

DESCRIPTION

TITLE OF THE INVENTION: SEALING SHEET FOR SEMICONDUCTOR ELEMENT,
SEMICONDUCTOR DEVICE, AND SEMICONDUCTOR DEVICE PRODUCTION
METHOD

TECHNICAL FIELD

[0001]

The present invention relates to a sealing sheet for a semiconductor element, a semiconductor device, and a semiconductor device production method.

BACKGROUND ART

[0002]

A resin-sealed semiconductor device (a semiconductor package) is shipped after the name of the manufacturer, a product name, a lot number, etc. are marked to identify the product. When the marking portion of the semiconductor device has poor visibility, problems may occur such that the product cannot be identified by a manufacturer and the product cannot be identified by a user.

[0003]

Patent Document 1 describes that a specified amount of each of inorganic filler, organic dye and carbon black is used to obtain good YAG laser marking properties. However, there is still room for improvement in visibility of the marking

portion.

[0004]

Incidentally, scratches or stains on the surface of a semiconductor package may become a problem from the point of external appearance. Such small external scratches and stains can be substantially made less noticeable by making the surface of the semiconductor package be pearskin-finished not mirror-finished.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0005]

Patent Document 1: JP-A-2001-247747

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0006]

However, it is more difficult to perform marking on a pearskin-finished surface than a mirror-finished surface. The non-marking portion on a pearskin-finished surface reflects light and shines white (the brightness of the non-marking portion on the pearskin-finished surface increases), so that it is difficult to identify the marking portion. Therefore, when the surface of the semiconductor package is pearskin-finished, it is difficult to read the information

given by marking as compared to the case where the surface is mirror-finished.

[0007]

The present invention has been made in consideration of the above-described problems, and an object thereof is to provide a sealing sheet for a semiconductor element and a production method that enable production of a semiconductor device in which the information given by marking can be satisfactorily visually recognized. Another object of the invention is to provide a semiconductor device in which the information given by marking can be satisfactorily visually recognized even when the surface of the semiconductor device is pearskin-finished.

MEANS FOR SOLVING THE PROBLEMS

[0008]

That is, a first aspect of the present invention relates to a sealing sheet for a semiconductor element, comprising a release film having a surface smoothness (Ra) of 0.1 to 0.5 μm and an average distance of unevenness (RSm) of 90 to 125 μm in surface conditions and a sealing material layer arranged on the release film.

[0009]

In the sealing sheet according to the first aspect of the present invention, the sealing material layer arranged on the

release film has a distinctive pearskin-finished state because the release film has a specific surface condition. The surface of the semiconductor device that is obtained by sealing a semiconductor element with the sealing sheet according to the first aspect of the present invention has a distinctive pearskin-finished state. Therefore, the sealing sheet according to the first aspect of the present invention is used to produce a semiconductor device in which the information given by marking can be satisfactorily visually recognized. As a result, the identification properties of the product can be improved, and the misidentification of a product name, a lot number, etc. can be prevented. The surface of the semiconductor device is in a pearskin-finished state, so that scratches and stains are less noticeable.

[0010]

The first aspect of the present invention also relates to a semiconductor device obtained by sealing a semiconductor element with a sealing sheet comprising a release film having a surface smoothness (Ra) of 0.1 to 0.5 μm and an average distance of unevenness (RSm) of 90 to 125 μm in surface conditions and a sealing material layer arranged on the release film.

[0011]

An example of a semiconductor device production method using the sealing sheet is a method of sealing a semiconductor element such as a semiconductor chip using the sealing sheet,

peeling the release film from the sealing sheet to expose the sealing material layer, and performing marking on the exposed sealing material layer.

[0012]

In the sealing sheet according to the first aspect of the present invention, the sealing material layer (the exposed portion) laminated on the release film has a distinctive pearskin-finished state because the release film has a specific surface condition. The surface of the semiconductor device sealed with this sealing sheet has a distinctive pearskin-finished state. Therefore, an increase in brightness of the non-marking portion can be suppressed, and the visibility of the marking portion can be improved. As a result, the identification properties of the product can be improved, and the misidentification of a product name, a lot number, etc. can be prevented. The surface of the semiconductor device is in a pearskin-finished state, so that scratches and stains are less noticeable.

[0013]

A resin composition that forms the sealing material layer preferably contains carbon black in an amount of 0.01 to 1% by weight. This provides good marking properties.

[0014]

The resin composition preferably contains a filler in an amount of 70 to 95% by weight. This makes it possible to provide

resin surface hardness excellent in marking properties.

[0015]

The semiconductor device according to the first aspect of the present invention is preferably obtained with a method including a step (I) of sealing the semiconductor element with the sealing sheet to form a sealed body including the semiconductor element and the sealing material layer that covers the semiconductor element; and a step (II) of peeling the release film from the sealed body. The method may further include a step (III) of marking the exposed portion of the sealing material layer.

[0016]

The first aspect of the present invention also relates to a method of producing a semiconductor device, the method including a step (I) of sealing the semiconductor element with the sealing sheet to form a sealed body including the semiconductor element and the sealing material layer that covers the semiconductor element; and a step (II) of peeling the release film from the sealed body. The method may further include a step (III) of marking the exposed portion of the sealing material layer.

[0017]

A second aspect of the present invention relates to a semiconductor device obtained by sealing a semiconductor element with a resin using a metal mold having a surface

smoothness (Ra) of 0.1 to 0.5 μm and an average distance of unevenness (RSm) of 90 to 125 μm in surface conditions.

[0018]

An example of the semiconductor device production method using a metal mold is a method of sealing a semiconductor element such as a semiconductor chip with a resin in the metal mold and performing marking on the sealing resin portion.

[0019]

The metal mold that is used in the second aspect of the present invention has a specific surface condition, so that the surface of the semiconductor device sealed by using this metal mold has a distinctive pearskin-finished state. Therefore, an increase in brightness of the non-marking portion can be suppressed, and the visibility of the marking portion can be improved. As a result, the identification properties of the product can be improved, and the misidentification of a product name, a lot number, etc. can be prevented.

[0020]

For example, the metal mold includes a first metal mold part (also referred to as a cavity mold) with a cavity recessed part having specific surface condition formed thereon and a second metal mold part (also referred to as a core mold) having a parting surface. Normally, the second metal mold part further includes a holding member arranged on the parting surface. The holding member is a member for holding a workpiece.

[0021]

Example of the method of sealing a semiconductor element with a resin are a method including steps of arranging a resin composition on the cavity recessed part; arranging a workpiece on the parting surface; melting the resin composition arranged on the cavity recessed part under heating; and performing mold clamping to form a sealed body including a semiconductor element and the resin composition that covers the semiconductor element; etc. Further, the sealed body may be heated to cure the resin composition.

[0022]

The semiconductor device is preferably resin-sealed with a resin composition containing carbon black in an amount of 0.01 to 1% by weight. This provides good marking properties.

[0023]

The resin composition preferably contains a filler in an amount of 70 to 95% by weight. This makes it possible to provide resin surface hardness excellent in marking properties.

[0024]

The semiconductor device according to the second aspect of the present invention is preferably obtained with a method including a step (i) of sealing the semiconductor element with the resin by using the metal mold to form a sealed body including the semiconductor element and the resin composition that covers the semiconductor element. The method may further include a

step (ii) of marking the sealed body.

[0025]

The second aspect of the present invention also relates to a method of producing a semiconductor device, the method including a step (i) of sealing a semiconductor element with a resin by using a metal mold to form a sealed body including the semiconductor element and a resin composition that covers the semiconductor element. The method may further include a step (ii) of marking the sealed body.

EFFECT OF THE INVENTION

[0026]

The present invention can provide a sealing sheet for a semiconductor element and a production method that enable production of a semiconductor device in which the information given by marking can be satisfactorily visually recognized. The invention can provide a semiconductor device in which the marking portion can be satisfactorily visually recognized although the surface is pearskin-finished.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

Fig. 1 is a schematic view showing a cross section of a sealing sheet.

Fig. 2 is a cross-sectional view schematically showing

one step of a semiconductor device production method of Embodiment 1.

Fig. 3 is a cross-sectional view schematically showing one step of the semiconductor device production method of Embodiment 1.

Fig. 4 is a cross-sectional view schematically showing one step of the semiconductor device production method of Embodiment 1.

Fig. 5 is a cross-sectional view schematically showing one step of the semiconductor device production method of Embodiment 1.

Fig. 6 is a cross-sectional view schematically showing one step of the semiconductor device production method of Embodiment 1.

Fig. 7 is a cross-sectional view schematically showing one step of the semiconductor device production method of Embodiment 1.

Fig. 8 is a cross-sectional view schematically showing one step of the semiconductor device production method of Embodiment 1.

Fig. 9 is a cross-sectional view schematically showing one step of a semiconductor device production method of Embodiment 2.

Fig. 10 is a cross-sectional view schematically showing one step of the semiconductor device production method of

Embodiment 2.

Fig. 11 is a cross-sectional view schematically showing one step of the semiconductor device production method of Embodiment 2.

MODE FOR CARRYING OUT THE INVENTION

[0028]

[Embodiment 1]

[Sealing sheet]

As shown in Fig. 1, a sealing sheet 10 includes a release film 31 and a sealing material layer 32 arranged on the release film 31. When the release film 31 is peeled, the contact surface between the sealing material layer 32 and the release film 31 is exposed. In Fig. 1, the sealing material layer 32 is formed on the entire surface of the release film 31. However, it is not necessary to form the sealing material layer 32 on the entire surface of the release film 31.

[0029]

The contact surface between the release film 31 and the sealing material layer 32 has a surface smoothness (Ra) of 0.1 to 0.5 μm and an average distance of unevenness (RSm) of 90 to 125 μm in surface conditions.

[0030]

The release film 31 has a surface smoothness (Ra) of 0.1 μm or more, and preferably 0.2 μm or more. The surface

smoothness of 0.1 μm or more can form a resin surface having excellent scratch resistance (fine scratches, etc. can be made less noticeable), and as a result, the external appearance of a semiconductor device can be improved. In addition, a contrast can be easily given to the resin surface, so that the resin surface is excellent in visibility of the marking portion. On the other hand, the release film 31 has a surface smoothness (R_a) of 0.5 μm or less, and preferably 0.4 μm or less. The surface smoothness of 0.5 μm or less prevents a decrease in film strength, and there is no concern for breakage or damage when the film is produced or used. In addition, a contrast can be easily given to the resin surface, so that the resin surface is excellent in visibility of the marking portion.

[0031]

The surface smoothness (R_a) of the release film 31 can be adjusted by changing the production method in production steps of the release film 31 or changing the amount of material.

The surface smoothness (R_a) can be measured with the method described in Examples.

[0032]

The release film 31 has an average distance of unevenness (R_{Sm}) of 90 μm or more, and preferably 95 μm or more. The average distance of unevenness of 90 μm or more makes it possible to prevent a character blur, etc. when the marking is performed by laser irradiation, etc. Further, an increase in brightness

of the non-marking portion can be suppressed. The release film 31 has an average distance of unevenness (RSm) of 125 μm or less, and preferably 120 μm or less. The average distance of unevenness of 125 μm or less makes it possible to prevent a character blur, etc. when the marking is performed by laser irradiation, etc. Further, an increase in brightness of the non-marking portion can be suppressed.

[0033]

The average distance of unevenness (RSm) of the release film 31 can be adjusted to the above range by changing the production steps of the release film and changing the amount of material.

The average distance of unevenness (RSm) can be measured with the method described in Examples.

[0034]

In order to adjust each of the surface smoothness (Ra) and the average distance of unevenness (RSm) to the above range, the release film 31 is preferably subjected to surface processing. The method of surface processing is not especially limited; however, emboss processing is preferable. For example, heat is applied to the release film 31 to soften the release film 31, and the film is allowed to pass through a roll-shaped embossing mold under pressure to form specific unevenness on the surface of the release film 31.

[0035]

A constituting material of the release film 31 is not especially limited; however, examples thereof include polyethylene, polypropylene, polyethylene terephthalate (PET), polymethylpentene and vinyl chloride. Among these, polyethylene terephthalate (PET) is preferable from the point that each of the surface smoothness (Ra) and the average distance of unevenness (RSm) can be easily adjusted to the above range. The surface of the release film 31 may be coated with a conventionally known peeling agent such as a fluorine peeling agent.

[0036]

The thickness of the release film 31 is not especially limited, and it is appropriately set. For example, the thickness can be set to 5 to 125 μm .

[0037]

The sealing material layer 32 normally has a thermosetting property.

[0038]

A resin composition forming the sealing material layer 32 preferably contains carbon black.

[0039]

The content of carbon black in the resin composition is preferably 0.01% by weight or more, and more preferably 0.02% by weight or more. If the content is 0.01% by weight or more, good marking properties are obtained. The content of carbon

black is preferably 1% by weight or less, and more preferably 0.5% by weight or less. If the content is 1% by weight or less, the contrast of the marking characters becomes clear, and a good marking state can be obtained.

[0040]

The resin composition preferably contains a filler. The filler is preferably an inorganic filler such as powders of quartz glass, talc, silica (fused silica, crystalline silica, etc.), alumina, aluminum nitride, silicon nitride, or boron nitride. These may be used alone or in combination of two or more thereof.

[0041]

Among these, silica powders are preferably used from the points that the coefficient of linear thermal expansion of the cured body can be decreased and warping after sealing can be suppressed. Among the silica powders, fused silica powders are more preferably used. Examples of the fused silica powders include spherical fused silica powders and crashed and fused silica powders. However, spherical fused silica powders are especially preferably used from the viewpoint of fluidity. Among these, powders having an average particle size of 0.1 to 100 μm are preferably used, and powders having an average particle size of 0.3 to 60 μm are especially preferably used.

[0042]

The average particle size can be obtained by measurement

on a sample that is extracted arbitrarily from the population using a laser diffraction-scattering type particle size distribution measuring apparatus.

[0043]

The content of the filler in the resin composition is preferably 70% by weight or more, more preferably 80% by weight or more, and further preferably 85% by weight or more. If the content is 70% by weight or more, a highly reliable semiconductor device with a low water absorption rate is obtained. The content of the filler is preferably 95% by weight or less, and more preferably 90% by weight or less. If the content is 95% by weight or less, flexibility as a sealing sheet is easily obtained.

[0044]

The resin composition preferably contains a thermosetting resin. Examples of the thermosetting resin include an epoxy resin and a phenol resin.

[0045]

The epoxy resin is not particularly limited, and examples thereof include triphenyl methane type epoxy resin, cresol novolak type epoxy resin, biphenyl type epoxy resin, modified bisphenol A type epoxy resin, bisphenol A type epoxy resin, bisphenol F type epoxy resin, modified bisphenol F type epoxy resin, dicyclopentadiene type epoxy resin, phenol novolak type epoxy resin, phenoxy resin, and other various epoxy resins.

These epoxy resins may be used alone or in combination of two or more thereof.

[0046]

The epoxy resin is preferably an epoxy resin which is in a solid form at room temperature, and has an epoxy equivalent of 150 to 250 and a softening point or melting point of 50°C to 130°C in order to certainly attain a desired toughness after curing and reactivity. Particularly preferred are triphenylmethane type epoxy resin, cresol novolak type epoxy resin, and biphenyl type epoxy resin from the viewpoint of the reliability. A bisphenol F type epoxy resin is preferable from the point of having excellent flexibility.

[0047]

The phenol resin is not particularly limited as far as the resin causes a curing reaction with the epoxy resin. Examples thereof include phenol novolak resin, phenol aralkyl resin, biphenyl aralkyl resin, dicyclopentadiene type phenol resin, cresol novolak resin, and resol resin. These phenol resins may be used alone or in combination of two or more thereof.

[0048]

The phenol resin is preferably a resin having a hydroxyl equivalent of 70 to 250 and a softening point of 50°C to 110°C from the viewpoint of the reactivity thereof with the epoxy resin. The phenol resin is in particular preferably phenol novolak resin because the resin is high in curing reactivity.

Moreover, from the viewpoint of the reliability, the phenol resin is a low-hygroscopicity phenol resin such as phenol aralkyl resin, or biphenyl aralkyl resin can be preferably used.

[0049]

Regarding the blend ratio between the epoxy resin and the phenol resin, the entire amount of the hydroxyl groups in the phenol resin is preferably from 0.7 to 1.5 equivalents, more preferably 0.9 to 1.2 equivalents per equivalent of epoxy groups in the epoxy resin from the viewpoint of the curing reactivity therebetween.

[0050]

The total content of the epoxy resin and the phenol resin in the resin composition is preferably 5% by weight or more. The total content of the epoxy resin and the phenol resin is preferably 8% by weight or less.

[0051]

The resin composition preferably contains an elastomer.

[0052]

The elastomer gives the sealing material layer 32 flexibility that is necessary for sealing, and its structure is not especially limited as long as the elastomer exhibits such an effect. Examples of the elastomer that can be used include various types of acrylic copolymers such as polyacrylic ester; styrene-acrylate copolymers; and rubbery polymers such as butadiene rubber, styrene-butadiene rubber (SBR),

ethylene-vinylacetate copolymer (EVA), isoprene rubber and acrylonitrile rubber. Among these, butadiene copolymers or styrene copolymers are preferably used from the viewpoint that the flexibility, heat resistance, and strength of the sealing material layer 32 can be improved because they are easily dispersed into epoxy resin and they have high reactivity with epoxy resin. These may be used alone or in combination of two or more thereof.

[0053]

For example, acrylic copolymers can be synthesized by radically polymerizing an acrylic monomer mixture having a prescribed mixing ratio in a predetermined manner. The radical polymerization may be solution polymerization using an organic solvent as a solvent or suspension polymerization performing polymerization while dispersing raw material monomers into water. Examples of the polymerization initiator used in the radical polymerization include 2,2'-azobisisobutyronitrile, 2,2'-azobis-(2,4-dimethylvaleronitrile), 2,2'-azobis-4-methoxy-2,4-dimethylvaleronitrile, other azo or diazo polymerization initiators, and peroxide polymerization initiators such as benzoylperoxide and methyl ethyl ketone peroxide. In case of suspension polymerization, a dispersant such as polyacrylamide or polyvinyl alcohol is desirably added.

[0054]

The content of the elastomer is preferably 15 parts by weight or more and more preferably 30 parts by weight or more to the total content 100 parts by weight of the epoxy resin and the phenol resin. The content of the elastomer is preferably 60 parts by weight or less, more preferably 50 parts by weight or less, and further preferably 35 parts by weight or less.

[0055]

The resin composition preferably contains a curing accelerator.

[0056]

The curing accelerator is not especially limited as long as it accelerates curing; however, organophosphorus compounds such as triphenylphosphine and tetraphenylphosphonium tetraphenylborate and imidazole compounds are suitably used from the viewpoints of curability and preservability. These curing accelerators may be used alone, or may be in combination with other curing accelerators.

[0057]

The content of the curing accelerator is preferably 0.2 parts by weight or more to the total content 100 parts by weight of the epoxy resin and the phenol resin. The content of the curing accelerator is preferably 3 parts by weight or less.

[0058]

An additive such as a silane coupling agent can be appropriately compounded in the resin composition besides each

component described above as necessary.

[0059]

The thickness of the sealing material layer 32 is not especially limited, and it is determined by the thickness standard, etc. of the semiconductor device. However, the thickness is normally preferably set to 20 to 1,000 μm , and more preferably 50 to 500 μm .

[0060]

The sealing sheet 10 can be produced, for example, as follows.

First, each material for the sealing material layer 32 described before is uniformly dispersed and mixed to prepare a resin composition. Then, the prepared resin composition is formed in a sheet form. Examples of the forming method include a method of extrusion-molding the prepared resin composition to be formed into a sheet (kneading-extrusion); and a method of dissolving or dispersing the prepared resin composition into an organic solvent, etc. to prepare varnish, applying this varnish onto the release film 31, and drying the varnish to produce the sealing sheet 10 (solvent application). In the solvent application, a plurality of the sealing material layers 32 are laminated on the obtained sealing sheet 10 as necessary to adjust the thickness of the sealing material layer 32. Regarding the release sheet 10, a release sheet such as a polyester film may be pasted on the sealing material layer 32

to protect the surface of the sealing material layer 32 as necessary, and the release sheet may be peeled therefrom at sealing.

[0061]

Examples of the organic solvent to be used when the varnish is prepared include methyl ethyl ketone, acetone, cyclohexanone, dioxane, diethylketone, toluene and ethylacetate. These may be used alone or in combination of two or more thereof. Normally, the organic solvent is preferably used so that the solid content concentration of the varnish falls within a range of 60 to 90% by weight.

[0062]

When the sealing sheet 10 is produced by kneading-extrusion, the sealing sheet 10 is excellent in thickness uniformity with less voids. An example of the method of producing the sealing sheet by kneading-extrusion includes a method of melt-kneading each component described above to prepare a resin composition (a kneaded mixture), subjecting the resin composition to plastic processing to form the composition into a sheet form, and stacking the sheet-form resin composition on the release film 31.

[0063]

The kneading method is not especially limited; and examples thereof include methods using known kneaders such as a mixing roll, a pressure kneader and an extruder. The kneading

temperature is not especially limited as long as it is the softening point or higher of each component described above, and it is for example 30 to 150°C. If the thermosetting properties of the epoxy resin are considered, the temperature is preferably 40 to 140°C, and more preferably 60 to 120°C. The kneading time is 1 to 30 minute(s), and preferably 5 to 15 minutes.

[0064]

The resin composition after melt-kneading is preferably subjected to plastic processing in a high temperature state without being cooled. The plastic processing is not especially limited, and examples thereof include a plate pressing method, a T-die extrusion method, a rolling method, a roll kneading method, an inflation extrusion method, a co-extrusion method and a calendar molding method. The plastic processing temperature is not especially limited as long as it is the softening point or higher of each component described above. If the thermosetting properties and processability of the epoxy resin are considered, the temperature is for example 40 to 150°C, preferably 50 to 140°C, and more preferably 60 to 120°C.

[0065]

The sealing sheet 10 is used to seal a semiconductor element. Typical examples of the method of sealing a semiconductor element with the sealing sheet 10 include a method of embedding a semiconductor element in the sealing material

layer 32 of the sealing sheet 10 and a method of covering a semiconductor element with the sealing sheet 10 that is soften.

[0066]

In regards to the method of embedding a semiconductor element in the sealing material layer 32, for example, hot press is performed with a parallel planar method on a laminate having a support plate, a chip temporarily fixing body including a pressure-sensitive adhesive laminated on the support plate and a semiconductor element that is temporarily fixed on the pressure-sensitive adhesive, and the sealing sheet 10 arranged on the chip temporarily fixing body, so that the semiconductor element can be embedded in the sealing material layer 32. The material of the support plate is not especially limited, and examples thereof include metal materials such as SUS and plastic materials such as polyimide, polyamideimide, polyether ether ketone and polyether sulfone. The pressure-sensitive adhesive is not especially limited; however, a thermally releasable pressure-sensitive adhesive such as a thermally expandable pressure-sensitive adhesive is normally used because it can be easily peeled.

[0067]

In regards to the method of embedding a semiconductor element in the sealing material layer 32, for example, hot press is performed with a parallel planar method on a laminate structure having a substrate, a semiconductor element arranged

on the substrate, and the sealing sheet 10 arranged on the semiconductor element, so that the semiconductor element can be embedded in the sealing material layer 32. The substrate is not especially limited, and examples thereof include a glass fabric-epoxy resin copper clad laminate plate, an iron-nickel alloy plate and a semiconductor wafer.

[0068]

The sealing material layer 32 can function as a sealing resin to protect the semiconductor element and elements attached thereto from the external environment.

[0069]

[Outline of semiconductor device production method]

A method of producing the semiconductor device of Embodiment 1 includes a step (I) of sealing a semiconductor element with the sealing sheet 10 to form a sealed body including the semiconductor element and the sealing material layer 32 that covers the semiconductor element; a step (II) of peeling the release film 31 from the sealed body to expose the sealing material layer 32; and a step (III) of marking the exposed portion of the sealing material layer 32.

[0070]

Examples of the order of the steps (I) to (III) include the order of the steps (I), (II) and (III); and the order of the steps (II), (I) and (III). Among these, the order of the steps (I), (II) and (III) is preferable.

[0071]

As shown in Figs. 2 to 8, a semiconductor package 37 can be specifically produced by, for example, a method including a step (A) of performing hot press with a parallel planar method on a laminate having a chip temporarily fixing body 23 and the sealing sheet 10 arranged on the temporarily fixing body 23 to form a sealed body 34; a step (B) of peeling the release film 31 from the sealed body 34 to expose the sealing material layer 32; a step (C) of dicing the sealed body 34 to obtain the semiconductor package 37; and a step (D) of marking the exposed portion of the sealing material layer 32.

[0072]

Examples of the order of the steps (A) to (D) include the order of the steps (A), (B), (C) and (D); and the order of the steps (B), (A), (C) and (D). In these orders, the step (D) may be performed before the step (C). Among these, the order of the steps (A), (B), (C) and (D) is preferable.

[0073]

[Specific example of semiconductor device production method]

One example of the semiconductor device production method will be described hereinafter in detail.

[0074]

As shown in Fig. 2, a laminate is prepared which has the chip temporarily fixing body 23 and the sealing sheet 10 arranged on the chip temporarily fixing body 23.

[0075]

The chip temporarily fixing body 23 includes a temporarily fixing material 20 and semiconductor chips 33 arranged on the temporarily fixing material 20. Examples of the temporarily fixing material 20 include a stainless steel plate, a metal plate and a semiconductor wafer. The temporarily fixing material 20 normally includes a support plate such as a stainless steel plate, a metal plate, or a semiconductor wafer and a pressure-sensitive adhesive laminated on the support plate. In this case, the semiconductor chips 33 are temporarily fixed to the support plate with the pressure-sensitive adhesive.

[0076]

Next, as shown in Fig. 3, hot press is performed with a parallel planar method on the laminate to form the sealed body 34. The sealed body 34 includes the semiconductor chips 33 and the sealing material layer 32 that covers the semiconductor chips 33. The sealed body 34 is in contact with the temporarily fixing material 20 and the release film 31.

[0077]

The sealing condition (temperature, time, etc. of hot press) can be appropriately set.

[0078]

The temperature of the hot press is preferably 70°C or higher, more preferably 80°C or higher, and further preferably

90°C or higher. If the temperature is 70°C or higher, the sealing material layer 32 can be melted. The temperature of the hot press is preferably 120°C or lower, and more preferably 110°C or lower. If the temperature is 120°C or lower, warping of the molding can be suppressed.

[0079]

The pressure of the hot press is preferably 0.5 MPa or more, and more preferably 1 MPa or more. If the pressure is 0.5 MPa or more, sealing can be performed without voids. The pressure of the hot press on the laminate is preferably 10 MPa or less, and more preferably 8 MPa or less. If the pressure is 10 MPa or less, sealing can be performed without significantly damaging the semiconductor chips 33.

[0080]

The time of the hot press is preferably 0.3 minutes or more, and more preferably 0.5 minutes or more. The time of the hot press is preferably 10 minutes or less, and more preferably 5 minutes or less.

[0081]

The hot press is preferably performed under a reduced pressure atmosphere. The hot press under a reduced pressure atmosphere can reduce voids. As a reduced pressure condition, the pressure is for example 0.1 kPa to 5 kPa, and preferably 0.1 kPa to 1 kPa.

[0082]

As shown in Fig. 4, the release film 31 is peeled from the sealed body 34 to expose the sealing material layer 32.

[0083]

Then, the sealed body 34 is heated to cure the sealing material layer 32.

[0084]

The heating temperature is preferably 100°C or higher, and more preferably 110°C or higher. On the other hand, the upper limit of the heating temperature is preferably 200°C or lower, more preferably 180°C or lower, and further preferably 140°C or lower. The heating time is preferably 10 minutes or more, and more preferably 30 minutes or more. On the other hand, the upper limit of the heating time is preferably 720 minutes or less, and more preferably 480 minutes or less.

[0085]

Then, as shown in Fig. 5, the temporarily fixing material 20 is peeled from the sealed body 34. After the temporarily fixing material 20 is peeled, the surface of the sealed body 34 is preferably subjected to cleaning with plasma treatment, etc. while the semiconductor chips 33 are exposed.

[0086]

As shown in Fig. 6, rewirings 35 that connect to the semiconductor chips 33 exposed by peeling of the temporarily fixing material 20 are formed on the sealed body 34.

[0087]

Specifically, a metallic seed layer is formed on the exposed semiconductor chips 33 using a known method such as a vacuum film deposition method, and the rewirings 35 are formed with a semi-additive method, etc. After that, an insulating layer such as polyimide or PBO is preferably formed on the rewiring 35 and the sealed body 34.

[0088]

As shown in Fig. 7, bumping for forming a bump 36 on the rewiring 35 is preferably performed. The bumping is performed with a known method such as solder ball or solder plating. The material of the bump 36 is not especially limited; however, examples thereof include solders (alloys) such as tin-lead metal, tin-silver metal, tin-silver-copper metal, tin-zinc metal, and tin-zinc-bismuth metal; gold metal; and copper metal.

[0089]

As shown in Fig. 8, the sealed body 34 is diced to obtain the semiconductor package 37. The dicing can be performed with a conventionally known method. The semiconductor package 37 includes the semiconductor chip 33 and the sealing material layer 32 that covers the semiconductor chip 33.

[0090]

Marking is performed on the sealing material layer 32 of the semiconductor package 37.

[0091]

The marking method is not especially limited, and various marking methods can be used such as a printing method and a laser marking method. Among these, laser marking is preferable because marking can be suitably performed on the exposed portion of the sealing material layer. This makes it possible to give clear marking, and the misidentification of a product name, a lot number, etc. can be prevented.

[0092]

A known laser marking apparatus can be used when the laser marking is performed. Various types of lasers can be used such as a gas laser, a solid laser and a liquid laser. Specifically, a gas laser is not especially limited, and a known gas laser can be used. A carbon dioxide laser (CO₂ laser) and an excimer laser (ArF laser, KrF laser, XeCl laser, XeF laser, etc.) are preferable. A solid laser is not especially limited, and a known solid laser can be used. A YAG laser (Nd: YAG laser, etc.) and a YVO₄ laser are preferable. Among these, a YAG laser is preferable because a film having the above surface condition can be suitably marked.

[0093]

The semiconductor package 37 obtained with the above method can be used in electronics.

[0094]

(Variation Example 1)

In Embodiment 1, marking is performed on the sealing

material layer 32 of the semiconductor package 37. However, marking is performed on the sealing material layer 32 of the sealed body 34 in Variation Example 1. Specifically, the sealing material layer 32 is cured, the temporarily fixing material 20 is then peeled from the sealed body 34, and marking is performed on the sealing material layer 32 of the sealed body 34. The temporarily fixing material 20 may be peeled from the sealed body 34 after the sealing material layer 32 is cured and marking is performed on the sealing material layer 32 of the sealed body 34.

[0095]

[Embodiment 2]

In Embodiment 2, a semiconductor element is sealed with a resin to obtain a semiconductor device by using a metal mold having a surface smoothness (Ra) of 0.1 to 0.5 μm and an average distance of unevenness (RSm) of 90 to 125 μm in surface conditions.

The contents described in Embodiment 1 will be omitted.

[0096]

First, a metal mold 51 will be described.

[0097]

The metal mold 51 has a surface smoothness (Ra) of 0.1 μm or more, and preferably 0.2 μm or more. The surface smoothness of 0.1 μm or more can form a resin surface having excellent scratch resistance (fine scratches, etc. can be made

less noticeable), and as a result, the external appearance of a semiconductor device can be improved. In addition, a contrast can be easily given to the resin surface, so that the resin surface is excellent in visibility of the marking portion. The metal mold 51 has a surface smoothness (Ra) of 0.5 μm or less, and preferably 0.4 μm or less. The surface smoothness of 0.5 μm or less prevents a decrease in film strength, and there is no concern for breakage or damage when the film is produced or used. In addition, a contrast can be easily given to the resin surface, so that the resin surface is excellent in visibility of the marking portion.

[0098]

The surface smoothness (Ra) of the metal mold 51 can be adjusted to the above range by the material of the metal mold and the production steps such as finishing when the metal mold is produced.

The surface smoothness (Ra) can be measured with the method described in Examples.

[0099]

The metal mold 51 has an average distance of unevenness (RSm) of 90 μm or more, and preferably 95 μm or more. The average distance of unevenness of 90 μm or more makes it possible to prevent a character blur, etc. when the marking is performed by laser irradiation, etc. Further, an increase in brightness of the non-marking portion can be suppressed. The metal mold

51 has an average distance of unevenness (RSm) of 125 μm or less, and preferably 120 μm or less. The average distance of unevenness of 125 μm or less makes it possible to prevent a character blur, etc. when the marking is performed by laser irradiation, etc. Further, an increase in brightness of the non-marking portion can be suppressed.

[0100]

The average distance of unevenness (RSm) of the metal mold 51 can be adjusted to the above range by the material of the metal mold and the production steps such as finishing when the metal mold is produced.

The average distance of unevenness (RSm) can be measured with the method described in Examples.

[0101]

In order to adjust each of the surface smoothness (Ra) and the average distance of unevenness (RSm) to the above range, the metal mold 51 is preferably subjected to finish processing. The method of finish processing is not especially limited; and examples thereof include microblasting. The microblasting is a method of jetting, from a nozzle, fine abrasive grains each having several μm to several tens μm that are accelerated by carrier gas such as compressed air and allowing the fine abrasive grains to collide with the surface of a product to be processed at a high speed and with a high density to perform fine processing.

[0102]

The material of the metal mold 51 is not especially limited, and a conventionally known material can be used. Among the materials, alloy tool steel such as SKD is preferable from the point that each of the surface smoothness (Ra) and the average distance of unevenness (RSm) can be easily adjusted to the above range.

[0103]

As shown in Fig. 9, the metal mold 51 includes an upper mold 52 and a lower mold 53 that are arranged opposite to each other. These molds are brought close to each other and clamped. Then, mold opening is performed by separating these molds.

[0104]

Claw-like holding members 54 are provided on the parting surface of the upper mold 52. The edge portion of a workpiece 61 is held by these holding members 54. The workpiece 61 includes the temporarily fixing material 20 and a plurality of the semiconductor chips 33 arranged on the temporarily fixing material 20.

[0105]

Sealing materials 55 are provided on the parting surface of the upper mold 52. In the metal mold 51 clamped, a closed space including a cavity recessed part 56 is formed by the sealing materials 55.

[0106]

The cavity recessed part 56 is formed in the lower mold 53. The resin composition is supplied to the cavity recessed part 56.

[0107]

The cavity recessed part 56 has a surface condition that satisfies the above surface smoothness (Ra) and the above average distance of unevenness (RSm). The semiconductor chips 33 are sealed with the resin composition in the cavity recessed part 56 having such a surface condition, so that the surface of the sealed body to be obtained has a distinctive pearskin-finished state, and the marking portion has excellent visibility.

[0108]

As described above, the metal mold 51 includes the lower mold 53 in which the cavity recessed portion 56 is formed and the upper mold 52 including the parting surface and the holding members 51 for holding the workpiece 61 on the parting surface.

[0109]

For example, the semiconductor device can be suitably produced with a method including a step (i) of sealing a semiconductor element with a resin using the metal mold 51 and a step (ii) of marking the sealed body obtained in the step (i).

[0110]

More specifically, the semiconductor device can be produced with a method including a step (a) of supplying the

resin composition 57 to the metal mold 51 to seal a plurality of the semiconductor chips 33 arranged on the temporarily fixing material 20; a step (b) of marking the sealed body obtained in the step (a); and a step (c) of dicing the sealed body to produce a semiconductor package.

[0111]

As the order of the steps (a) to (c), any order is available as long as the step (a) is the first step. Specific examples thereof include the order of the steps (a), (b) and (c); and the order of the steps (a), (c) and (b). These are properly used in consideration of productivity; however, among these, the order of the steps (a), (b) and (c) is preferable.

[0112]

Step (a)

First, as shown in Fig. 9, the workpiece 61 is held by the holding members 54 of the upper mold 52. Specifically, the workpiece 61 is held so that the surface on which the semiconductor chips 33 are temporarily fixed becomes the lower mold 53 side.

[0113]

Then, as shown in Fig. 10, the resin composition 57 is supplied to the cavity recessed part 56. The form of the resin composition 57 is not especially limited, and examples thereof include a granular form and a sheet form. For example, the resin composition described in Embodiment 1 can be used as the resin

composition 57.

[0114]

Then, the resin composition 57 is melted under heating. Normally, the metal mold 51 is heated in advance with a heater (not shown). The heating temperature is preferably 100°C or higher, more preferably 110°C or higher, and further preferably 130°C or higher. On the other hand, the upper limit of the heating temperature is preferably 200°C or lower, more preferably 180°C or lower, and further preferably 160°C or lower.

[0115]

Then, as shown in Fig. 11, the upper mold 52 and the lower mold 53 are brought close to each other to clamp the metal mold 51. At this time, the closed space including the cavity recessed portion 56 is depressurized. The degree of vacuum in the closed space is for example 0.01 kPa to 10 kPa. This can reduce voids.

[0116]

Then, the resin composition 57 is heated and cured while the mold is clamped. The heating temperature is preferably 100°C or higher, more preferably 110°C or higher, and further preferably 130°C or higher. On the other hand, the upper limit of the heating temperature is preferably 200°C or lower, more preferably 180°C or lower, and further preferably 160°C or lower. The heating time is preferably 1 minute or more, and more

preferably 5 minutes or more. On the other hand, the upper limit of the heating time is preferably 120 minutes or less, and more preferably 60 minutes or less.

[0117]

In this way, the semiconductor chips 33 can be sealed with the resin composition 57. The sealed body obtained in this way includes the semiconductor chips 33 and the resin composition 57 that covers the semiconductor chips 33.

[0118]

Steps (b) and (c)

Marking is performed on the sealed body in the step (b).

The sealed body is diced to produce the semiconductor package 37 in the step (c).

[0119]

The semiconductor package 37 obtained with the method described above can be used in electronics.

[0120]

(Variation Example 1)

In Variation Example 1, the metal mold 51 includes the lower mold 53 including the parting surface and the holding members for holding the workpiece 61 on the parting surface and the lower mold 52 in which the cavity recessed part is formed (not shown).

EXAMPLES

[0121]

The present invention is explained in detail with reference to the examples below. However, the present invention is not limited to the following examples, and includes variations of these examples as long as their purpose is not frustrated.

[0122]

[Outline of films A to J (also referred to as sealing sheets A to J)]

Sealing sheets A to J that are used in the examples will be described.

The sealing sheets A to J each have a transparent polyester release film and a sealing material layer arranged on the release film. Unevenness are formed on the release film by emboss processing.

[0123]

[Production of release films a to j]

Emboss processing was performed on a silicone-treated PET (MRF50 manufactured by Mitsubishi Chemical Corporation) having a thickness 50 μm to obtain release films a to j.

[0124]

[Production of varnish for application]

The components used in producing varnish for application will be described.

Epoxy resin: YSLV-80XY manufactured by Nippon Steel

Chemical Co., Ltd. (Bisphenol F type epoxy resin: epoxy equivalent 191, softening point 80°C)

Phenol resin: MEH7851SS manufactured by Meiwa Plastic Industries, Ltd. (Phenol aralkyl resin: hydroxy equivalent 203, softening point 67°C)

Catalyst: 2PHZ-PW manufactured by Shikoku Chemicals Corporation (imidazole catalyst)

Spherical fused silica: FB-9454 manufactured by DENKI KAGAKU KOGYO KABUSHIKI KAISHA (fused spherical silica, average particle size 20 μm)

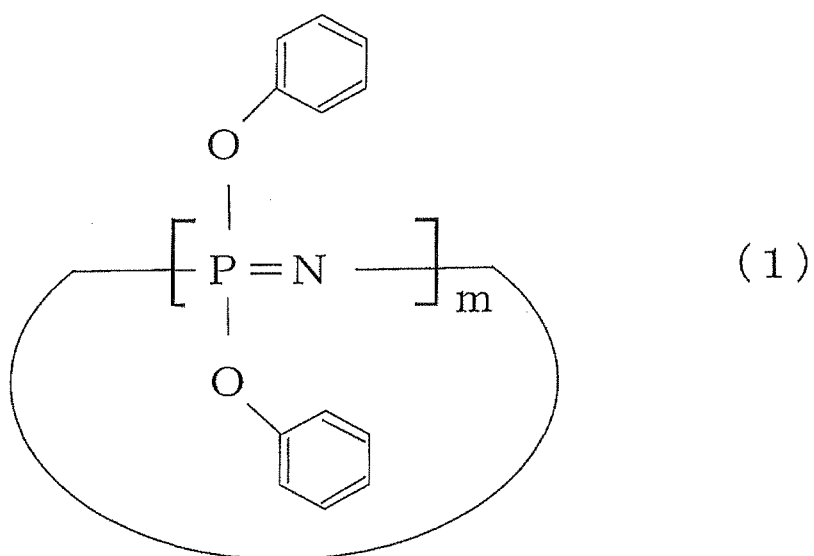
Carbon black: #20 manufactured by Mitsubishi Chemical Corporation

Silane coupling agent: KBM-403 manufactured by Shin-Etsu Chemical Co., Ltd. (3-glycidoxypropyltrimethoxysilane)

Elastomer (thermoplastic resin): SIBSTER 072T manufactured by Kaneka Corporation (styrene-isobutylene-styrene block copolymer)

Flame retardant: FP-100 manufactured by FUSHIMI Pharmaceutical Co., Ltd. (phosphazene flame retardant: compound represented by Formula (1))

[Formula 1]



wherein, m represents an integer of 3 or 4.

[0125]

According to the compounding ratio described in Table 1, each component was mixed with a mixed liquid containing methyl ethyl ketone and toluene with a ratio of 5 : 5 to produce a mixture having a component concentration of 90% by weight. The mixture was stirred at 200 rpm for 10 minutes using a planetary centrifugal mixer (Awatorirentarou manufactured by THINKY) to obtain varnish for application. The reason why the mixed liquid containing methyl ethyl ketone and toluene was used is because SIBSTAR 072T serving as an elastomer is hardly dissolved in methyl ethyl ketone.

[0126]

[Table 1]

			Varnish for Application
Compounding (Solid Content Ratio) (parts by weight)	Epoxy Resin	YSLV-80XY	3.4
	Phenol Resin	MEH7851SS	3.6
	Catalyst	2PHZ-PW	0.1
	Spherical Fused Silica	FB-9454	87.9
	Carbon Black	#20	0.1
	Silane Coupling Agent	KBM-403	0.1
	Elastomer	SIBSTAR 072T	3.0
	Flame Retardant	FP-100	1.8
Total			100
Production Method			Solvent Application

[0127]

[Production of sealing sheet A]

The varnish for application was applied onto the release film a, and it was dried at 110°C for 10 minutes with a hot air dryer to obtain a sheet including the release film a and a resin layer having a thickness of 100 μ m arranged on the release film a. Seven resin layers were laminated on the sheet at a roll temperature of 90°C and a speed of 0.4 m/min with a vacuum laminator to obtain the sealing sheet A having the release film a and a sealing material layer having a thickness of 0.8 mm arranged on the release film a.

[0128]

[Production of sealing sheets B to J]

The sealing sheets B to J were obtained in the same manner as in the sealing sheet A except that the release films b to

j produced according to Table 2 were used in place of the release film a.

[0129]

[Evaluation of surface condition]

After each of the release films a to j of each of the sealing sheets A to J was peeled from the sealing material layer, the following evaluations were performed on each surface that was in contact with the sealing material layer of each of the release films a to j. The results are shown in Table 2.

[0130]

[Surface smoothness (Ra)]

The surface smoothness (Ra) was measured in accordance with JIS B 0601:2001 using a surface profiler (Dektak 8M) manufactured by Veeco Instruments Inc. The measurement conditions were set to at room temperature and a measurement speed of 5 $\mu\text{m/s}$.

[0131]

[Average distance of unevenness (RSm)]

The average distance of unevenness (RSm) was measured in accordance with JIS B 0601:2001 using a surface profiler (Dektak 8M) manufactured by Veeco Instruments Inc. The measurement conditions were set to at room temperature and a measurement speed of 5 $\mu\text{m/s}$.

[0132]

[Table 2]

[Solvent Application Type]

		Sealing Sheet									
		A	B	C	D	E	F	G	H	I	J
Release Film		Release Film a	Release Film b	Release Film c	Release Film d	Release Film e	Release Film f	Release Film g	Release Film h	Release Film i	Release Film j
Evaluation	Surface smoothness (Ra) (μm)	0.37	0.17	0.26	0.32	0.38	0.22	0.38	0.3	0.08	0.55
	Average distance of unevenness (RSm) (μm)	124.6	92.4	101.2	66.9	60.1	37.8	77.3	130	100	110

[0133]

[Examples 1 to 3 and Comparative Examples 1 to 7]

According to Table 3, the sealing sheets A to J were used to obtain semiconductor packages with the method of Embodiment 1. Specific procedures are as follows.

A thermal release sheet (REVALALPHA No. 3195V manufactured by Nitto Denko Corporation) was arranged on a circular glass plate having a diameter of 300 mm to obtain a pedestal including the glass plate and the thermal release sheet arranged on the glass plate. One hundred semiconductor chips (semiconductor chip size: 5 mm square (thickness 300 μm)) were arranged on the pedestal at equal intervals by using a die bonder SPA-300 (manufactured by Shinkawa Ltd.). Each of the sealing sheets A to J were arranged on the semiconductor chips arranged on the pedestal to obtain a laminate. The laminate includes the pedestal, the semiconductor chips arranged on the pedestal, and each of the sealing sheets A to J arranged on the semiconductor chips. Next, the laminate was pressed using a parallel plate pressing machine in molding conditions of 100°C, 1 MPa, a pressure application time of 2 minutes, and a degree of vacuum of 5 Torr to obtain a sealed body. The sealed body includes the semiconductor chips and the sealing material layer that covers the semiconductor chips. Next, the sealed body was cured at 120°C for 3 hours under heating. After being heated at 175°C for 30 seconds, the sealed body was peeled and removed

from the pedestal at normal temperature. After that, rewiring layers and bumps were formed on the lower surface of the sealed body. Finally, the sealed body was diced into pieces to obtain semiconductor packages.

Marking was performed on the semiconductor packages in the conditions shown in Table 4. The brightness of the non-marking portion was measured. When the brightness was 70 or less, it was determined as "O", and when it exceeds 70, it was determined as "x".

[0134]

[Table 3]

[Semiconductor Package]

		Example			Comparative Example						
		1	2	3	1	2	3	4	5	6	7
Sealing Sheet		Sealing Sheet A	Sealing Sheet B	Sealing Sheet C	Sealing Sheet D	Sealing Sheet E	Sealing Sheet F	Sealing Sheet G	Sealing Sheet H	Sealing Sheet I	Sealing Sheet J
Evaluation	Brightness	31	57	65	76	80	81	88	71	72	88
	Determination	O	O	O	x	x	x	x	x	x	x

[0135]

[Table 4]

[Marking Condition]

Laser Type	Laser Power (%)	Scan Speed (mm/s)	Switch Frequency (KHz)	Number of Printing Times (times)	Spot Variation	Printing Time (ms)
YVO ₄ Laser	65	705	105	1	-25	800

[0136]

In the semiconductor packages obtained using the sealing sheets D to J, the brightness of the non-marking portion was high. On the other hand, in the semiconductor packages obtained using the sealing sheets A to C, the brightness of the non-marking portion was lower than that of each semiconductor package obtained using each of the sealing sheets D to J, and the information that was given by marking could be easily read.

[0137]

[Production of sealing sheet K]

According to the compounding ratio described in Table 5, each component was kneaded at 120°C for 10 minutes with a biaxial kneader to prepare a kneaded product. The kneaded product obtained was extruded from a T die to obtain a formation sheet for forming the sealing material layer. The formation sheet was laminated on the release film a in conditions of 80°C and 0.3 MPa to obtain a sealing sheet K including the release film a and the sealing material layer having a thickness of 0.8 mm arranged on the release film a.

[0138]

[Table 5]

			Kneaded Product
Compounding (Solid Content Ratio) (parts by weight)	Epoxy Resin	YSLV-80XY	3.4
	Phenol Resin	MEH7851SS	3.6
	Catalyst	2PHZ-PW	0.1
	Spherical Fused Silica	FB-9454	87.9
	Carbon Black	#20	0.1
	Silane Coupling Agent	KBM-403	0.1
	Elastomer	SIBSTAR 072T	3.0
	Flame Retardant	FP-100	1.8
Total			100
Production Method			Kneading-Extrusion

[0139]

[Production of sealing sheets L and M]

Sealing sheets L and M were obtained in the same manner as in the sealing sheet K except that the release films b and c according to Table 6 were used in place of the release film a.

[0140]

[Table 6]

[Kneading-Extrusion Type]

		Sealing Sheet		
		K	L	M
Release Film		Release Film a	Release Film b	Release Film c
Evaluation	Surface smoothness (Ra) (μm)	0.37	0.17	0.26
	Average distance of unevenness (RSm) (μm)	124.6	92.4	101.2

[0141]

[Evaluation of surface condition]

After the release films a to c of the sealing sheets K to M were peeled from the sealing material layer, the surface smoothness (Ra) and average distance of unevenness (RSm) of the release films a to c were evaluated. The results are shown in Table 6.

[0142]

[Examples 4 to 6]

According to Table 7, the sealing sheets K to M were used to obtain semiconductor packages with the method of Embodiment 1. Marking was performed on the semiconductor packages in the conditions shown in Table 4. The brightness of the non-marking portion was measured. When the brightness was 70 or less, it was determined as "O", and when it exceeds 70, it was determined

as "x".

[0143]

[Table 7]

[Semiconductor Package]

		Example		
		4	5	6
Sealing Sheet		Sealing Sheet K	Sealing Sheet L	Sealing Sheet M
Evaluation	Brightness	31	57	65
	Determination	○	○	○

[0144]

In the semiconductor packages obtained using the sealing sheets K to M, the information that was given by marking could be easily read.

[0145]

[Examples 7 to 9 and Comparative Examples 8 to 11]

A metal mold having the structure shown in Fig. 9 was prepared. The microblasting was performed on the cavity recessed part to obtain the metal mold 51 having the surface condition shown in Table 8. The metal mold 51 was used to obtain semiconductor packages with the method of Embodiment 2. Specific procedures are as follows. The workpiece 61 was prepared including the temporarily fixing material 20 and a plurality of the semiconductor chips 33 arranged on the

temporarily fixing material 20. The workpiece 61 was arranged on the parting surface of the upper mold 52. Next, a resin sheet was arranged on the cavity recessed part 56. Then, the resin sheet was melt at 150°C under heating. Next, the resin sheet was heated at 150°C for 10 minutes to be cured under a condition of a degree of vacuum of 5 Torr while the mold was clamped at an applied pressure of 5 MPa to obtain the semiconductor packages. Marking was performed on the obtained semiconductor packages in the conditions shown in Table 4. The brightness of the non-marking portion was measured. When the brightness was 70 or less, it was determined as "O", and when it exceeds 70, it was determined as "x".

[0146]

The resin sheet to be supplied to the metal mold was produced as follows.

According to the compounding ratio described in Table 5, each component was kneaded at 120°C for 10 minutes with a biaxial kneader, and the kneaded product was extruded from a T die having a gap of 800 μm into a sheet form to obtain a resin sheet having a thickness of 800 μm .

[0147]

[Table 8]

[Semiconductor Package]

		Example			Comparative Example			
		7	8	9	8	9	10	11
Surface smoothness (Ra) (μm)		0.12	0.35	0.48	0.28	0.42	0.05	0.65
Average distance of unevenness (RSm) (μm)		91	111	122	60	150	110	118
Evaluation	Brightness	25	43	66	76	82	85	90
	Determination	○	○	○	×	×	×	×

DESCRIPTION OF REFERENCE SIGNS

[0148]

- 10 Sealing Sheet
- 20 Temporarily Fixing Material
- 23 Chip Temporarily Fixing Material
- 31 Release Film
- 32 Sealing Material Layer
- 33 Semiconductor Chip
- 34 Sealed Body
- 35 Rewiring
- 36 Bump
- 37 Semiconductor Package
- 51 Metal Mold
- 52 Upper Mold
- 53 Lower Mold
- 54 Holding Member

55	Sealing Material
56	Cavity Recessed Part
57	Resin Composition
61	Workpiece

CLAIMS

1. A sealing sheet for a semiconductor element, comprising a release film having a surface smoothness (Ra) of 0.1 to 0.5 μm and an average distance of unevenness (RSm) of 90 to 125 μm in surface conditions and a sealing material layer arranged on the release film.
2. A semiconductor device obtained by sealing a semiconductor element with a sealing sheet comprising a release film having a surface smoothness (Ra) of 0.1 to 0.5 μm and an average distance of unevenness (RSm) of 90 to 125 μm in surface conditions and a sealing material layer arranged on the release film.
3. The semiconductor device according to claim 2, wherein a resin composition that forms the sealing material layer contains carbon black in an amount of 0.01 to 1% by weight.
4. The semiconductor device according to claim 3, wherein the resin composition contains a filler in an amount of 70 to 95% by weight.
5. The semiconductor device according to any of claims 2 to 4, which is obtained with a method comprising:

a step (I) of sealing the semiconductor element with the sealing sheet to form a sealed body including the semiconductor element and the sealing material layer that covers the semiconductor element; and

a step (II) of peeling the release film from the sealed body.

6. A method of producing a semiconductor device, the method comprising:

a step (I) of sealing a semiconductor element with a sealing sheet comprising a release film having a surface smoothness (Ra) of 0.1 to 0.5 μm and an average distance of unevenness (RSm) of 90 to 125 μm in surface conditions and a sealing material layer arranged on the release film to form a sealed body including the semiconductor element and the sealing material layer that covers the semiconductor element; and

a step (II) of peeling the release film from the sealed body.

7. A semiconductor device obtained by sealing a semiconductor element with a resin using a metal mold having a surface smoothness (Ra) of 0.1 to 0.5 μm and an average distance of unevenness (RSm) of 90 to 125 μm in surface conditions.

8. The semiconductor device according to claim 7, which

is resin-sealed with a resin composition containing carbon black in an amount of 0.01 to 1% by weight.

9. The semiconductor device according to claim 8, wherein the resin composition contains a filler in an amount of 70 to 95% by weight.

10. The semiconductor element according to claim 7, which is obtained with a method comprising a step (i) of sealing the semiconductor element with the resin by using the metal mold to form a sealed body including the semiconductor element and the resin composition that covers the semiconductor element.

11. A method of producing a semiconductor device, the method comprising:

a step (i) of sealing a semiconductor element with a resin by using a metal mold having a surface smoothness (Ra) of 0.1 to 0.5 μm and an average distance of unevenness (RSm) of 90 to 125 μm in surface conditions to form a sealed body including the semiconductor element and the resin composition that covers the semiconductor element.