[DESCRIPTION]

[TITLE OF THE INVENTION]

FILM FOR SPACER AND METHOD OF FORMING SPACER USING THE SAME

[BACKGROUND OF THE INVENTION]

1. Field of the Invention

The present invention relates to a film for a spacer applied to a multi-chip package and a method of forming a spacer using the same.

2. Description of the Related Art

With the development of semiconductor device manufacturing technologies, many studies have been performed on reduction in the size and multifunctional properties of electronic devices. Multi-chip package (MCP) technology is one of packaging solutions of semiconductor chips, and is a technology for implementing the same type of semiconductor chips or different types of semiconductor chips into a single package. The multi-chip package technology allows to implement high-speed transmission in a narrow package area, thereby having advantages in terms of reduction in the size and weight compared to the case of implementing the respective semiconductor chips as a separate package.

In order to obtain an effect of size reduction in the multi-chip package, it is necessary to stack a plurality of semiconductor chips and arrange the stacked body in one package. In this case, a component used for such the process is a spacer. For example, in a package in which two semiconductor chips are stacked, one semiconductor chip is directly attached to a package substrate, whereas the other semiconductor chip is not directly attached to the package substrate. A component serves to support the semiconductor chip which is not directly attached to the package substrate is the spacer.

The spacer is generally made of metal, a polymer, a photosensitive resist and the like. When the spacer is made of the metal or photosensitive resist, a method, in which the metal or photosensitive resist is deposited or coated on the package substrate, then a portion other than the spacer is removed by etching, may be used. When the spacer is made of the metal or polymer, a method, in which a spacer is manufactured in a predetermined shape and the spacer is bonded on the package substrate, may be used.

The method of forming a spacer by depositing or coating the metal or photosensitive resist then removing the portion other than the spacer by etching not only requires a complicated process such as photolithography, but also has a problem such as waste of materials. The method of manufacturing a spacer having a predetermined size and bonding the spacer on the

package substrate has problems in that it is not easy to accurately manufacture the spacer having the required size, as well as it is difficult to accurately attach the spacer on the package substrate.

Further, there is a method of manufacturing a spacer by using (cutting) a dummy wafer and bonding the spacer on the package substrate. In the case of this method, there is a problem of wasting the dummy wafer.

Meanwhile, a method of using a polymer film including a component such as polyimide instead of the dummy wafer as a spacer may be considered. However, a phenomenon, in which the film is bent at an edge portion of the chip due to a low elastic modulus of the polymer film after dicing, occurs, and thereby resulting in a failure in recognizing the die and a reduction in pickup ability.

[SUMMARY OF THE INVENTION]

An object of the present invention is to provide a film for a spacer that enables a dicing process without using a dummy wafer, while suppressing die recognition failure and having improved pickup ability.

In addition, another object of the present invention is to provide a method of forming a spacer, which is capable of performing a dicing process with excellent efficiency without using a dummy wafer.

Further, another object of the present invention is to provide a multi-chip package which does not use a dummy wafer.

The technical problem to be achieved by the present invention is not limited to the problems described above, and other problems not described above will be clearly understood by those skilled in the art from the following descriptions.

To achieve the above objects, according to an aspect of the present invention, there is provided a film for a spacer including: a first film having a glass transition temperature (Tg) of 130℃ or higher; and an adhesive layer disposed on a lower portion of the first film, wherein the film for a spacer satisfies Equation 1 below:

[Equation 1]

1 ppm/GPa ≤ (Thermal expansion coefficient/Storage modulus) ≤ 15 ppm/GPa

(In Equation 1, the thermal expansion coefficient and storage modulus are values measured at 25℃, respectively.)

In some embodiments, the thermal expansion coefficient may be 10 ppm to 50 ppm.

In some embodiments, the storage modulus may be 2 GPa to 10 GPa.

In some embodiments, the first film may include at least one of polyimide, polyetheretherketone, polyamideimide, polyphenylene sulfide, polyphthalamide, polysulfone, polyethersulfone, and polyetherimide.

In some embodiments, the first film may include a coating layer on a lower portion thereof.

In some embodiments, the coating layer may include at least one of a compound containing a polyimide functional group, a compound containing a polyamideimide functional group, a compound containing an epoxy functional group, and a compound containing a urethane acrylate functional group.

In some embodiments, the adhesive layer may include at least one of an acrylic compound and an epoxy resin.

The film for a spacer may further include a first pressure sensitive adhesive layer disposed on a lower portion of the adhesive layer.

In some embodiments, the first pressure sensitive adhesive layer may include an acrylic compound.

In some embodiments, an edge of an upper surface of the first pressure sensitive adhesive layer may be exposed.

In some embodiments, an adhesive force between the first pressure sensitive adhesive layer and the adhesive layer may be 20 to 200 N/m before UV curing of the first pressure sensitive adhesive layer, and 15 N/m or less after UV curing of the first pressure sensitive adhesive layer.

The film for a spacer may further include a second film disposed on a lower portion of the first pressure sensitive adhesive layer.

In some embodiments, the second film may include a polyolefin resin.

The film for a spacer may further include: a second pressure sensitive adhesive layer disposed on an upper portion of the first film; and a cover film disposed on the second pressure sensitive adhesive layer.

In addition, according to another aspect of the present invention, there is provided a method of forming a spacer including: a fixation step of fixing the film for a spacer according to claim 1 to a frame; a dicing step of dicing the film for a spacer to individualize the same; a pickup step of picking up the spacer including a first film and an adhesive layer from the resulting individualized product; and an attachment step of attaching the picked up spacer onto a package substrate.

In some embodiments, the film for a spacer further may include a first pressure sensitive adhesive layer disposed on a lower portion of the adhesive layer, wherein an edge of an upper surface of the first pressure sensitive adhesive layer may be exposed, and a frame may be disposed on the edge of the upper surface of the first pressure sensitive adhesive layer.

Further, according to another aspect of the present invention, there is provided a multi-chip package including: a package substrate; a spacer comprising the film for a spacer according to claim 1 disposed on the package substrate; a first

semiconductor chip unit disposed on the package substrate; a second semiconductor chip unit stacked on the spacer and the first semiconductor chip unit; a chip pad of the first semiconductor chip unit and a first substrate pad corresponding thereto; and a wire configured to electrically connect the chip pad of the second semiconductor chip unit and a second substrate pad corresponding thereto; and a package body configured to seal the first semiconductor chip unit, the second semiconductor chip unit, the wire and the spacer.

The film for a spacer according to the present invention includes the first film having a glass transition temperature (Tg) of 130℃ or higher instead of a dummy wafer, wherein a value obtained by dividing the thermal expansion coefficient by the storage modulus is 1 ppm/GPa to 15 ppm/GPa.

Accordingly, the film for a spacer according to the present invention may suppress the die recognition failure occurring in the pickup process after dicing, facilitate classification between chips and pickup in pickup equipment, and improve reliability after the package assembly is completed.

In addition, it is possible to easily manufacture individualized spacers having desired sizes from the film for a spacer according to the present invention through a dicing process.

Further, in accordance with the method of forming a spacer according to the present invention, it is possible to easily

attach the individualized spacers to the package substrate through the pickup process and the attachment process.

Furthermore, the present invention may provide a multi-chip package which does not use a dummy wafer by using the film for a spacer.

[BRIEF DESCRIPTION OF THE DRAWINGS]

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a cross-sectional view schematically illustrating an example of a multi-chip package including a spacer according to an embodiment of the present invention;

FIG. 2 is a cross-sectional view schematically illustrating a multi-chip package including a spacer according to another embodiment of the present invention;

FIG. 3 is a cross-sectional view schematically illustrating a multi-chip package including a spacer according to another embodiment of the present invention;

FIG. 4 is a cross-sectional view schematically illustrating a multi-chip package including a spacer according to another embodiment of the present invention;

FIG. 5 is a cross-sectional view schematically illustrating a film for a spacer according to an embodiment of the present invention;

FIG. 6 is a cross-sectional view schematically illustrating a film for a spacer according to another embodiment of the present invention;

FIG. 7 is cross-sectional views schematically illustrating a method of forming a spacer using a dicing process according to the present invention; and

FIG. 8 is plan views corresponding to FIG. 7(a), (b) and (c).

[DETAILED DESCRIPTION OF THE INVENTION]

In descriptions of the embodiments of the present invention, publicly known techniques that are judged to be able to make the purport of the present invention unnecessarily obscure will not be described in detail. Referring to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views. In addition, the terms as used herein are defined by taking functions of the present invention into account and can be changed according to the custom or intention of users or operators. Therefore, definition of the terms should be made according to the overall disclosure set forth herein.

It should be understood that the technical spirit and scope of the present invention are defined by the appended claims, and the following embodiments are only made to efficiently describe the present invention to persons having common knowledge in the technical field to which the present invention pertains.

Hereinafter, specific embodiments of the present invention will be described with reference to the accompanying drawings. However, these are merely illustrative examples and the present invention is not limited thereto.

FIG. 1 is a cross-sectional view schematically illustrating an example of a multi-chip package including a spacer.

Referring to FIG. 1, a first semiconductor chip unit 120 is disposed on a package substrate 110. The first semiconductor chip unit 120 may include a first adhesive layer 121 and a first semiconductor chip 122. The first adhesive layer 121 serves to attach the first semiconductor chip 122 to the package substrate 110. Herein, a chip pad and a first substrate pad corresponding thereto are connected with each other through a wire 125, such that the first semiconductor chip unit 120 may be electrically connected to the package substrate 110.

A spacer 130 is disposed around the first semiconductor chip unit 120. The spacer 130 includes an adhesive layer 131

and a support 132. The adhesive layer 131 serves to attach the support 132 to the package substrate.

A second semiconductor chip unit 140 is disposed on the spacer 130. The second semiconductor chip unit 140 may include a second adhesive layer 141 and a second semiconductor chip 142. The second adhesive layer 141 serves to attach the second semiconductor chip 142 to the support 132 of the spacer 130. Herein, a chip pad and a second substrate pad corresponding thereto are connected with each other through a wire 145, such that the second semiconductor chip unit 140 may be electrically connected to the package substrate 110. As another example, the second semiconductor chip 142 may be electrically connected to the package substrate 110 through a via hole passing through the spacer 130.

The first semiconductor chip unit 120, the spacer 130, and the second semiconductor chip unit 140 are disposed on the package substrate 110, and a wire bonding process is performed thereon, then a package body 150 for sealing these components is formed. The package body 150 may be made of a sealing material such as an epoxy resin.

As shown in FIG. 1, the spacer 130 may have a higher height than the height of the first semiconductor chip unit 120. Thereby, the second semiconductor chip units 140 may be stacked using the spacer 130 as a support. As another example, the spacer 130 may have the same height as the height of the first

semiconductor chip unit 120. In addition, due to the fact that the spacer 130 has the same height as the height of the first semiconductor chip unit 120, an effect of burying the first semiconductor chip unit 120 by the spacer 130 and the second semiconductor chip unit 140 may be obtained.

FIGS. 2 to 4 are cross-sectional views schematically illustrating other examples of the multi-chip package including a spacer.

Similar to the example shown in FIG. 1, the second semiconductor chip units (140-1 to 140-4 in FIG. 2, 140-1 to 140-5 in FIG. 3, and 140-1 to 140-7 in FIG. 4) in FIGS. 2 to 4 may be electrically connected to another second semiconductor chip unit or the package substrate 110 through a wire (not illustrated) or a via hole (not illustrated), respectively.

Even in the case of the multi-chip packages shown in FIGS. 2 to 4, the semiconductor chip units may be stacked through the spacer 130 disposed on the package substrate 110, respectively.

FIG. 5 is a cross-sectional view schematically illustrating a film for a spacer according to an embodiment of the present invention. Referring to FIG. 5, the film for a spacer illustrated includes a first film 510 and an adhesive layer 520, which have a glass transition temperature (Tg) of 130℃ or higher, and may further include a first pressure sensitive adhesive layer 535 disposed on a lower portion of the

adhesive layer 520. The film for a spacer according to an embodiment of the present invention satisfies Equation 1 below.

[Equation 1]

1 ppm/GPa ≤ (Thermal expansion coefficient/Storage modulus) ≤ 15 ppm/GPa

In Equation 1, the thermal expansion coefficient and storage modulus are values measured at 25℃, respectively.

In Equation 1, the value of (thermal expansion coefficient/storage elastic modulus) is preferably 1 to 30 ppm/GPa, and more preferably 1 to 15 ppm/GPa. Within the above value range, it is easy to secure pickup workability and high temperature reliability process after moisture absorption.

The thermal expansion coefficient was obtained by heating the film for a spacer cut to 4 mm × 16 mm at a heating rate of 10℃/min from a temperature range of -30℃ and measured at 25℃ using a thermomechanical analysis (TMA, manufacturer: TA, model name: TMA Q400) equipment. The thermal expansion coefficient is preferably 10 ppm to 50 ppm. If the thermal expansion coefficient exceeds 50 ppm, the expansion of the film is increased in a high temperature soldering process, such that peeling-off may occur at an interface therebetween, and thereby causing a reduction in reliability.

The storage modulus of elasticity (E′) was obtained by heating the film for a spacer cut to 5 mm × 20 mm at a heating rate of 10℃/min from a temperature range of -30℃ and measured

at 25℃ using a dynamic mechanical analyzer (DMA, manufacturer: TA, model name: DMA850) equipment. The storage modulus is preferably 1 GPa to 30 GPa, and more preferably 2 GPa to 10 GPa. If the storage modulus is less than 2 GPa, die recognition failure may occur during expansion and a pickup process may not be performed at a needle pin height of pickup equipment. If the storage modulus exceeds 10 GPa, hardness of the film may be excessively increased, such that commercialization in a form of a roll may not be achieved.

First film

The first film 510 is a portion which will be the support 132 of the spacer 130 shown in FIGS. 1 to 4.

Preferably, the first film 510 has a glass transition temperature (Tg) of 130℃ or higher. When the glass transition temperature is 130℃ or higher, it is possible to suppress peeling-off at the interface by providing resistance to thermal deformation in the high temperature soldering process, thereby improving reliability.

When the glass transition temperature is 130℃ or higher, the desired effect of the present invention may be achieved. Therefore, when considering the material of the first film, an upper limit thereof may be 500℃ or lower, but it is not limited thereto.

The glass transition temperature may be obtained by heating the first film cut to 5 mm × 20 mm at a heating rate of

10℃/min and measured using the dynamic mechanical analyzer (DMA, manufacturer: TA, model name: DMA850) equipment. As used herein, the glass transition temperature may refer to a temperature at which tanδ of the first film is maximized.

In addition, the first film 510 preferably has heat resistance. Accordingly, as the first film 510, the present invention exemplifies a film whose weight reduction rate was limited to 2% or less at 200℃ and linear expansion coefficient was limited 50 ppm/℃ or lower at 100℃ or lower. If the weight reduction rate at 200℃ exceeds 2% or the linear expansion coefficient at 100℃ or lower exceeds 50 ppm/℃, it may be seen that the heat resistance is not good.

The first film 510 having the above-described heat resistance may include at least one of polyimide, polyetheretherketone, polyamideimide, polyphenylene sulfide, polyphthalamide, polysulfone, polyethersulfone, and polyetherimide. Among them, it is preferable to use polyimide or polyether ether ketone which is more excellent in heat resistance as a material of the first film.

The first film 510 may have a single layer structure. As another example, the first film 510 may have a multi-layered structure.

The first film 510 may include a coating layer on a lower portion thereof. The coating layer may have a higher elastic modulus or shrinkage rate than the first film 510. The coating

layer may include at least one of a compound containing a polyimide functional group, a compound containing a polyamideimide functional group, a compound containing an epoxy functional group, and a compound containing a urethane acrylate functional group. The compound may be included in the form of a cured product.

A thickness of the first film layer may be determined according to the thickness of a target spacer support (132 in FIG. 1), and may be 2 μm to 100 μm, but it is not particularly limited thereto.

Adhesive layer

The adhesive layer 520 is a portion which will be the adhesive layer 131 of the spacer 130 shown in FIGS. 1 to 4.

The adhesive layer 520 is disposed on the lower portion of the first film 510. The adhesive layer 520 may have a thickness of about 3 to 60 μm, but it is not limited thereto.

In the present invention, the adhesive layer 520 may include an acrylic compound. In addition, the adhesive layer 520 may include an epoxy resin for curing. As the epoxy resin, at least one of bisphenol-A type, bisphenol-F type, bisphenol-S type, bisphenol-AF type, biphenyl type, naphthalene type, fluorene type, phenol novolak type, orthocresol novolak type, and glycidylamine type epoxy resins, etc. may be used.

In addition, the adhesive layer 520 may further include at least one additive. As the additive, a curing agent

(phenolic resin, amines, etc.), inorganic particles (silica, aluminum hydroxide, alumina, titanium dioxide, calcium carbonate, etc.), a curing enhancer, and a silane coupling agent, etc. may be presented, but it is not limited thereto.

The acrylic compound usable for the adhesive layer 520 and a first pressure sensitive adhesive layer 535 and a second pressure sensitive adhesive layer 545, which will be described below, preferably includes a monomer derived from (meth)acrylic acid ester.

As the monomer, (meth)acrylic acid ester, (meth)acrylic acid alkyl ester, (meth)acrylic acid cycloalkyl ester, (meth)acrylic acid aryl ester, etc., may be presented.

The acrylic compound may further include a carboxyl group-containing monomer, an acid anhydride monomer, a hydroxyl group-containing monomer, a glycidyl group-containing monomer, a sulfonic acid group-containing monomer, a phosphoric acid group-containing monomer, an acrylonitrile-containing monomer and the like.

In addition, the acrylic compound may further include one or more polyfunctional monomers. As the polyfunctional monomer, hexanediol di(meth)acrylate, (poly)ethylene glycol di(meth)acrylate, (poly)propylene glycol di(meth)acrylate, neopentyl glycol di(meth)acrylate, pentaerythritol di(meth)acrylate, trimethylolpropane tri(meth)acrylate, pentaerythritol tri(meth)acrylate, dipentaerythritol

hexa(meth)acrylate, epoxy(meth)acrylate (i.e., polyglycidyl(meth)acrylate), polyester(meth)acrylate, urethane(meth)acrylate, etc. may be presented.

Second film

The film for a spacer according to an exemplary embodiment of the present invention may further include a second film 530 disposed on a lower portion of the adhesive layer 520.

The first pressure sensitive adhesive layer 535 may be disposed between the second film 530 and the adhesive layer 520. The first pressure sensitive adhesive layer 535 may be formed by directly casting coating on the second film 530 followed by drying, or may be formed by laminating on the second film 530.

The second film 530 may serve as a support in a dicing process. The thickness of the second film 530 may be controlled to 40 μm or more in order to secure expanding and pickup abilities. Meanwhile, even when the thickness of the second film 530 exceeds 300 μm to be too thick, there is a possibility that an expanding failure and a pickup failure may occur. Therefore, the second film 530 preferably has a thickness of 300 μm or less. The second film 530 may have a thickness in a range of 40 to 300 μm, preferably 50 to 250 μm, more preferably 60 to 200 μm, and most preferably 70 to 150 μm.

The second film 530 may use a polyolefin resin. Specifically, the second film 530 may be made of a material including at least one of a low-density polyethylene, medium-

density polyethylene, high-density polyethylene, ultra-low-density polyethylene, random copolymer polypropylene, block copolymer polypropylene, homo polypropylene, polybutene, polymethylpentene, ethylene-vinyl acetate copolymer, ionomer resin, ethylene-(meth)acrylic acid copolymer, ethylene-(meth)acrylic acid ester copolymer, ethylene-butene copolymer, and ethylene-hexene copolymer.

The second film 530 may have a single layer structure, or as another example, may have a multi-layered structure.

The first pressure sensitive adhesive layer 535 may be formed in a thickness of about 5 to 30 μm, but it is not limited thereto. The first pressure sensitive adhesive layer 535 may include an acrylic compound. However, unlike the adhesive layer 520, the first pressure sensitive adhesive layer 535 may not include an epoxy resin.

In addition, the first pressure sensitive adhesive layer 535 may further include at least one additive. As the additive, a thermal curing agent such as an isocyanate curing agent or a photo-initiator such as benzophenone may be presented, but it is not limited thereto.

The first pressure sensitive adhesive layer 535 may exist in a B-stage state until UV curing in the dicing process.

Meanwhile, an adhesive force between the first pressure sensitive adhesive layer 535 and the adhesive layer 520 may exhibit 20 to 200 N/m before UV curing of the first pressure

sensitive adhesive layer, and may be 15 N/m or less after UV curing. This is intended so that only the first film 510 and the adhesive layer 520 individualized in a pickup process after dicing are picked up. The control of the adhesive force of the first pressure sensitive adhesive layer 535 may be performed, for example, by controlling components of the pressure sensitive adhesive. For example, the acrylic compound of the first pressure sensitive adhesive layer 535 may include a copolymer obtained by copolymerizing 10 to 40 parts by weight of acrylic acid-2-hydroxyethyl and 10 to 45 parts by weight of 2-methacryloyloxyethyl isocyanate, based on 100 parts by weight of acrylic acid-2-ethylhexyl.

Meanwhile, referring to FIG. 5, an edge of an upper surface of the first pressure sensitive adhesive layer 535 may be exposed. This is intended to facilitate the fixation of the film for a spacer to a ring frame in the dicing process, which will be described below with reference to FIG. 7.

FIG. 6 is a cross-sectional view schematically illustrating a film for a spacer according to another embodiment of the present invention.

Similar to the film for a spacer shown in FIG. 5, the film for a spacer shown in FIG. 6 includes a first film 510, an adhesive layer 520, a second film 530, and a first pressure sensitive adhesive layer 535. The first film 510, the adhesive layer 520, the second film 530, and the first pressure sensitive

adhesive layer 535 in the film for a spacer shown in FIG. 6 are the same as those described in FIG. 5, and therefore will not be described in detail.

Meanwhile, the film for a spacer shown in FIG. 6 further includes a cover film 540 and a second pressure sensitive adhesive layer 545.

Cover film

The cover film 540 serves as a protective film for protecting the first film 510 before the dicing process. The cover film 540 is previously removed in the dicing process. The cover film 540 may be made of a material such as polyethylene terephthalate, polyethylene, polypropylene, polyvinyl chloride, polycarbonate, polyimide, etc., but it is not limited thereto.

The second pressure sensitive adhesive layer 545 may be disposed between the cover film 540 and the first film 510.

The second pressure sensitive adhesive layer 545 may be formed in a thickness of about 3 to 30 μm, but it is not limited thereto. Similar to the first pressure sensitive adhesive layer 535, the second pressure sensitive adhesive layer 545 may include an acrylic compound but may not include an epoxy resin. The second pressure sensitive adhesive layer 545 may further include at least one additive such as a curing agent, for example, a phenol resin and amine, or a silane coupling agent, etc.

Meanwhile, referring to FIG. 6, an edge of a lower surface of the second pressure sensitive adhesive layer 545 may be

exposed. This is intended to facilitate the removal of the cover film 540 and the second pressure sensitive adhesive layer 545 immediately before the dicing process.

Method of forming a spacer

FIG. 7 is cross-sectional views schematically illustrating a method of forming a spacer using a dicing process according to the present invention. FIG. 8 is plan views corresponding to FIG. 7(a), (b) and (c), which will be referred to when describing the method of FIG. 7.

Referring to FIG. 7, the method of forming a spacer according to the present invention includes a fixation step, a dicing step, a pickup step and an attachment step.

First, as in the example shown in FIG. 7(a), a film for a spacer including the first film 510, the adhesive layer 520, the first pressure sensitive adhesive layer 535 and the second film 530 from the top is prepared. For example, by removing the second pressure sensitive adhesive layer 545 and the cover film 540 from the film for a spacer shown in FIG. 6, the film for a spacer as the example shown in FIG. 7(a) may be prepared.

Then, as in the example shown in FIG. 7(b) and FIG. 8(b), the film for a spacer is fixed. A frame 610 such as a ring frame may be used to fix the film for a spacer. Meanwhile, when the edge of the upper surface of the first pressure sensitive adhesive layer 535 is exposed in the film for a spacer, the

frame 610 may be easily disposed on the edge of the upper surface of the first pressure sensitive adhesive layer 535.

Thereafter, as in the example shown in FIG. 7(c), the film for a spacer is diced along predetermined cutting lines SL using a dicing saw 601 or a laser beam to individualize the film. As described above, in accordance with the film for a spacer according to the present invention, it is possible to prevent the film for a spacer from being bent upward at an edge of the chip during expanding, thereby suppressing the expanding failure and pickup failure.

Subsequently, as in the example shown in FIG. 7(d), the spacer including the first film 510 and the adhesive layer 520 is picked up from the resulting individualized product using a pushing means 620 and an adsorption means 630.

Thereafter, as in the example shown in FIG. 7(e), the spacer including the first film 510 and the adhesive layer 520 is attached to the package substrate 110.

<Example>

Hereinafter, preferred examples are presented to help the understanding of the present invention. However, the following examples are only provided to more easily understand the present invention, and the contents of the present invention are not limited by the following examples.

Preparation of adhesive film for a spacer

Films for a spacer, which include a first film (polyimide), an acrylic-epoxy adhesive layer, an acrylic pressure sensitive adhesive layer, and a second film (polyethylene film) from the top, were prepared. As the first film, films with or without a coating layer formed on a lower portion thereof were used, respectively.

The thermal expansion coefficient was obtained by heating a specimen, which was fabricated by cutting the prepared film for a spacer to 4 mm × 16 mm, according to the method of condition at a heating rate of 10℃/min, and measured at 25℃ using the TMA equipment.

The storage modulus was obtained by heating a specimen, which was fabricated by cutting the prepared film for a spacer to 5 mm × 20 mm, according to the method of the condition at a heating rate of 10℃/min, and measured at 25℃ using the DMA equipment.

The glass transition temperature was obtained by heating a specimen, which was fabricated by cutting the first film to 5 mm × 20 mm according to the method of the condition at a heating rate of 10℃/min, and measured using the DMA equipment.

Measurement results of the thermal expansion coefficient, the storage modulus and the glass transition temperature measured for each specimen are shown in Table 1 below.

[TABLE 1]

Section						

	First film (thickness, μm)	Coating layer (thickness, μm)	Adhesive layer (thickness, μm)	Glass transition temperature (℃)	Thermal expansion coefficient (Ppm)	Storage modulus (Gpa)
Example 1	50	Polyimide, 5 μM	15	305	11	10.0
Example 2	50	Polyimide, 5 μM	15	410	25	3.5
Example 3	50	Polyimide, 5 μM	15	400	31	2.1
Example 4	50	-	20	143	50	3.7
Example 5	50	-	20	131	49	5.6
Comparative Example 1	50	Polyimide, 5 μM	15	145	29	1.9
Comparative Example 2	50	Polyimide, 5 μM	15	175	9	10.2
Comparative Example 3	50	Polyimide, 5 μM	15	278	51	2.5
Comparative Example 4	50	Polyimide, 5 μM	15	128	47	7.8

Evaluation of adhesive film for a spacer

Thereafter, a ring frame was bonded to an upper edge of the acrylic pressure sensitive adhesive layer to fix the film for a spacer, and then, a process, in which each specimen is divided into individual spacers having a size of 9 mm × 12 mm, has been performed using a dicing device DFD-6361 (manufactured by Disco). Then, individual spacers were expanded and picked up using a pickup equipment SPA-300 (manufactured by Shinkawa).

The following evaluations were performed, and results thereof are shown in Table 2.

Evaluation of chip recognition: After dicing, an expanding process for expanding the second film was performed

to facilitate classification between chips and pickup in pickup equipment, such that a chip recognition rate at a height of 3 mm of an expanding ring was measured. When the chip recognition rate was 95% or more, it was evaluated as good (O), and if the rate was less than 95%, it was evaluated as failure (X).

Evaluation pickup ability: The spacers were picked up at needle pin heights of 0.35 mm and 0.45 mm of pickup equipment, and when a pickup success rate was 95% or more, it was evaluated as good (O), and if the rate was less than 95%, it was evaluated as failure (X).

Evaluation of reliability: A package was manufactured together with a silicon wafer and left under conditions of 85℃/85% temperature and humidity for 168 hours, followed by performing a high temperature reflow process at 260℃ three times. At this time, when the amount of voids (black area) measured in an SAT transmission mode was 5% or less, it was evaluated as good (O), and if the amount exceeded 5%, it was evaluated as failure (X).

[TABLE 2]

Section	Glass transition temperature (℃)	Thermal expansion coefficient / Storage modulus (ppm/GPa)	Chip recognition	Pickup property	Reliability
				0.45 mm	
Example 1	305	1.1	O	O	O
Example 2	410	7.1	O	O	O
Example 3	400	14.8	O	O	O

Example 4	143	13.5	O	O	O
Example 5	131	8.8	O	O	O
Comparative Example 1	145	15.3	X	X	X
Comparative Example 2	175	0.9	X	X	X
Comparative Example 3	278	20.4	X	X	X
Comparative Example 4	128	6.0	O	O	X

Referring to Table 2 above, in the case of Examples 1 to 5 in which the glass transition temperature of the first film is 130℃ or higher, and a value of (thermal expansion coefficient/storage modulus) of the film for a spacer is 1 ppm/GPa to 15 ppm/GPa, any failure was not shown in chip recognition, pickup ability and reliability. On the other hand, in the case of Comparative Examples 1 to 3 in which the value of (thermal expansion coefficient/storage modulus) is greater than 15 ppm/GPa or less than 1 ppm/GPa, chip recognition failure, pickup ability failure and reliability failure at the needle pin height of 0.45 mm of the pickup equipment were confirmed. In addition, even if the value of (thermal expansion coefficient/storage modulus) satisfies 1 ppm/GPa to 15 ppm/GPa, in the case of Comparative Example 4 in which the glass transition temperature is less than 130℃, chip recognition and pickup ability failures were not shown but reliability failure was shown.

Therefore, it can be confirmed that maintaining the value of (thermal expansion coefficient/storage modulus) so as to have 1 to 15 ppm/GPaa by controlling the thermal expansion coefficient and storage modulus of the film for a spacer is effective to improve the chip recognition and pickup ability, and when the glass transition temperature of the first film is 130℃ or higher, it can be confirmed that reliability is also satisfied, and thereby it is suitable for use as the film for a spacer.

Although the present invention has been described above, the present invention is not limited by the embodiments disclosed herein, and it will be apparent by those skilled in the art that various modifications can be made within the scope of the technical spirit of the present invention. In addition, although the effects according to the configuration of the present invention have not been explicitly described while describing the embodiments of the present invention, it will be apparent that the effects predictable by the corresponding configuration should also be admitted.

[Description of Reference Numerals]

110: Package substrate

120: First semiconductor chip unit

130: Spacer

131: Adhesive layer

132: Support

140: Second semiconductor chip unit

150: Package body

510: First film

520: Adhesive layer

530: Second film

535: First pressure sensitive adhesive layer

540: cover film

545: Second pressure sensitive adhesive layer

601: Dicing saw

610: Frame

620: Pushing means

630: Adsorption means

WHAT IS CLAIMED IS:

1. A film for a spacer comprising:

a first film having a glass transition temperature (Tg) of 130℃ or higher; and

an adhesive layer disposed on a lower portion of the first film,

wherein the film for a spacer satisfies Equation 1 below:

[Equation 1]

1 ppm/GPa ≤ (Thermal expansion coefficient/Storage modulus) ≤ 15 ppm/GPa

(In Equation 1, the thermal expansion coefficient and storage modulus are values measured at 25℃, respectively.)

2. The film for a spacer according to claim 1, wherein the thermal expansion coefficient is 10 ppm to 50 ppm.

3. The film for a spacer according to claim 1, wherein the storage modulus is 2 GPa to 10 GPa.

4. The film for a spacer according to claim 1, wherein the first film comprises at least one of polyimide, polyetheretherketone, polyamideimide, polyphenylene sulfide, polyphthalamide, polysulfone, polyethersulfone, and polyetherimide.

5. The film for a spacer according to claim 1, wherein the first film comprises a coating layer on a lower portion thereof.

6. The film for a spacer according to claim 5, wherein the coating layer comprises at least one of a compound containing a polyimide functional group, a compound containing a polyamideimide functional group, a compound containing an epoxy functional group, and a compound containing a urethane acrylate functional group.

7. The film for a spacer according to claim 1, wherein the adhesive layer comprises at least one of an acrylic compound and an epoxy resin.

8. The film for a spacer according to claim 1, further comprising a first pressure sensitive adhesive layer disposed on a lower portion of the adhesive layer.

9. The film for a spacer according to claim 8, wherein the first pressure sensitive adhesive layer comprises an acrylic compound.

10. The film for a spacer according to claim 8, wherein an edge of an upper surface of the first pressure sensitive adhesive layer is exposed.

11. The film for a spacer according to claim 8, wherein an adhesive force between the first pressure sensitive adhesive layer and the adhesive layer is 20 to 200 N/m before UV curing of the first pressure sensitive adhesive layer, and 15 N/m or less after UV curing of the first pressure sensitive adhesive layer.

12. The film for a spacer according to claim 8, further comprising a second film disposed on a lower portion of the first pressure sensitive adhesive layer.

13. The film for a spacer according to claim 12, wherein the second film comprises a polyolefin resin.

14. The film for a spacer according to claim 1, further comprising:

a second pressure sensitive adhesive layer disposed on an upper portion of the first film; and

a cover film disposed on the second pressure sensitive adhesive layer.

15. A method of forming a spacer comprising:

a fixation step of fixing the film for a spacer according to claim 1 to a frame;

a dicing step of dicing the film for a spacer to individualize the same;

a pickup step of picking up the spacer including a first film and an adhesive layer from the resulting individualized product; and

an attachment step of attaching the picked up spacer onto a package substrate.

16. The method of forming a spacer according to claim 15, wherein the film for a spacer further comprises a first pressure sensitive adhesive layer disposed on a lower portion of the adhesive layer,

wherein an edge of an upper surface of the first pressure sensitive adhesive layer is exposed, and

a frame is disposed on the edge of the upper surface of the first pressure sensitive adhesive layer.

17. A multi-chip package comprising:

a package substrate;

a spacer comprising the film for a spacer according to claim 1 disposed on the package substrate;

a first semiconductor chip unit disposed on the package substrate;

a second semiconductor chip unit stacked on the spacer and the first semiconductor chip unit;

a chip pad of the first semiconductor chip unit and a first substrate pad corresponding thereto; and

a wire configured to electrically connect the chip pad of the second semiconductor chip unit and a second substrate pad corresponding thereto; and

a package body configured to seal the first semiconductor chip unit, the second semiconductor chip unit, the wire and the spacer.