

DESCRIPTION

Title of Invention: METHOD FOR PRODUCING RESIN MOLDED PRODUCT, MOLDING
DIE, AND RESIN MOLDING APPARATUS

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TECHNICAL FIELD

[0001] The present disclosure relates to a method for producing a resin molded product, a molding die, and a resin molding apparatus.

BACKGROUND ART

10 [0002] Compression molding using a molding die is widely employed for the production of resin molded products. In the compression molding, a release film may be used for the purpose of preventing resin leakage from the molding die.

[0003] Patent Literature 1 describes a configuration in which, in a lower die of a molding die for performing compression molding using a release film, a projection is formed on the outer
15 peripheral edge of the upper surface of the lower die bottom surface member (compression molding die) to form a step on the inner peripheral surface of the lower die side surface member (frame molding die). According to the description of Patent Literature 1, with this configuration, it is possible to eliminate wrinkles formed in the release film during clamping in compression molding performed with the release film placed on the upper surface of the lower die. Prevention
20 of wrinkle formation in the release film makes it possible to suppress defects and the like in the resin molded product attributable to such wrinkles.

Citation List

Patent Literature

[0004] Patent Literature 1: JP 2013-180461 A

25 SUMMARY OF INVENTION

Technical Problem

[0005] However, in the molding die described in Patent Literature 1, a protrusion corresponding to the step of the lower die side surface member remains on the outer peripheral portion of the resin molded product after resin molding. If such a protrusion remains, the
30 protrusion may fall off when the resin molded product is taken out of the molding die and conveyed. Falling off of such a protrusion may cause defective products or stop the resin molding apparatus from operating, which may reduce productivity.

[0006] Hence, it is an object of the present disclosure to provide a method for producing a resin molded product, a molding die, and a resin molding apparatus that suppress the formation of
35 resin protrusions that may fall off during the conveyance of the resin molded products after resin

molding while suppressing the formation of wrinkles in the release film during compression molding using a release film.

Solution to Problem

[0007] In order to achieve the above object, the present disclosure provides a method for

5 producing a resin molded product using a molding die, the molding die including: an upper die; and a lower die, wherein the upper die and the lower die are disposed so as to face each other, the lower die includes a lower die bottom surface member and a lower die side surface member, and a cavity is formed by a space surrounded by an upper surface of the lower die bottom surface member and an inner peripheral surface of the lower die side surface member, the upper surface
10 of the lower die bottom surface member forms a bottom surface of the cavity, and the inner peripheral surface of the lower die side surface member forms a side surface of the cavity, the method for producing a resin molded product, including: resin molding; and conveying, wherein in the resin molding, a resin molded product is produced by performing resin molding through compression molding by clamping the molding die in a state where a molding target is placed
15 between the upper die and the lower die, a release film is placed on the bottom surface and the side surface of the cavity, and a resin material is placed on the release film, in the conveying, the molding die is opened after the resin molding, and the molded product is taken out of the molding die and then conveyed, and on an upper surface of the lower die side surface member, a step having a depth equal to or less than a thickness of the release film is formed at a position
20 adjacent to the inner peripheral surface of the lower die side surface member.

[0008] The present disclosure also provides a first molding die for use in the method for producing a resin molded product according to the present disclosure.

[0009] The present disclosure also provides a second molding die for compression molding for use in a method for producing a resin molded product, including: an upper die; and a lower die,
25 wherein the upper die and the lower die are disposed so as to face each other, the lower die includes a lower die bottom surface member and a lower die side surface member, and a cavity is formed by a space surrounded by an upper surface of the lower die bottom surface member and an inner peripheral surface of the lower die side surface member, the upper surface of the lower die bottom surface member forms a bottom surface of the cavity, and the inner peripheral surface
30 of the lower die side surface member forms a side surface of the cavity, in the method for producing a resin molded product, a resin molded product is produced by performing resin molding through compression molding by clamping the molding die in a state where a molding target is placed between the upper die and the lower die, a release film is placed on the bottom surface and the side surface of the cavity, and a resin material is placed on the release film, and
35 on an upper surface of the lower die side surface member, a step having a depth equal to or less

than a thickness of the release film is formed at a position adjacent to the inner peripheral surface of the lower die side surface member. Note that, hereinafter, the term “the molding die of the present disclosure” simply refers to both the first molding die of the present disclosure and the second molding die of the present disclosure unless otherwise specified.

5 [0010] The present disclosure also provides a resin molding apparatus, including: the molding die according to the present disclosure; and a clamping mechanism that clamps the upper die and the lower die of the molding die.

Advantageous Effects of Invention

10 [0011] The present disclosure can provide a method for producing a resin molded product, a molding die, and a resin molding apparatus that suppress the formation of resin protrusions that may fall off during the conveyance of the resin molded products after resin molding while suppressing the formation of wrinkles in the release film during compression molding using a release film.

BRIEF DESCRIPTION OF DRAWINGS

15 [0012] [FIGs. 1A and 1B] FIGs. 1A and 1B show diagrams illustrating an example of the configuration of the molding die of the present disclosure. FIG. 1A is a plan view. FIG. 1B is a cross-sectional view.

[FIG. 2] FIG. 2 is a cross-sectional view illustrating one process in the method for producing a resin molded product of the present disclosure.

20 [FIG. 3] FIG. 3 is a cross-sectional view illustrating another process in the method for producing a resin molded product of the present disclosure.

[FIG. 4] FIG. 4 is a cross-sectional view illustrating still another process in the method for producing a resin molded product of the present disclosure.

25 [FIG. 5] FIG. 5 is a cross-sectional view illustrating still another process in the method for producing a resin molded product of the present disclosure.

[FIG. 6] FIG. 6 is a cross-sectional view illustrating still another process in the method for producing a resin molded product of the present disclosure.

[FIG. 7] FIG. 7 is a cross-sectional view illustrating still another process in the method for producing a resin molded product of the present disclosure.

30 [FIG. 8] FIG. 8 is a plan view showing an example of the configuration of the resin molding apparatus of the present disclosure.

DESCRIPTION OF EMBODIMENTS

[0013] In the present disclosure, the molding die is not particularly limited, and may be, for example, a metal die or a ceramic die.

35 [0014] In the present disclosure, the term "suppression" of phenomena such as the formation of

resin protrusions, the slack of the release film, and the formation of wrinkles of the release film is not limited to the case of suppressing the generation of these phenomena to be small, but also includes the case of making the generation of these phenomena zero, unless otherwise specified.

[0015] In the present disclosure, the resin molded product is not particularly limited, and may be any electronic component in which an electronic element such as an IC, a semiconductor chip, or the like is resin-sealed (hereinafter sometimes simply referred to as a "chip"). More specifically, for example, by resin-sealing the chip, the electronic component in which the chip is resin-sealed (also referred to as a finished electronic component, a package, or the like, and hereinafter sometimes simply referred to as an "electronic component") can be produced. In general, the term "electronic component" may refer to a chip before resin sealing or a chip after resin sealing. In the present disclosure, however, a chip before resin sealing is also referred to as an "electronic element", and a resin-sealed chip is referred to as an "electronic component" (a finished electronic component). That is, in the present disclosure, the "chip" and the "electronic element" have the same meaning, and specific examples thereof include chips such as an IC, a semiconductor chip, a semiconductor element for power control, a resistor element, and a capacitor element. The "semiconductor element" refers to, for example, a circuit element made of a semiconductor material. The "chip" or the "electronic element" in the present disclosure is not particularly limited as long as being a chip before resin sealing, and not necessarily be in the form of a chip.

[0016] In the present disclosure, a resin material before molding and a resin after molding are not particularly limited, and may be, for example, a thermosetting resin such as an epoxy resin or a silicone resin, or may be a thermoplastic resin. The resin material before molding and the resin after molding may also be a composite material partially containing a thermosetting resin or a thermoplastic resin. In the present disclosure, examples of the form of the resin material before molding include a particulate resin (including granular resin), a liquid resin, a sheet-like resin, and a tablet-like resin. In the present disclosure, the liquid resin may be in a liquid state at room temperature, and also includes molten resin which is melted by heating to become liquid. The form of the resin may be any other form as long as the resin can be supplied to the cavity or pot of the molding die.

[0017] Specific embodiments of the present disclosure will be described below with reference to the drawings. Each drawing is schematically illustrated by appropriately omitting, exaggerating, and the like for convenience in explanation.

First Embodiment

[0018] In the present embodiment, an example of a molding die of the present disclosure and an example of a method for producing a resin molded product using the molding die will be

described.

[0019] FIGs. 1A and 1B show an example of the configuration of the molding die of the present disclosure. FIG. 1A is a plan view (top view). FIG. 1B is a cross-sectional view taken along the line I-I of FIG. 1A. Note that, in FIGs. 1A and 1B, for simplification of illustration, the upper die of the molding die is not shown, and the lower die is illustrated in a simplified manner.

[0020] As shown in FIGs. 1A and 1B, this molding die includes a lower die 200. Although it is not shown, this molding die includes an upper die as described above. The upper die and the lower die 200 are disposed such that the lower surface of the upper die and the upper surface of the lower die 200 face each other. The configuration of the upper die is not particularly limited.

For example, as shown in FIGs. 2 to 7 to be described below, the upper die may have a configuration in which an object to be molded (hereinafter also referred to as a molding target) can be fixed to the lower surface of the upper die.

[0021] As shown in FIGs. 1A and 1B, the lower die 200 includes a lower die bottom surface member 202 and a lower die side surface member 201. A cavity 200A is formed by a space surrounded by the upper surface of the lower die bottom surface member 202 and the inner peripheral surface of the lower die side surface member 201. The upper surface of the lower die bottom surface member 202 forms the bottom surface of the cavity 200A, and the inner peripheral surface of the lower die side surface member 201 forms the side surface of the cavity 200A. As will be described below with reference to FIGs. 2 to 7, a resin molded product is produced by performing resin molding through compression molding by clamping the molding die in a state where a molding target is placed between the upper die and the lower die 200, a release film is placed on the bottom surface and the side surface of the cavity 200A, and a resin material is placed on the release film.

[0022] Also, in the lower die 200 of FIGs. 1A and 1B, no projection is formed on the outer peripheral edge of the upper surface of the lower die bottom surface member 202, and the surface is flat.

[0023] On the upper surface of the lower die side surface member 201, a step 201D having a depth equal to or less than the thickness of the release film is formed at a position adjacent to the inner peripheral surface of the lower die side surface member 201. The outer end of the step 201D is positioned inside the outer edge of the molding target placement region α . Further, air vent grooves 201C extending outward beyond the step 201D are formed on the upper surface of the lower die side surface member 201. The air vent grooves 201C are grooves formed on the upper surface of the lower die side surface member 201. A plurality of air vent grooves 201C are radially formed in a part of the periphery of the step 201D. In FIGs. 1A and 1B, the step 201D and the air vent grooves 201C are connected to each other. The outer end of the air vent groove

201C is positioned outside the outer edge of the molding target placement region α . For example, gas (air or the like) in the cavity 200A can be released into the air vent grooves 201C. Also, for example, it is also possible to suction the release film through the air vent grooves 201C.

[0024] The width W1 (distance from the side in contact with the inner peripheral surface of the lower die side surface member 201 to the opposite side) of the step 201D is not particularly limited, and is preferably 0.05 mm or more from the viewpoint of making it easier to suppress the formation of wrinkles in the release film. The upper limit value is not particularly limited, and depends on the distance from the end surface of the molding target (e.g., substrate) to the step 201D. The upper limit value is, for example, 30 mm or less, 20 mm or less, 10 mm or less, 5 mm or less, 4 mm or less, 3 mm or less, 2 mm or less, 1 mm or less, 0.5 mm or less, 0.4 mm or less, 0.3 mm or less, 0.2 mm or less, or 0.1 mm or less.

[0025] Also, in FIGs. 1A and 1B, the step 201D is formed continuously along the entire circumference on the upper surface of the lower die side surface member 201, adjacent to its inner circumferential surface. However, the present disclosure is not limited thereto, and the step 201D may not be formed on the entire circumference. For example, the step 201D may be provided only on part of the upper surface of the lower die side surface member 201, adjacent to its inner circumferential surface, and may be omitted on other parts. Specifically, for example, it is also acceptable to employ a configuration in which the step 201D is omitted, for example, in certain portions where leakage of even a minute amount of resin material is unacceptable.

[0026] Furthermore, a through hole 201A and a through hole 201B are formed on the upper surface of the lower die side surface member 201. The through hole 201A is provided in a part outside the step 201D and the air vent grooves 201C, and penetrates from the upper surface to the lower surface of the lower die side surface member 201. As shown in FIGs. 1A and 1B, the through hole 201A has a structure in which a groove having a V-shaped cross section when viewed from the side is formed on the upper surface of the lower die side surface member 201, and a plurality of through holes each having a circular planar shape are formed at the bottom of the V-shaped groove. The through hole 201B is disposed so as to surround the entire outer circumference of the through hole 201A, and penetrates from the upper surface to the lower surface of the lower die side surface member 201. As shown in FIGs. 2 to 7 to be described below, the release film can be suctioned through the through holes 201A and 201B to adhere to the cavity surface of the cavity 200A. Also, as described below, resin for resin molding can be accommodated in the cavity 200A.

[0027] Next, a method for producing a resin molded product of the present disclosure using the molding die of FIGs. 1A and 1B and the resin molding apparatus of the present disclosure including the molding die will be described by way of example with reference to schematic

process cross-sectional views of FIGs. 2 to 7. In FIGs. 2 to 7, identical parts to those shown in FIGs. 1A and 1B are indicated with identical reference signs. However, for convenience of illustration, the shape and the like may be different from those shown in FIGs. 1A and 1B.

[0028] First, the configuration of the resin molding apparatus will be described with reference to FIG. 2. As shown in FIG. 2, the molding die in this resin molding apparatus has an upper die 100 in addition to the lower die 200 shown in FIGs. 1A and 1B. Furthermore, as shown in FIGs. 1A and 1B, this resin molding apparatus includes, in addition to the molding die, an outside air blocking member 300 and a release film suction mechanism (not shown). The die surface of the upper die 100 and the die surface of the lower die 200 face each other. The upper die 100 is fixed to the lower surface of the upper die holding member 110. The lower die 200 is fixed to the upper surface of the lower die holding member 210. As will be described below, the upper die 100 is a die to which the substrate 10 is fixed. The substrate 10 corresponds to the "molding target" of the present disclosure. As will be described below, the lower die 200 is a die in which a cavity is formed in the die surface and a release film adheres to this die surface by suction. The outside air blocking members 300 are attached to the lower surface of the upper die holding member 110 and the upper surface of the lower die holding member 210, respectively so as to surround the upper die 100 and the lower die 200. As will be described below, the outside air blocking members 300 together with the upper die holding member 110 and the lower die holding member 210 surround the molding die (upper die 100 and lower die 200) and block outside air from entering the molding die.

[0029] The upper die 100 is formed by attaching a film presser 103 and a clamper 104 to an upper die body 102. The film presser 103 is attached to the lower portion of the upper die body 102 via an upper die elastic member 103s. In the present embodiment, a spring is used as the upper die elastic member. The film presser 103 is vertically movable by expansion and contraction of the upper die elastic member 103s. As will be described below, the film presser 103 can press the release film against the lower die side surface member 201. As shown in FIG.2, the clamper 104 can fix the substrate 10 by sandwiching it between the lower surface of the upper die body 102 and the clamper 104. The positions where the film presser 103 and the clamper 104 are disposed are not limited to the positions shown in FIG. 2 and may be arranged as appropriate.

[0030] In the upper die body 102 and the upper die holding member 110, through holes 100B and 300B are formed, penetrating from the upper surface to the lower surface thereof. The lower end of the through hole 100B is open to the fixing surface for the substrate 10 on the lower surface of the upper die body 102. As will be described below, the substrate 10 can be adhered to the upper die body 102 by reducing the pressure inside the through hole 100B. The lower end of

the through hole 300B is open to the outer peripheral portion of the fixing surface for the substrate 10 on the lower surface of the upper die body 102. As will be described below, the space surrounded by the outside air blocking member 300 can be brought into a negative pressure state by reducing the pressure inside the through hole 300B.

5 [0031] As described with reference to FIGs. 1A and 1B, the lower die 200 includes the lower die bottom surface member 202 and the lower die side surface member 201. The lower die side surface member 201 is attached to the peripheral edge portion of the upper surface of the lower die bottom surface member 202 via the lower die elastic member 201s. In the present embodiment, a spring is used as the lower die elastic member. The lower die side surface member 201 is vertically movable by expansion and contraction of the lower die elastic member 201s. As shown in FIGs. 1A and 1B, a cavity 200A is formed by a space surrounded by the central portion (a portion to which the lower die side surface member 201 is not attached) of the upper surface of the lower die bottom surface member 202 and the inner surface of the lower die side surface member 201. As will be described below, resin for molding can be accommodated in the cavity 200A.

[0032] As described above, no projection is formed on the outer peripheral edge of the upper surface of the lower die bottom surface member 202, and the surface is flat.

[0033] The step 201D and the air vent groove 201C described with reference to FIGs. 1A and 1B are formed on the upper surface of the lower die side surface member 201. The arrangement and configuration of the step 201D and the air vent groove 201C are as described with reference to FIGs. 1A and 1B.

[0034] As described above, the lower die side surface member 201 is provided with the through holes 201A and 201B. Further, a through hole 200B is provided in the lower die bottom surface member 202 and the lower die holding member 210. The lower end of the through hole 200B is opened from the lower surface of the lower die bottom surface member 202 to the lower surface of the lower die holding member 210, and the other end of the through hole 200B is connected to the gap between the lower die bottom surface member 202 and the lower die side surface member 201 to form the through hole 200B together with the gap. The through hole 201A penetrates the lower die holding member 210, and further penetrates from the lower surface of the lower die bottom surface member 202 to the upper surface of the inner edge portion of the lower die side surface member 201. The through hole 201B penetrates the lower die holding member 210, and further penetrates from the lower surface of the lower die bottom surface member 202 to the upper surface of the outer edge portion of the lower die side surface member 201. As will be described below, by reducing the pressure inside the through holes 200B, 201A, and 201B using a release film suction mechanism, the release film can be adhered to the die

surface of the lower die 200. Then, as will be described below, resin molding is performed between the die surface of the upper die 100 and the die surface of the lower die 200 in a state in which the release film is adhered. The lower die side surface member 201 optionally has through holes for suctioning the release film, and when provided, the through holes may be arranged as appropriate.

[0035] Although it is not shown, a vacuum pump or the like can be used as the release film suction mechanism. Although it is not shown, this resin molding apparatus further includes a conveyance mechanism that opens the molding die after molding, takes out the resin molded product from the molding die, and conveys it.

[0036] The outside air blocking members 300 are attached to the peripheral edge portions of the upper die holding member 110 and the lower die holding member 210, respectively. A plurality of O-rings 300A, each having elasticity, are provided respectively between the upper die holding member 110 and the upper outside air blocking member 300, between the upper outside air blocking member 300 and the lower outside air blocking member 300, and between the lower outside air blocking member 300 and the lower die holding member 210.

[0037] Next, an example of a resin molding method using the resin molding apparatus will be described. First, as shown in FIG. 2, the substrate 10 is sandwiched and fixed between the lower surface of the upper die body 102 and the clamper 104. The substrate 10, as described above, corresponds to the "molding target" in the present disclosure. As shown in FIG. 2, a chip 10a is fixed to the lower surface (the surface opposite to the fixing surface with respect to the upper die body 102) of the substrate 10. During resin molding, the electronic component (resin molded product) can be produced by resin-sealing the chip 10a. However, the present disclosure is not limited thereto, and for example, there is no need to fix components such as chips to the substrate. Also, for example, components other than chips (such as wires) may be fixed to the substrate. Furthermore, as shown in FIG. 2, the release film 11 is conveyed to the position of the die surface of the lower die 200 together with the resin material 20a placed on the release film 11. The means and method for placing the resin material 20a on the release film 11 are not particularly limited, and for example, known means and methods such as feeders may be used as appropriate. The means and method for conveying the release film 11 and the resin material 20a to the position of the die surface of the lower die 200 are not particularly limited, and for example, known means and methods such as loaders may be used as appropriate. While the resin material 20a is granular resin in the present embodiment, the resin material 20a is not limited thereto, and may be, for example, sheet-like resin, liquid resin, tablet-like resin, or semi-solid flowable resin.

[0038] Next, as shown in FIGs. 3 and 4, the release film suctioning is performed. First, as

shown in FIG. 3, the release film 11 and the resin material 20a are transferred to the lower die 200. Further, as indicated by arrows 201a and 201b, the pressure inside the through holes 201A and 201B in the lower die side surface member 201 is reduced by a release film suction mechanism (not shown). The release film suction mechanism is not particularly limited, and may be, for example, a vacuum pump or the like. As a result, the release film 11 adheres to the upper surface of the lower die side surface member 201 by suction, and tension is applied to the release film 11 placed on the cavity 200A, so that the wrinkles of the release film are smoothed. At this time, since the step 201D is formed in the lower die side surface member 201, the release film is stretched by the step 201D, so that the stretching of the release film is further promoted. As a result, slack of the release film is suppressed. Therefore, the formation of wrinkles in the release film is suppressed, and it is also possible to suppress defects and the like of the resin molded product caused by the wrinkles. In addition, since the air vent groove 201C is formed in the lower die side surface member 201, the generation of slack and wrinkles in the release film can be further suppressed, and defects and the like in the resin molded product caused by the wrinkles can be suppressed.

[0039] Further, as indicated by arrow 200b in FIG. 4, the pressure inside the through hole 200B communicating with the gap between the lower die side surface member 201 and the lower die bottom surface member 202 is reduced by the release film suction mechanism to perform suction. As a result, tension is further applied to the release film 11 to smooth out wrinkles, and the release film 11 adheres to the cavity surface of the cavity 200A by suction. In this way, the release film 11 is placed on the bottom surface and the side surface of the cavity 200A. As a result, as shown in FIG. 4, the resin material 20a is placed (arranged) in the cavity 200A while being placed (arranged) on the release film 11. At this time, as shown in FIG. 4, it is preferable to arrange the release film 11 at least on the upper surface of the step 201D of the lower die side surface member 201. In addition, the order in which the release film 11 is suctioned onto the lower die 200 is not limited to the above-described order, and may be appropriately changed according to the type of the release film 11 as long as the release film 11 can be adhered to the cavity surface of the cavity 200A by suction so as not to be wrinkled.

[0040] Further, as indicated by arrow 100b in FIG. 4, the pressure inside the through hole 100B of the upper die body 102 is reduced by a molding target suction mechanism (not shown) to perform suction. The molding target suction mechanism is not particularly limited, and may be, for example, a vacuum pump or the like. As a result, the substrate 10 has its entire upper surface sucked to the lower surface of the upper die body 102, and is more firmly fixed. For example, the suction of the substrate 10 to the upper die body 102 may be started at the stage of FIG. 2 or 3.

[0041] In the present embodiment, as a mechanism that holds (fixes) the substrate (molding

target) to the upper die, suction by pressure reduction is used in addition to clamping by the clamper. Thus, the force for holding the substrate is increased, and the force for peeling off the release film is also increased. However, in the present disclosure, the mechanism that holds the molding target to the upper die is not limited thereto, and for example, the upper die may be held only by the clamper.

[0042] In the present embodiment, the molding die is always preheated by a heater (not shown) provided therein, and the resin material 20a begins to melt when it is placed in the cavity 200A together with the release film 11, and eventually becomes molten resin 20b. The molten resin 20b corresponds to the melted "resin material". The preheating of the molding die may be performed prior to or simultaneously with the release film suctioning (FIGs. 3 to 4). Also, the preheating of the molding die may be started after the release film suctioning.

[0043] Next, as shown in FIGs. 5 to 7, the resin molding and conveying are performed. Note that, as described above, in the resin molding, a resin molded product is produced by performing resin molding through compression molding by clamping the molding die in a state where a molding target is placed between the upper die and the lower die, a release film is placed on the bottom surface and the side surface of the cavity, and a resin material is placed on the release film. As described above, in the conveying, the molding die is opened after the resin molding, and the molded product is taken out of the molding die and then conveyed.

[0044] First, the lower die holding member 210 is raised, and the lower die 200 is raised together with the outside air blocking member 300. Thereby, as shown in FIG. 5, first, the upper and lower outside air blocking members 300 are closed via O-rings 300A, and the upper die holding member 110, the lower die holding member 210, and the outside air blocking member 300 block outside air from entering the molding die (the upper die 100 and the lower die 200). Hereinafter, a space S surrounded by the upper die holding member 110, the lower die holding member 210, and the outside air blocking member 300 may be referred to as an "outside air blocking space". Substantially at the same time when the outside air blocking member 300 is closed, the film presser 103 comes into contact with the lower die side surface member 201 via the release film 11, and the release film 11 is sandwiched between the lower die side surface member 201 and the film presser 103. At this time, the upper die 100 and the lower die 200 are not yet clamped, and the substrate 10 and the molten resin 20b are not yet in contact with each other. In this state, as indicated by arrow 300b, the pressure inside the through hole 300B of the upper die 100 is reduced by an internal pressure-reducing mechanism of the outside air blocking member (not shown). As a result, the outside air blocking space S is brought into a negative pressure state. The internal pressure-reducing mechanism of the outside air blocking member is not particularly limited, and may be, for example, a vacuum pump or the like.

[0045] Thereafter, as shown in FIG. 6, the lower die holding member 210 (lower die 200) is further raised. As a result, the chip 10a is immersed in the molten resin 20b and the substrate 10 comes into contact with the molten resin 20b. In this way, the molten resin 20b fills the cavity 200A, and the upper die 100 and the lower die 200 are clamped together. At this time, since no projection is formed on the outer peripheral edge of the upper surface of the lower die bottom surface member 202 and the surface is flat, the height of the outer peripheral edge of the upper surface of the lower die bottom surface member 202 is lower than the height of the step 201D in the lower die side surface member 201. As a result, no protrusion corresponding to the projection (step) of the outer peripheral edge of the upper surface of the lower die bottom surface member 202 is formed in the produced resin molded product. Therefore, such a protrusion does not detach and fall off when the resin molded product is taken out of the molding die and conveyed. Consequently, there is no risk that the falling off of such a protrusion causes defective products or stops the resin molding apparatus from operating, which may reduce productivity. Furthermore, since the resin material is not wasted due to the formation of such protrusions, the yield is also good. In addition, since the effective area of the substrate 10 is not reduced, the substrate 10 can be utilized efficiently.

[0046] Also, as described above, the depth of the step 201D is equal to or less than the thickness of the release film 11. This makes it possible to suppress the phenomenon in which the molten resin 20b enters the area of the step 201D and hardens to form an excess resin portion (resin burr). Furthermore, if the depth of the step 201D is equal to or less than the thickness of the release film 11, even if molten resin 20b enters the area of the step 201D, the amount of such molten resin 20b is very small. Therefore, even if the excess resin portion as described above is formed, it will be extremely thin and lightweight, making it unlikely to cause problems due to falling off of such an excess resin portion.

[0047] Note that at this time, the step 201D may be formed inside the end surface of the substrate 10 in plan view, and for example, the distance W2 from the outer end surface of the step 201D to the end surface of the substrate 10 can be set to 1 mm or more. The upper limit of the distance W2 is not particularly limited, and may be, for example, 50 mm or less, 40 mm or less, 30 mm or less, 20 mm or less, 10 mm or less, 5 mm or less, 4 mm or less, 3 mm or less, or 2 mm or less. Note that the distance W2 can also be expressed as the distance between the outer end surface of the step 201D and the outer edge of the molding target (substrate 10) placement region.

[0048] After clamping, the inside of the outside air blocking space S is returned to atmospheric pressure. The timing for returning the inside of the outside air blocking space S atmospheric pressure may be any time after clamping, as long as it is before the molten resin 20b has

completely hardened.

[0049] Furthermore, as shown in FIG. 7, by solidifying (curing) the molten resin 20b, the resin molding is completed to produce the resin molded product, and the release film is peeled off from the resin molded product.

5 [0050] First, the molten resin 20b is solidified in a state in which the molding die is clamped as shown in FIG. 6. For example, when the molten resin 20b is a thermosetting resin, it may be formed into a cured resin (cured resin 20 shown in FIG. 7) by further heating the molding die with its internal heater. Additionally, for example, when the molten resin 20b is a thermoplastic resin, the molten resin 20b may be solidified into the cured resin 20 by stopping the heating of
10 the molding die and allowing it to cool naturally or rapidly. Note that even after clamping, a force continues to act on the lower die holding member 210 to push the lower die 200 upward, so that the molten resin 20b is cured while being compressed. As a result, a resin molded product 30 (FIG. 7) including the substrate 10, the chip 10a, and the cured resin 20 can be produced.

[0051] Thereafter, the conveying is performed, in which the molding die is opened, and the
15 resin molded product is taken out of the molding die and conveyed. Specifically, first, as shown in FIG. 7, the lower die holding member 210 is lowered, thereby lowering the lower die 200 and the outside air blocking member 300, and opening the molding die by separating the upper die 100 from the lower die 200. Thereby, as shown in FIG. 7, the release film 11 adhered to the cured resin 20 is peeled off from the cured resin 20. Thereafter, the resin molded product 30 is
20 taken out of the molding die and conveyed by a conveyance mechanism (not shown).

[0052] As described above, by performing the method for producing a resin molded product of the present embodiment, the resin molded product 30 can be produced in which one surface of the substrate 10 is resin-molded with the cured resin 20.

[0053] According to the molding die of the present disclosure, for example, it is also possible to
25 improve the releasability between the resin molded product and the release film with an extremely simple configuration, without depending on molding conditions or providing a resin pool outside the molding area.

Second Embodiment

[0054] In the present embodiment, an overall configuration of a resin molding apparatus of the
30 present disclosure and an example of a method for producing a resin molded product using the resin molding apparatus will be described.

[0055] An example of a resin molding method using a resin molding apparatus 1 will be described with reference to FIG. 8. In the resin molding apparatus 1, granular resin 20a (see FIGs. 2 to 4) is used as the resin material. First, in the substrate supply and storage module 41,
35 the substrate 10 (see FIGs. 2 to 7) is supplied from the substrate supply part 44 to the substrate

mounting part 50. Next, the substrate conveyance mechanism 51 is moved from a predetermined position S1 in the -Y direction to receive the substrate 10 from the substrate mounting part 50. The substrate conveyance mechanism 51 is returned to the predetermined position S1. Next, the substrate conveyance mechanism 51 is moved in the +X direction to a predetermined position P1 of a molding module 42B, for example, among three molding modules 42A to 42C provided in the resin molding apparatus 1. Next, in the molding module 42B, the substrate conveyance mechanism 51 is moved in the -Y direction and stopped at a predetermined position C1 on the lower die 200. Next, the substrate conveyance mechanism 51 is raised to fix the substrate 10 to the upper die 100. Thereafter, the substrate conveyance mechanism 51 is returned to the predetermined position S1 of the substrate supply and storage module 41.

[0056] As will be described below, the substrate conveyance mechanism 51 can also be used as a "conveyance mechanism" that takes out the resin molded product from the molding die in an open state after the resin molding, and conveys it.

[0057] Next, the release film 11 accommodated in the release film supply mechanism 53 is received by a material conveyance mechanism 56, conveyed to the lower die 200 of the molding die of the molding module 42B, and placed in the cavity 200A of the lower die 200.

[0058] Next, an X-Y table 52 is moved from a predetermined position T1 in the -Y direction, and the X-Y table 52 is stopped at a predetermined position below a resin material accommodation frame 54. The resin material accommodation frame 54 is placed on the X-Y table 52. The X-Y table 52 on which the resin material accommodation frame 54 is placed is moved in the +X direction, and the resin material accommodation frame 54 is stopped at a predetermined position below the resin material supply mechanism 55. By moving the X-Y table 52 in the X and Y directions, a predetermined amount of the resin material 20a (see FIGs. 2 to 4) is supplied from the resin material supply mechanism 55 to the resin material accommodation frame 54. The X-Y table 52 on which the resin material accommodation frame 54 is placed is returned to the predetermined position T1.

[0059] Next, the material conveyance mechanism 56 is moved from a predetermined position M1 in the -Y direction to receive the resin material accommodation frame 54 placed on the X-Y table 52. The material conveyance mechanism 56 is returned to the predetermined position M1.

Next, the material conveyance mechanism 56 is moved in the -X direction to a predetermined position P1 of the molding module 42B. Next, in the molding module 42B, the material conveyance mechanism 56 is moved in the -Y direction and stopped at a predetermined position C1 on the lower die 200. The material conveyance mechanism 56 is lowered to supply the resin material 20a onto the upper surface of the release film 11 placed in the cavity 200A. After the supply is finished, the material conveyance mechanism 56 is returned to the predetermined

position M1.

[0060] Next, in a molding module 42B, the "resin molding" in the method for producing a resin molded product of the present disclosure is performed. In the "resin molding", a resin molded product 30 is produced by performing resin molding through compression molding by clamping the molding die in a state where a substrate (molding target) 10 is placed between the upper die and the lower die, a release film 11 (see FIGs. 2 to 7) is placed on the bottom surface and the side surface of the cavity 200A, and a resin material is placed on the release film 11. In the present embodiment, the clamping mechanism 60 raises the lower die 200 to clamp the upper die 100 and the lower die 200 together, thereby performing resin molding and producing the resin molded product 30. More specifically, the "resin molding" can be performed, for example, as described with reference to FIGs. 5 to 7.

[0061] After the resin molding, the "conveying" in the method for producing a resin molded product of the present disclosure is performed. In the conveying, the molding die is opened, and the resin molded product 30 is taken out of the molding die and then conveyed. Specifically, first, after the resin molding is completed, the upper die 100 and the lower die 200 of the molding die are opened. After the molding die is opened, the substrate conveyance mechanism 51 is moved from the predetermined position S1 of the substrate supply and storage module 41 to the predetermined position C1 on the lower die 200 to receive the resin molded product 30. Next, the substrate conveyance mechanism 51 is moved to transfer the resin molded product 30 to the substrate mounting part 50. The resin molded product 30 is stored in a resin molded product storage part 45 from the substrate mounting part 50.

[0062] In the present embodiment, three molding modules 42A, 42B, and 42C are disposed in the X direction between the substrate supply and storage module 41 and the material supply module 43. However, the number of molding modules is not limited to three, and any number of molding modules may be provided. The substrate supply and storage module 41 and the material supply module 43 may be integrated into one module, and one molding module 42A may be mounted on the module so as to be arranged in the X direction. This allows the molding modules 42A, 42B, ... to be increased or decreased. Therefore, the configuration of the resin molding apparatus 1 can be optimized in accordance with the production form and the production amount, which can improve productivity.

[0063] In the present embodiment, the release film supply mechanism 53 that supplies the release film 11 is provided in the material supply module 43. However, the present disclosure is not limited thereto, and the release film supply mechanism 53 that supplies the release film 11 may be provided as a new release film supply module, not within the material supply module 43. In this case, for example, the release film supply module may be attached between the molding

module 42C and the material supply module 43 or next to the material supply module 43 on the side opposite to the molding module 42C. In this way, the resin molding apparatus 1 can be configured simply by adding the release film supply module to a conventional apparatus.

[0064] The present disclosure is not limited to the above-described embodiments. Various

5 combination, changes, and selections may be made freely and appropriately in the configuration and specifics of the present disclosure without departing from the scope of the present disclosure.

[0065] Some or all of the above embodiments may be described as in the following Supplementary Notes, but are not limited thereto.

(Supplementary Note 1)

10 A method for producing a resin molded product using a molding die, the molding die including:
 an upper die; and
 a lower die, wherein
 the upper die and the lower die are disposed so as to face each other,
 the lower die includes a lower die bottom surface member and a lower die side
 15 surface member, and
 a cavity is formed by a space surrounded by an upper surface of the lower die bottom surface member and an inner peripheral surface of the lower die side surface member, the upper surface of the lower die bottom surface member forms a bottom surface of the cavity, and the inner peripheral surface of the lower die side surface
 20 member forms a side surface of the cavity,
 the method for producing a resin molded product, including:
 resin molding; and
 conveying, wherein
 in the resin molding, a resin molded product is produced by performing resin molding
 25 through compression molding by clamping the molding die in a state where a molding target is placed between the upper die and the lower die, a release film is placed on the bottom surface and the side surface of the cavity, and a resin material is placed on the release film,
 in the conveying, the molding die is opened after the resin molding, and the molded product is taken out of the molding die and then conveyed, and
 30 on an upper surface of the lower die side surface member, a step having a depth equal to or less than a thickness of the release film is formed at a position adjacent to the inner peripheral surface of the lower die side surface member.

(Supplementary Note 2)

The method according to Supplementary Note 1, wherein

the resin molding is performed at least in a state where the release film is placed on the upper surface of the step in the lower die side surface member.

(Supplementary Note 3)

The method according to Supplementary Note 1 or 2, wherein

5 the step of the lower die side surface member is formed annularly.

(Supplementary Note 4)

The method according to any one of Supplementary Notes 1 to 3, wherein

an outer end of the step in the lower die side surface member is positioned inside an outer edge of a molding target placement region.

10 (Supplementary Note 5)

The method according to any one of Supplementary Notes 1 to 4, wherein

an air vent groove extending outward beyond the step is formed on the upper surface of the lower die side surface member.

(Supplementary Note 6)

15 The method according to Supplementary Note 5, wherein

the step and the air vent groove are connected to each other in the lower die side surface member.

(Supplementary Note 7)

The method according to Supplementary Note 5 or 6, wherein

20 an outer end of the air vent groove is positioned outside the outer edge of the molding target placement region.

(Supplementary Note 8)

The method according to any one of Supplementary Notes 1 to 7, wherein

in the resin molding, the molding target is placed on a lower surface of the upper die.

25 (Supplementary Note 9)

A molding die for use in the method for producing a resin molded product according to any one of Supplementary Notes 1 to 8.

(Supplementary Note 10)

A molding die for compression molding for use in a method for producing a resin molded product, including:

30

an upper die; and

a lower die, wherein

the upper die and the lower die are disposed so as to face each other,

the lower die includes a lower die bottom surface member and a lower die side surface

35 member, and

a cavity is formed by a space surrounded by an upper surface of the lower die bottom surface member and an inner peripheral surface of the lower die side surface member, the upper surface of the lower die bottom surface member forms a bottom surface of the cavity, and the inner peripheral surface of the lower die side surface member forms a side surface of the cavity,

in the method for producing a resin molded product, a resin molded product is produced by performing resin molding through compression molding by clamping the molding die in a state where a molding target is placed between the upper die and the lower die, a release film is placed on the bottom surface and the side surface of the cavity, and a resin material is placed on the release film, and

on an upper surface of the lower die side surface member, a step having a depth equal to or less than a thickness of the release film is formed at a position adjacent to the inner peripheral surface of the lower die side surface member.

(Supplementary Note 11)

A resin molding apparatus, including:

the molding die according to Supplementary Note 9 or 10; and

a clamping mechanism that clamps the upper die and the lower die of the molding die.

(Supplementary Note 12)

The resin molding apparatus according to Supplementary Note 11, further including:

a conveyance mechanism that takes out the resin molded product from the molding die

in an open state after the resin molding, and conveys it.

[0066] This application claims priority from Japanese Patent Application No. 2023-035729 filed on March 8, 2023. The entire subject matter of the Japanese Patent Application is incorporated herein by reference.

Reference Signs List

[0067]

1: Resin molding apparatus

10: Substrate (molding target)

10a: Chip

11: Release film

20: Cured resin (molded resin)

20a: Resin material

20b: Molten resin

30: Resin molded product

41: Substrate supply and storage module

42A, 42B, 42C: Molding module

	43:	Material supply module
	44:	Substrate supply part
	45:	Resin molded product storage part
	50:	Substrate mounting part
5	51:	Substrate conveyance mechanism
	52:	X-Y Table
	53:	Release film supply mechanism
	54:	Resin material accommodation frame
	55:	Resin material supply mechanism
10	56:	Material conveyance mechanism
	60:	Clamping mechanism
	100:	Upper die
	100B:	Through hole
	102:	Upper die body
15	103:	Film presser
	103s:	Upper die elastic member
	104:	Clamper
	110:	Upper die holding member
	200:	Lower die
20	200A:	Cavity
	200B:	Through hole
	201A, 201B:	Through hole
	201C:	Air vent groove
	201D:	Step
25	201:	Lower die side surface member
	201s:	Lower die elastic member
	202:	Lower die bottom surface member
	210:	Lower die holding member
	300:	Outside air blocking member
30	300B:	Through hole
	α :	Molding target placement region
	S:	Outside air blocking space

CLAIMS

[Claim 1] A method for producing a resin molded product using a molding die, the molding die comprising:

5 an upper die; and
a lower die, wherein
the upper die and the lower die are disposed so as to face each other,
the lower die comprises a lower die bottom surface member and a lower die side surface member, and

10 a cavity is formed by a space surrounded by an upper surface of the lower die bottom surface member and an inner peripheral surface of the lower die side surface member, the upper surface of the lower die bottom surface member forms a bottom surface of the cavity, and the inner peripheral surface of the lower die side surface member forms a side surface of the cavity,

15 the method for producing a resin molded product, comprising:

resin molding; and
conveying, wherein

in the resin molding, a resin molded product is produced by performing resin molding through compression molding by clamping the molding die in a state where a molding target is
20 placed between the upper die and the lower die, a release film is placed on the bottom surface and the side surface of the cavity, and a resin material is placed on the release film,

in the conveying, the molding die is opened after the resin molding, and the molded product is taken out of the molding die and then conveyed, and

25 on an upper surface of the lower die side surface member, a step having a depth equal to or less than a thickness of the release film is formed at a position adjacent to the inner peripheral surface of the lower die side surface member.

[Claim 2] The method according to claim 1, wherein

the resin molding is performed at least in a state where the release film is placed on the
30 upper surface of the step in the lower die side surface member.

[Claim 3] The method according to claim 1 or 2, wherein

the step of the lower die side surface member is formed annularly.

35 [Claim 4] The method according to any one of claims 1 to 3, wherein

an outer end of the step in the lower die side surface member is positioned inside an outer edge of a molding target placement region.

[Claim 5] The method according to any one of claims 1 to 4, wherein

5 an air vent groove extending outward beyond the step is formed on the upper surface of the lower die side surface member.

[Claim 6] The method according to claim 5, wherein

10 the step and the air vent groove are connected to each other in the lower die side surface member.

[Claim 7] The method according to claim 5 or 6, wherein

15 an outer end of the air vent groove is positioned outside the outer edge of the molding target placement region.

[Claim 8] The method according to any one of claims 1 to 7, wherein

in the resin molding, the molding target is placed on a lower surface of the upper die.

[Claim 9] A molding die for use in the method according to any one of claims 1 to 8.

20

[Claim 10] A molding die for compression molding for use in a method for producing a resin molded product, comprising:

an upper die; and

a lower die, wherein

25 the upper die and the lower die are disposed so as to face each other,

the lower die comprises a lower die bottom surface member and a lower die side surface member, and

a cavity is formed by a space surrounded by an upper surface of the lower die bottom surface member and an inner peripheral surface of the lower die side surface member, the upper surface of the lower die bottom surface member forms a bottom surface of the cavity, and the inner peripheral surface of the lower die side surface member forms a side surface of the cavity,

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in the method for producing a resin molded product, a resin molded product is produced by performing resin molding through compression molding by clamping the molding die in a state where a molding target is placed between the upper die and the lower die, a release film is placed on the bottom surface and the side surface of the cavity, and a resin material is placed on

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the release film, and

on an upper surface of the lower die side surface member, a step having a depth equal to or less than a thickness of the release film is formed at a position adjacent to the inner peripheral surface of the lower die side surface member.

5

[Claim 11] A resin molding apparatus, comprising:

the molding die according to claim 9 or 10; and

a clamping mechanism that clamps the upper die and the lower die of the molding die.

10 [Claim 12] The resin molding apparatus according to claim 11, further comprising:

a conveyance mechanism that takes out the resin molded product from the molding die in an open state after the resin molding, and conveys it.