend surface through the PSA sheet. The specific test method is as follows: A test panel is used, with the panel having an aluminum punching plate with many punched holes (punched hole diameter 5 mm, 0.3 mm thick) bonded to a stainless steel plate. To this test panel, a PSA sheet to be tested is applied. With respect to the PSA sheet backside, using the surface shape analyzer, from X-Y data between 0.3 mm and 1.0 mm wavelength, the curvature (corresponding to visual observation from 40 cm away) is obtained. A smaller curvature indicates that the punching plate contours are less visible through the PSA sheet. When the curvature is 15 m^{-1} or smaller, it is judged that the adherend surface shape is concealed.

[0167]

<Example 1>

(Preparation of PSA composition)

Using ethyl acetate as solvent and 0.1 part of azobisisobutyronitrile as initiator, by a typical method, were solution-polymerized 93 parts of butyl acrylate, 7 parts of acrylic acid and 0.1 part of 4-hydroxybutyl acrylate to obtain a solution (25 % non-volatiles) of acrylic polymer with 150×10^4 weight average molecular weight. To this solution, relative to 100 parts of the acrylic polymer, was added 2 parts (by non-volatiles) of isocyanate-based crosslinking agent (product name CORONATE L available from Tosoh Corporation; a trimethylolpropane adduct of tolylene diisocyanate, 75 % non-volatiles) to obtain an acrylic PSA composition solution.

[0168]

(Preparation of substrate)

By dry bonding lamination, were laminated 38 μm thick white-colored PET film (product name LUMIRROR E20 available from Toray Industries, Inc.) as a resin layer A, 7 μm thick aluminum foil as a metal layer and 9 μm thick PET film as a resin layer B in this order to obtain a substrate according to this Example. Between each resin layer and the metal layer, was laminated a 4 μm thick adhesive layer.

[0169]

(Preparation of PSA sheet)

The acrylic PSA composition was applied to one face (resin layer B-side surface) of the substrate to have a thickness of 30 μm after dried, and allowed to dry at 120 °C for 3 minutes to form a PSA layer on the substrate. A PSA sheet was thus obtained according to this Example. To the surface (adhesive face) of the PSA layer, was adhered a release-treated and embossed polyolefinic release liner (product name SFL-70T4 available from Sun A Kaken Co., Ltd., 70 μm thick) to obtain a release-lined PSA sheet according to this Example.

[0170]

<Examples 2 and 3>

As the resin layer A, metal layer and resin layer B, were used the materials having the thicknesses shown in Table 1. Otherwise in the same manner as Example 1, were obtained a PSA sheet and a release-lined PSA sheet according to each Example.

[0171]

<Example 4>

(Preparation of PSA composition)

In toluene, was dissolved 50 parts of butyl rubber (IIR; product name JSR BUTYL 268 available from JSR Corporation, $Mw \approx 54 \times 10^4$, $Mw/Mn \approx 4.5$) as base polymer and 50 parts of polybutene (product name NISSEKI POLYBUTENE HV-1900 available from JXTG Nippon Oil & Energy Corporation; Mn 2900) to prepare a PSA composition with 25 % non-volatiles (NV).

[0172]

(Preparation of substrate)

By dry bonding lamination, were laminated 50 μm thick PET film (product name E-150 available from Mitsubishi Chemical Corporation) as a resin layer A, 7 μm thick aluminum foil as a metal layer and 9 μm thick PET film as a resin layer B in this order to obtain a substrate according to this Example. Between each resin layer and the metal layer, was laminated a 4 μm thick adhesive layer.

[0173]

(Preparation of PSA sheet)

Using the PSA composition and substrate obtained above, but otherwise in the same manner as Example 1, was obtained a PSA sheet according to this Example. To the PSA layer surface (adhesive face), was adhered a release-treated silicone-based release liner (product name HP-S0 available from Fujico Co., Ltd.; 50 μm thick) to obtain a release-lined PSA sheet according to this Example.

[0174]

<Example 5>

As the resin layer A, was used 50 μm thick PET film (product name LUMIRROR X42G available from Toray Industries, Inc.). Otherwise in the same manner as Example 2, was obtained a substrate (resin layer A/metal layer/resin layer B laminate) according to this Example. Using this substrate, but otherwise in the same manner as Example 2, were obtained a PSA sheet and a release-lined PSA sheet according to this Example.

[0175]

<Example 6>

Was obtained 50 μm thick white-colored PET film (product name LUMIRROR E20 available from Toray Industries, Inc.) having one sand matte surface. Using this as the resin layer A, but otherwise in the same manner as Example 2, was obtained a substrate (resin layer A/metal layer/resin layer B laminate) according to this Example. Using this substrate, but otherwise in the same manner as Example 2, were obtained a PSA sheet and a release-lined PSA sheet according to this Example. In the PSA sheet of this Example, the matte face of the resin layer A is placed on the PSA sheet backside.

[0176]

<Example 7>

By dry bonding lamination, were laminated 75 μm thick white-colored PET film (product name LUMIRROR E20 available from Toray Industries, Inc.) as a resin layer and 7 μm thick aluminum foil as a metal layer to obtain a substrate according to this Example. Between the resin layer and the metal layer, was laminated a 4 μm thick adhesive layer. Using the resulting substrate, but otherwise in the same manner as Example 1, were obtained a PSA sheet and a release-lined PSA sheet according to this Example.

[0177]

<Example 8>

As the substrate (substrate consisting of a resin layer), was used 50 μm thick white-colored PET film (product name CRISPER #50 available from Toyobo Co., Ltd.). Besides this, in the same manner as Example 1, were obtained a PSA sheet and a release-lined PSA sheet according to this Example.

[0178]

<Example 9>

Was obtained 50 μm thick white-colored PET film (product name LUMIRROR E20 available from Toray Industries, Inc.) having one sand matte surface. Using this as the substrate (substrate consisting of a resin layer), but otherwise in the same manner as Example 1, were obtained a PSA sheet and a release-lined PSA sheet according to this Example. In the PSA sheet of this Example, the matte face of the substrate is placed on the PSA sheet backside.

[0179]

<Example 10>

In preparing the acrylic PSA composition according to Example 1, to 100 parts of the acrylic polymer, was added 3 parts of a black pigment (product name ATDN101 BLACK available from Dainichiseika Color & Chemicals Mfg. Co., Ltd.) in addition to 2 parts of the isocyanate-based crosslinking agent to obtain an acrylic PSA composition solution according to this Example.

To one face of 50 μm thick PET film (product name LUMIRROR X42G available from Toray Industries, Inc.) as the substrate, the resulting acrylic PSA composition was applied to have a thickness of 35 μm after dried, and allowed to dry at 120 °C for 3 minutes to form a PSA layer on the substrate. A PSA sheet was thus obtained according to this Example. To the PSA layer surface (adhesive face), was adhered a release-treated and embossed polyolefinic release liner (product name SFL-70T4 available from Sun A Kaken Co., Ltd., 70 μm thick) to obtain a release-lined PSA sheet according to this Example. The PSA layer according to this Example had a total light transmittance of 20 % or lower by itself.

[0180]

<Comparative Example 1>

As the resin layer A, was used 25 μm thick transparent PET film (product name LUMIRROR S10 available from Toray Industries, Inc.). Otherwise in the same manner as Example 1, was obtained a substrate (resin layer A/metal layer/resin layer B laminate) according to this Example. Using this substrate, but otherwise in the same manner as Example 1, were obtained a PSA sheet and a release-lined PSA sheet according to this Example.

[0181]

<Comparative Examples 2 and 3>

As the substrate (substrate consisting of a resin layer), was used 50 μm thick PET film (product name E-150 available from Mitsubishi Chemical Corporation) (Comp. Ex. 2) or 38 μm thick PET film (product name LUMIRROR EA3Savailable from Mitsubishi Chemical Corporation) (Comp. Ex. 3). Besides this, in the same manner as Example 1, were obtained a PSA sheet and a release-lined PSA sheet according to this Example.

[0182]

Table 1 summarizes the features and test results of the PSA sheet according to each Example.

[0183]

[Table 1]

Table 1

		Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Ex. 7	Ex. 8	Ex. 9	Ex. 10	Comp. Ex. 1	Comp. Ex. 2	Comp. Ex. 3
Color of PSA sheet backside		White	White	White	Gray	Gray	White	White	White	White	Gray	Silver	Semitransparent white	Semitransparent white
Substrate (μm)	Resin layer A	38	50	38	50	50	50	75	50	50	50	25	50	38
	Metal layer	7	7	30	7	7	7	7	-	-	-	7	-	-
	Resin layer B	9	9	12	9	9	9	-	-	-	-	9	-	-
Total substrate thickness (μm)		62	74	88	74	74	74	86	50	50	50	49	50	38
PSA type (color)		Acrylic (transparent)	Acrylic (transparent)	Acrylic (transparent)	Rubber-based (transparent)	Acrylic (transparent)	Acrylic (transparent)	Acrylic (transparent)	Acrylic (transparent)	Acrylic (transparent)	Acrylic (black)	Acrylic (transparent)	Acrylic (transparent)	Acrylic (transparent)
PSA layer thickness (μm)		30	30	30	30	30	30	30	30	30	30	30	30	30
Backside 60° gloss (GU)		38.2	35.7	35.7	55.4	14.7	8.2	40.3	59	8.2	14.7	125.8	45.3	83.8
Total light transmittance (%)		0	0	0	0	0	0	0	13	11.8	19.3	0	75.9	18.6
Haze value (%)		98.9	100	100	79.5	98.1	100	100	99.5	100	98.1	5.5	79.5	99.5
Backside arithmetic average roughness Ra (nm)		270	270	270	400	460	620	270	170	620	460	40	400	109
Gas emission ($\mu g/cm^2$)		< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Siloxane gas emission (ng/cm^2)		< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Concealment of adherend surface shape (m^{-1})		10	7.3	12.1	7.2	3.4	1.9	4.1	9.8	2.1	7.5	16.2	36.2	15.1

[0184]

As shown in Table 1, the PSA sheets according to Examples 1 to 10 with PSA sheet backside gloss ≤ 80 GU and total light transmittances ≤ 75 % had PSA sheet backside curvatures of 15 m^{-1} or less in the adherend surface shape concealment test. On the other hand, the PSA sheets of Comparative Examples 1 to 3 with backside gloss > 80 GU or total light transmittance > 75 % had PSA sheet curvatures of greater than 15 m^{-1} in the adherend surface shape concealment test. These results indicate that according to a PSA sheet having a PSA sheet backside gloss of 80 GU or lower and a total light transmittance of 75 % or lower, even when applied to a contoured adherend surface, the adherend surface shape becomes less visible.

It is noted that although not shown in Table 1, the PSA sheets according to all Examples showed no lifting in the flexible bonding test. The PSA sheets according to Examples 1 to 7 had moisture permeabilities below 0.01 g/(m^2·24h).

[0185]

Although specific embodiments of the present invention have been described in detail above, these are merely for illustrations and do not limit the scope of claims. The art according to the claims includes various modifications and changes made to the specific embodiments illustrated above.

[Reference Signs List]

[0186]

1, 2, 101, 201, 301 PSA sheets

1A, 2A adhesive faces

1B, 2B backsides

10 substrate

12 resin layer A

14 inorganic layer

16 resin layer B

20 PSA layer

30 release liner

51, 52 release-lined PSA sheets

100, 200, 300 magnetic disc devices

[Claims]

[Claim 1]

A pressure-sensitive adhesive sheet having a pressure-sensitive adhesive layer and a substrate supporting the pressure-sensitive adhesive layer, wherein

the pressure-sensitive adhesive sheet has an adhesive face formed of the pressure-sensitive adhesive layer and a backside opposite to the adhesive face, and

the backside of the pressure-sensitive adhesive sheet has a gloss of 80 GU or lower and the pressure-sensitive adhesive sheet has a total light transmittance of 75 % or lower.

[Claim 2]

The pressure-sensitive adhesive sheet according to Claim 1, wherein the backside of the pressure-sensitive adhesive sheet has an arithmetic average roughness in the range of 50 nm or greater and 3000 nm or less.

[Claim 3]

The pressure-sensitive adhesive sheet according to Claim 1 or 2, wherein the backside of the pressure-sensitive adhesive sheet has a haze value of 70 % or higher.

[Claim 4]

The pressure-sensitive adhesive sheet according to any one of Claims 1 to 3, having a gas emission of 1.0 μg/cm^2 or less, determined at 130 °C for 30 minutes by gas chromatography/mass spectrometry.

[Claim 5]

The pressure-sensitive adhesive sheet according to any one of Claims 1 to 4, having a siloxane gas emission of 0.1 μg/cm^2 or less, determined at 130 °C for 30 minutes by gas chromatography/mass spectrometry.

[Claim 6]

The pressure-sensitive adhesive sheet according to any one of Claims 1 to 5, wherein the substrate is formed of a resin monolayer.

[Claim 7]

The pressure-sensitive adhesive sheet according to Claim 6, wherein the substrate has a total light transmittance of 20 % or lower.

[Claim 8]

The pressure-sensitive adhesive sheet according to Claim 6 or 7, wherein the pressure-sensitive adhesive layer has a total light transmittance of 20 % or lower.

[Claim 9]

The pressure-sensitive adhesive sheet according to any one of Claims 1 to 8, wherein the substrate has a thickness of 20 μm or greater and 200 μm or less.

[Claim 10]

The pressure-sensitive adhesive sheet according to any one of Claims 1 to 5, wherein the substrate has one, two or more resin layers as well as a metal layer.

[Claim 11]

The pressure-sensitive adhesive sheet according to Claim 10, wherein the metal layer has a thickness of 2 μm or greater and 30 μm or less.

[Claim 12]

The pressure-sensitive adhesive sheet according to Claim 10 or 11, wherein the resin layer has a thickness of 20 μm or greater and 200 μm or less.

[Claim 13]

The pressure-sensitive adhesive sheet according to any one of Claims 10 to 12, wherein the substrate has, as the resin layers, resin layers A and B placed to have the metal layer therebetween, and the resin layer A is placed on the side of the pressure-sensitive adhesive sheet backside.

[Claim 14]

A release-lined pressure-sensitive adhesive sheet having the pressure-sensitive adhesive sheet according to any one of Claims 1 to 13, and a polyolefinic release liner protecting the adhesive face of the pressure-sensitive adhesive sheet.

[Claim 15]

The pressure-sensitive adhesive sheet according to any one of Claims 1 to 13, that is for application to at least one face of the outer housing surface of a hard disc drive, and the pressure-sensitive adhesive sheet has a size equivalent to at least 20 % up to 150 % of the area of the one face.

[Claim 16]

The pressure-sensitive adhesive sheet according to any one of Claims 1 to 13, that is for application to the top cover outer circumference in a hard disc drive.