

Description

Title of Invention

RESIN MOLDING APPARATUS AND METHOD FOR PRODUCING RESIN
MOLDED PRODUCT

5

Technical Field

[0001]

This disclosure relates to a resin molding apparatus and a method for producing a resin molded product.

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Background Art

[0002]

Substrates with semiconductor chips mounted thereon, for example, are typically sealed up in resin for use as electronic parts. A conventional resin molding apparatus supplies a resin material onto a precut release film and conveys the release film to a molding die (see, for example, Patent Literature 1).

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[0003]

Patent Literature 1 discloses a resin molding apparatus configured to, if a resin material on a release film is inappropriate, for example, heavier than intended, discard the release film together with the resin material.

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Citation List

Patent Literature

[0004]

25 Patent Literature 1: JP 2021-171920 A

Summary of Invention

Technical Problem

[0005]

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The user of a resin molding apparatus may want to, in discarding a release film with a resin material thereon, separate the resin material and the release film from each other for collection in order to, for example, recycle the resin material and the release film.

[0006]

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The above circumstances have led to a demand for a resin molding apparatus and a method for producing a resin molded product each of which allows a resin material and

a release film to be separated from each other for collection.

Solution to Problem

[0007]

5 A resin molding apparatus as an embodiment of this disclosure includes: a resin supply mechanism configured to supply powder resin to a resin containing section including a release film and a frame placed on the release film; a resin molding mechanism including a molding die that includes an upper die and a lower die facing the upper die and configured to place between the upper die and the lower die the release film with the powder resin on the release film for resin molding; and a resin collecting
10 mechanism configured to suck the powder resin from the resin containing section for collection before the resin molding mechanism places the release film on the molding die.

[0008]

A method as an embodiment of this disclosure for producing a resin molded product includes: supplying a predetermined amount of powder resin to a resin containing
15 section including a release film and a frame on the release film; determining whether the resin containing section has received the powder resin appropriately; if it has been determined during the determining that the resin containing section has received the powder resin inappropriately, sucking the powder resin from the resin containing section for collection; and if it has been determined during the determining that the resin
20 containing section has received the powder resin appropriately, placing between an upper die and a lower die the release film with the powder resin on the release film and a substrate to be molded and molding in the powder resin the object to be molded.

Advantageous Effects

[0009]

25 This disclosure provides as embodiments a resin molding apparatus and a method for producing a resin molded product each of which allows a resin material and a release film to be separated from each other for collection.

Brief Description of Drawings

30 [0010]

Fig. 1 is a diagram schematically illustrating a resin molding apparatus as the present embodiment.

Fig. 2 is a diagram schematically illustrating the configuration of a resin molding module.

35 Fig. 3A is a diagram schematically illustrating a resin collecting mechanism for a first embodiment.

Fig. 3B is a plan view of a plate.

Fig. 4 is a diagram schematically illustrating a resin collecting mechanism for a second embodiment.

Fig. 5 is a flowchart of a method for producing a resin molded product.

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Description of Embodiments

[0011]

The description below deals with a resin molding apparatus and a method for producing a resin molded product as embodiments of this disclosure with reference to drawings. The embodiments described below are merely examples for describing this disclosure. This disclosure is not limited to the embodiments. This disclosure may be embodied variously without departing from the scope of this disclosure.

[0012]

For example, substrates with semiconductor chips (hereinafter also referred to as "chips") mounted thereon (that is, an object to be molded) are sealed up in resin for use as electronic parts (that is, a resin molded product). Substrates are sealed up in resin by, for example, a compression method (compression molding) or transfer method. An example compression method is a resin sealing method that includes supplying liquid or powder resin onto a release film, placing the release film onto a lower die of a molding die, melting the resin on the release film, and immersing an object to be molded into the molten resin for resin molding. Example electronic elements include resistor elements and capacitor elements other than semiconductor chips.

[0013]

[Configuration of Resin Molding Apparatus]

Fig. 1 is a diagram schematically illustrating a resin molding apparatus 1. The resin molding apparatus 1 as the present embodiment is based on a compression method, and includes a resin supply module 2, two or more (three for the present embodiment) resin molding modules 3 (which is an example resin molding mechanism), a substrate supply module 4, and a control section 5. The resin supply module 2, the resin molding modules 3, and the substrate supply module 4 are each attachable and detachable independently. The resin molding apparatus 1 includes three resin molding modules 3 as the present embodiment, but may include one or two resin molding modules 3 or four or more resin molding modules 3. The resin molding apparatus 1 may alternatively include any optimal number of resin molding modules 3 in accordance with the production volume. Fig. 1 shows a Z axis to indicate the vertical direction of the resin molding apparatus 1, an X axis to indicate an axis along which the resin supply module 2, the resin

molding modules 3, and the substrate supply module 4 are arranged, and a Y axis perpendicular to the X and Z axes (that is, across the depth of each module). The description below refers to a +X direction extending along the X axis and indicated by the corresponding arrow, a -X direction opposite to the direction indicated by the arrow, a +Y direction extending along the Y axis and indicated by the corresponding arrow, a -Y direction opposite to the direction indicated by the arrow, a +Z direction extending along the Z axis and indicated by the corresponding arrow, and a -Z direction opposite to the direction indicated by the arrow.

[0014]

The control section 5 includes a processor such as a central processing unit (CPU) and a storage device such as a random access memory (RAM). The control section 5 is configured such that the processor executes control programs stored in the storage device to control how the resin molding apparatus 1 operates. The resin molding apparatus 1 operates as described below on the basis of operation instructions from the control section 5 unless otherwise specified. The description below basically omits to deal with operation instructions from the control section 5 and deals as necessary with operation instructions from the control section 5.

[0015]

The substrate supply module 4 includes an unmolded substrate supply section 41 configured to supply a substrate to be molded Sa (which is an example object to be molded), a molded substrate containing section 42 configured to contain a molded substrate Sb (which is an example resin molded product), a substrate placement section 43 configured to transfer a substrate to be molded Sa and a molded substrate Sb, and a substrate conveying mechanism 44 configured to convey a substrate to be molded Sa and a molded substrate Sb. The substrate placement section 43 is movable along the Y axis in the substrate supply module 4. The substrate conveying mechanism 44 is movable along the X and Y axes in the substrate supply module 4 and each resin molding module 3. The substrate conveying mechanism 44 is configured to be on standby and not in operation at a predetermined position S1.

[0016]

The resin molding modules 3 each include a lower die LM configured to be lifted and lowered and an upper die UM facing the lower die LM (see Fig. 2 as well). The upper die UM and the lower die LM constitute a molding die M. The resin molding modules 3 each include a mold clamp mechanism 35 (see the circular portion indicated with a double-dashed chain line) configured to clamp and open the upper die UM and the lower die LM. The mold clamp mechanism 35 moves the lower die LM and the upper die UM

relative to each other to clamp and open the upper die UM and the lower die LM. The lower die LM has a lower-die cavity MC configured to receive a release film F and powder resin as a resin material (see Fig. 2 as well). The resin molding modules 3 are detailed later.

5 [0017]

The release film F for use for the present embodiment is made of a resin material with properties such as heat resistance, releasing property, flexibility, and extensibility. Examples of the resin material include polytetrafluoroethylene (PTFE), ethylene tetrafluoroethylene (ETFE), polyethylene terephthalate (PET), tetrafluoroethylene
10 hexafluoropropylene copolymer (FEP), polypropylene, polystyrene, and polyvinylidene chloride. The powder resin for use for the present embodiment may have any average particle size. The average particle size is, for example, not more than 5 mm, preferably not more than 1 mm, more preferably not more than 0.9 mm, not more than 0.8 mm, not more than 0.7 mm, not more than 0.6 mm, not more than 0.5 mm, not more than 0.4 mm,
15 not more than 0.3 mm, not more than 0.2 mm, or not more than 0.1 mm. The powder resin preferably has a particle size distribution with which not less than 80% of the resin particles each have a particle size within $\pm 10\%$ of the average particle size.

[0018]

The resin supply module 2 includes an X-Y table 21, a release film supply
20 mechanism 22 configured to supply a release film F onto the X-Y table 21, a cleaning mechanism 23, a resin containing section 24 including a frame 24a and a release film F, a resin conveying mechanism 25 configured to convey the resin containing section 24, a resin supply mechanism 26 configured to supply powder resin to the resin containing section 24, and a resin collecting mechanism 6 configured to collect the powder resin
25 from the release film F. The X-Y table 21 is movable along the X and Y axes in the resin supply module 2. The cleaning mechanism 23 is configured to clean, for example, the lower surface and the inner surface of the frame 24a. The frame 24a is in the shape of a rectangle with an opening at the center as viewed along the Z axis. The resin conveying mechanism 25 is movable along the X and Y axes in the resin supply module 2 and each
30 resin molding module 3. The resin conveying mechanism 25 is configured to be on standby and not in operation at a predetermined position M1. The resin collecting mechanism 6 is adjacent to the resin supply mechanism 26. The resin collecting mechanism 6 is detailed later.

[0019]

35 [Configuration of Resin Molding Modules]

The description below deals in detail with the configuration of each resin

molding module 3, which includes a molding die M. As illustrated in Fig. 2, each resin molding module 3 for the present embodiment includes a pressed frame including a lower fixed plate 31, an upper fixed plate 33, and plate-shaped members 32 by which the lower fixed plate 31 and the upper fixed plate 33 are integrated with each other. The resin molding module 3 includes a movable platen 34 disposed between the lower fixed plate 31 and the upper fixed plate 33. The movable platen 34 is movable upward and downward along the plate-shaped members 32. The resin molding module 3 includes, over the lower fixed plate 31, a mold clamp mechanism 35 including a ball screw and configured to move the movable platen 34 upward and downward. The mold clamp mechanism 35 is configured to move the movable platen 34 upward to clamp the molding die M and downward to open the molding die M. The mold clamp mechanism 35 is drivable by any driving source, for example, an electric motor such as a servomotor (not illustrated in the drawings).

[0020]

The molding die M includes an upper die UM and a lower die LM made of, for example, metal and facing each other. The resin molding module 3 includes, on the lower surface of the upper fixed plate 33, an upper-mold holder 39 including an upper heater 37 and having a lower surface to which the upper die UM is attached. The upper die UM includes, on its lower surface, an upper-die substrate attachment section (not illustrated in the drawings) to which is attachable a substrate to be molded Sa provided with, for example, chips mounted thereon. The resin molding module 3 includes, on the upper surface of the movable platen 34, a lower-die holder 38 including a lower heater 36 and having an upper surface on which the lower die LM is disposed. The lower die LM has a lower-die cavity MC configured to receive a release film F and powder resin R. The resin molding module 3 seals up a substrate to be molded Sa in powder resin R to produce a molded substrate Sb.

[0021]

[Configuration of Resin Collecting Mechanism for First Embodiment]

The description below deals in detail with the configuration of a resin collecting mechanism 6 for a first embodiment with reference to Figs. 3A and 3B. The resin collecting mechanism 6 for the present embodiment includes a plate 61, a first hose 63 (which is an example collection path), second hoses 64, an air pump 65 (which is an example suction source), a resin collector 66 (which is an example collector), and a film collector 67 (see Fig. 1).

[0022]

The plate 61 is a rectangular plate made of resin or metal and having an outer

shape substantially identical to that of the frame 24a and a size substantially equal to that of the frame 24a. The plate 61 has a surface with an area large enough to cover at least the entire opening of the frame 24a. The plate 61 has a first hole 61a at its center and in the form of a circular through hole and two or more (four for the present embodiment) second holes 61b around the first hole 61a and each in the form of a circular through hole smaller in diameter than the first hole 61a. The second holes 61b for the present embodiment are proximate to the respective corners of the plate 61. With the plate 61 over the frame 24a, the first hole 61a and the second holes 61b coincide with the inner opening of the frame 24a.

[0023]

The first hose 63 includes a first connector 63a and has a first end connected to the first hole 61a with use of the first connector 63a. The resin collecting mechanism 6 includes a gasket or the like (not illustrated in the drawings) at a position at which the plate 61 is connected to the first connector 63a and a gasket or the like (not illustrated in the drawings) at a position at which the first connector 63a is connected to the first hose 63. The gaskets prevent leakage of air at the respective connection positions. The first hose 63 has a second end to which the air pump 65 is connected. The air pump 65 is contained in the resin collector 66 and configured to suck air. The resin collector 66 is in the form of a box and is, for example, a dust collecting box provided for the resin molding apparatus 1. The resin collector 66 may alternatively be a dedicated box other than a dust collecting box.

[0024]

The second hoses 64 each include a second connector 64a and has a first end connected to one of the second holes 61b with use of the second connector 64a. The resin collecting mechanism 6 includes a gasket or the like (not illustrated in the drawings) at a position at which the plate 61 is connected to each second connector 64a and a gasket or the like (not illustrated in the drawings) at a position at which each second connector 64a is connected to a second hose 64. The gaskets prevent leakage of air at the respective connection positions. The second hoses 64 each have a second end to which an air compressor (not illustrated in the drawings) is connected. The air compressor is configured to blow air (which is an example gas).

[0025]

The description below deals with a method for collecting powder resin R from the release film F of the resin containing section 24. The resin containing section 24 includes a release film F cut to have a predetermined size and a frame 24a on the release film F. The X-Y table 21 moves the resin containing section 24 and stops at a

predetermined position below the resin supply mechanism 26 (see Fig. 1). The resin containing section 24 then receives powder resin R. If there is a need to collect the powder resin R for a reason described below, the X-Y table 21 keeps the resin containing section 24 at the predetermined position, and with use of an actuator or the like (not illustrated in the drawings), moves the plate 61 and places the plate 61 over the resin containing section 24 (including the frame 24a) such that the plate 61 is in close contact with the frame 24a and not separated therefrom by a gap G (see Fig. 4). The actuator or the like may press the plate 61 against the frame 24a with a small force. While the resin collecting mechanism 6 has a resin containing space 62 defined by the release film F, the frame 24a, and the plate 61, the above operation causes the powder resin R to be contained in the resin containing space 62.

[0026]

Next, the resin collecting mechanism 6 activates the air pump 65 and the air compressor in the above state to suck the powder resin R from the resin containing space 62 together with air therein through the first hole 61a for discharge to the outside, that is, into the first hose 63 and then into the air pump 65. The resin collecting mechanism 6 may adjust the amount of air that the air pump 65 sucks from the resin containing space 62 through the first hole 61a over a unit time so that the amount is equal to the total amount of air that the air compressor supplies through the second holes 61b into the resin containing space 62 over the unit time. This allows the resin collecting mechanism 6 to discharge powder resin R while maintaining the pressure (that is, air pressure) of the resin containing space 62 at a particular level.

[0027]

The air pump 65, in sucking the powder resin R from the resin containing space 62 together with air therein, also applies a suction force to the release film F, which is placed on the X-Y table 21 and sucked onto the X-Y table 21 by air suction. If the air pump 65 applies a large suction force to the release film F, the air pump 65 may suck the release film F onto itself. The present embodiment, however, causes the air compressor to supply compressed air through the second holes 61b toward the release film F to press the release film F against the X-Y table 21. This prevents the air pump 65 from sucking the release film F onto itself. In particular, the second holes 61b being proximate to the respective corners of the plate 61 more effectively prevents the air pump 65 from sucking the release film F onto itself. Further, the compressed air stirs up the powder resin R. This allows the air pump 65 to easily suck that portion of the powder resin R which is away from the first hole 61a, and thereby allows the resin collecting mechanism 6 to collect the powder resin R within a short time period.

[0028]

The air pump 65 sucks powder resin R from the resin containing space 62 together with air through the first hose 63 so that the resin collector 66 collects the powder resin R. The X-Y table 21 transfers the release film F (from which the resin collecting mechanism 6 has collected powder resin R) to the resin conveying mechanism 25 together with the frame 24a. The control section 5 moves the resin conveying mechanism 25 back to the predetermined position M1 and then moves the resin conveying mechanism 25 from the +X direction in the -Y direction so that the film collector 67 collects the release film F (see Fig. 1).

[0029]

As described above, after the resin supply mechanism 26 supplies powder resin R onto the release film F of the resin containing section 24, the resin collecting mechanism 6 for the present embodiment automatically separates the powder resin R and the release film F from each other for collection. This eliminates the conventional need for a person to separate powder resin R and a release film F from each other, and facilitates the separation and collection.

[0030]

[Configuration of Resin Collecting Mechanism for Second Embodiment]

The description below deals in detail with the configuration of a resin collecting mechanism 6 for a second embodiment with reference to Fig. 4. The present embodiment is similar in configuration to the first embodiment except for how to maintain the pressure of the resin containing space 62 at a particular level. The description of the present embodiment uses identical reference signs for similar elements for the first embodiment and omits to deal with such elements in detail.

[0031]

The resin collecting mechanism 6 for the present embodiment includes a plate 61 having only a first hole 61a and no second holes 61b. The resin collecting mechanism 6 collects powder resin R from a release film F with the plate 61 placed over the resin containing section 24 (including the frame 24a) and separated from the frame 24a by a gap G. The expression "with the plate 61 placed over the resin containing section 24 (including the frame 24a)" may suggest that the plate 61 is in contact with the frame 24a as for the first embodiment or that the plate 61 is separated from the frame 24a by a gap G as for the present embodiment. The present embodiment is configured such that the plate 61 is placed over the resin containing section 24 (including the frame 24a) separated from the frame 24a by a gap G. This eliminates the need for an air compressor to supply air through second holes 61b into the resin containing space 62. The gap G connects the

resin containing space 62 to the space outside the resin containing section 24, and thereby allows the resin containing space 62 to constantly have a pressure (that is, air pressure) equal to the pressure of air outside the resin containing section 24. This prevents the resin containing space 62 from having a negative pressure as a result of the air pump 65 sucking powder resin R and air from the resin containing space 62.

[0032]

[Method for Producing Molded Substrate]

The description below deals with a method for producing a molded substrate Sb (that is, a resin molded product) with use of a resin molding apparatus 1 including the resin collecting mechanism 6 for the first embodiment, with reference to Figs. 1 to 3 and 5. The method for producing a molded substrate Sb includes supplying a predetermined amount of powder resin R to a resin containing section 24 including a release film F and a frame 24a holding the release film F; determining whether the resin containing section 24 has received the powder resin R appropriately; if it has been determined during the determining that the resin containing section 24 has received the powder resin R inappropriately, sucking the powder resin R from the release film F for collection; and if it has been determined during the determining that the resin containing section 24 has received the powder resin R appropriately, placing between an upper die UM and a lower die LM the release film F with the powder resin R on the release film F and a substrate to be molded Sa (that is, an object to be molded) and molding in the powder resin R the substrate to be molded Sa.

[0033]

First, at the substrate supply module 4, the unmolded substrate supply section 41 supplies a substrate to be molded Sa to the substrate placement section 43. Next, the substrate conveying mechanism 44 moves in the -Y direction from the predetermined position S1, receives the substrate to be molded Sa from the substrate placement section 43, and then returns to the predetermined position S1. Next, the substrate conveying mechanism 44 moves in the +X direction to the predetermined position P1 in, for example, the middle resin molding module 3 among the three resin molding modules 3. Next, at the middle resin molding module 3, the substrate conveying mechanism 44 moves in the -Y direction and stops at a predetermined position C1 over the lower die LM. Next, the substrate conveying mechanism 44 moves upward to fix the substrate to be molded Sa onto the upper die UM. Then, the substrate conveying mechanism 44 returns to the predetermined position S1 in the substrate supply module 4.

[0034]

While the substrate conveying mechanism 44 conveys the substrate to be molded

Sa from the substrate supply module 4 to the middle resin molding module 3, the resin supply module 2 supplies a predetermined amount of powder resin onto a release film F (resin supply step) specifically as follows: The release film supply mechanism 22 supplies a release film F onto the X-Y table 21. The resin supply module 2 cuts the release film F so that the release film F has a predetermined size (step S51 in Fig. 5). Next, the resin conveying mechanism 25 moves in the -Y direction from the predetermined position M1 and receives the frame 24a as cleaned by the cleaning mechanism 23. Next, the resin conveying mechanism 25 moves in the -Y direction and, while the X-Y table 21 sucks the release film F onto itself by air suction, places the frame 24a onto the release film F. This causes the frame 24a to hold the release film F, which provides a resin containing section 24. Then, the resin conveying mechanism 25 returns to the original position M1.

[0035]

Next, the X-Y table 21 (on which the resin containing section 24 is placed) moves in the +X direction and stops with the resin containing section 24 at a predetermined position below the resin supply mechanism 26. Next, the X-Y table 21 moves in the X and Y axes so that the resin supply mechanism 26 supplies a predetermined amount of powder resin onto the release film F (which is in the inner opening of the frame 24a) (step S52). Then, the resin supply module 2 causes a weight sensor (not illustrated in the drawings) to weigh the powder resin R on the resin containing section 24 (step S53). The weight sensor may be provided for a resin storage 26a of the resin supply mechanism 26 or for the X-Y table 21. The weight sensor measures the weight (amount) of the powder resin R supplied on the resin containing section 24 on the basis of (i) a decrease in the weight of the powder resin R if the weight sensor is provided for the resin storage 26a or (ii) an increase in the weight of the powder resin R if the weight sensor is provided for the X-Y table 21. The weight sensor constantly transmits data on the weight of the powder resin R to the control section 5.

[0036]

The control section 5 constantly determines on the basis of the data from the weight sensor whether the resin containing section 24 has received powder resin R appropriately (determining step). In response to the resin containing section 24 receiving a predetermined amount (weight) of powder resin R, the control section 5 determines that the resin containing section 24 has received powder resin R appropriately (that is, in a predetermined amount), and stops the resin supply mechanism 26 from supplying powder resin R (No in step S54). Then, while the predetermined amount of powder resin R is on the release film F, the X-Y table 21 (on which the resin containing section 24 is placed) returns to its original position.

[0037]

Next, the X-Y table 21 stops sucking the release film F onto itself. Then, the resin containing section 24 sucks the release film F onto the frame 24a with use of a suction groove (not illustrated in the drawings) in the frame 24a to hold the release film F on the frame 24a. Then, the resin conveying mechanism 25 moves in the -Y direction from the predetermined position M1 and receives the resin containing section 24 from the X-Y table 21. The resin conveying mechanism 25 returns to the original position M1. Next, the resin conveying mechanism 25 moves in the -X direction to the predetermined position P1 in the middle resin molding module 3. Next, at the resin molding module 3, the resin conveying mechanism 25 moves in the -Y direction and stops at the predetermined position C1 over the lower die LM. Next, the resin conveying mechanism 25 moves downward and supplies the powder resin and the release film F into the lower-die cavity MC (step S55). The resin molding module 3 causes a suction mechanism (not illustrated in the drawings) to suck the release film F onto the lower-die cavity MC to hold the release film F facedown. This causes the powder resin R on the release film F to be in the lower-die cavity MC. Then, the resin conveying mechanism 25 (on which the frame 24a is placed) returns to the predetermined position M1.

[0038]

Next, at the resin molding module 3, the mold clamp mechanism 35 moves the movable platen 34 upward (that is, in the +Z direction) to clamp the upper die UM and the lower die LM. While the mold clamp mechanism 35 is clamping the upper die UM and the lower die LM, the lower heater 36 and the upper heater 37 heat the lower die LM and the upper die UM, respectively, to melt and cure the powder resin R in the lower-die cavity MC. The resin molding module 3, in other words, causes the mold clamp mechanism 35 to clamp the molding die M with the substrate to be molded Sa and the release film F (with the powder resin R thereon) between the upper die UM and the lower die LM, and seals up the substrate to be molded Sa in resin for resin molding (molding step). This seals up, for example, chips mounted on the substrate to be molded Sa in the powder resin R in the lower-die cavity MC to produce a molded substrate Sb (step S56). Then, the mold clamp mechanism 35 moves the movable platen 34 downward to open the upper die UM and the lower die LM. Next, the substrate conveying mechanism 44 moves from the predetermined position S1 in the substrate supply module 4 to the predetermined position C1 over the lower die LM and receives the molded substrate Sb. Next, the substrate conveying mechanism 44 moves past the predetermined position S1 to a position over the substrate placement section 43 and transfers the molded substrate Sb to the substrate placement section 43. The substrate placement section 43 transfers the

molded substrate Sb to the molded substrate containing section 42.

[0039]

As described above, while the resin supply mechanism 26 is supplying powder resin R onto the resin containing section 24, the weight sensor (not illustrated in the drawings) weighs the powder resin R and constantly transmits data on the weight of the powder resin R to the control section 5. In response to the resin containing section 24 receiving a predetermined amount (weight) of powder resin R, the resin supply mechanism 26 stops supplying powder resin R. The term "predetermined amount" refers to an amount of resin in which a substrate to be molded Sa will be sealed up appropriately, that is, entirely and with no void. If the resin containing section 24 has finally received a predetermined amount (weight) of powder resin R, the control section 5 determines that the resin containing section 24 has received powder resin R appropriately. However, when the resin supply mechanism 26 stops supplying powder resin R, the resin containing section 24 may have received more than the predetermined amount (weight) of powder resin R for some reason. In that case, the resin molding apparatus 1 will be unable to use the powder resin R to seal up a substrate to be molded Sa and will need to discard the powder resin R and the release film F. The control section 5, in this case, determines that the resin containing section 24 has received powder resin R inappropriately (Yes in step S54).

[0040]

If the control section 5 has determined that the resin containing section 24 has received powder resin R inappropriately, the control section 5 causes the resin collecting mechanism 6 to collect the powder resin R. The control section 5 instructs the resin collecting mechanism 6 to move the plate 61 and place the plate 61 over the resin containing section 24 (including the frame 24a) with use of an actuator or the like (not illustrated in the drawings). The control section 5 activates the air pump 65 and an air compressor (not illustrated in the drawings) to collect the powder resin R from the resin containing section 24 (specifically, from the resin containing space 62) through the first hole 61a into the first hose 63 and then into the resin collector 66 (collecting step) (step S57). The X-Y table 21 transfers the release film F (from which the resin collecting mechanism 6 has collected powder resin R) to the resin conveying mechanism 25 together with the frame 24a. The control section 5 moves the resin conveying mechanism 25 back to the predetermined position M1 and then moves the resin conveying mechanism 25 from the +X direction in the -Y direction so that the film collector 67 collects the release film F (step S58).

[0041]

[Alternative Embodiments]

The description below deals with embodiments alternative to the first and second embodiments described above. For ease of understanding, the description below uses the same terms and reference signs as in the description of the above embodiment for similar elements.

[0042]

<1> The first embodiment is configured as described above such that the plate 61 is in close contact with the frame 24a and not separated therefrom by a gap G. The plate 61 may alternatively be separated from the frame 24a by a gap G as for the second embodiment. This allows the resin containing space 62 to constantly have a pressure equal to the pressure of air outside the resin containing section 24. The amount of air that the air pump 65 sucks from the resin containing space 62 through the first hole 61a over a unit time may not be equal to the total amount of air that the air compressor supplies through the second holes 61b into the resin containing space 62 over the unit time. Even in that case, the above configuration allows the resin containing space 62 to have a constant pressure (that is, air pressure).

[0043]

<2> The first embodiment is configured as described above such that the second hoses 64 are each connected to a second hole 61b to supply air into the resin containing space 62. The first embodiment may omit the second hoses 64 so that the resin containing space 62 is connected to outside air through the second holes 61b. This allows the resin containing space 62 to constantly have a pressure equal to the pressure of air outside the resin containing section 24 even if the plate 61 is in close contact with the frame 24a and not separated therefrom by a gap G.

[0044]

<3> The first and second embodiments are each configured as described above to have a single first hole 61a, but may be each altered to have two or more first holes 61a. The first hole 61a may be present at any position suitable in view of the distribution of powder resin R on the release film F.

[0045]

<4> The first and second embodiments are each configured as described above to have four second holes 61b proximate to the respective corners of the plate 61. The second holes 61b may alternatively be elsewhere. The first and second embodiments each include four second holes 61b around the first hole 61a, but may be each altered to have three or fewer or five or more second holes 61b. The second holes 61b may be present in any number and at any positions suitable for the distribution of powder resin R on the

release film F.

[0046]

<5> The first and second embodiments are each configured as described above such that the resin collecting mechanism 6 is adjacent to the resin supply mechanism 26.

5 The resin collecting mechanism 6 is so positioned as to be capable of collecting powder resin R without the need to significantly move the resin containing section 24 in response to the resin supply mechanism 26 receiving powder resin R inappropriately. The resin collecting mechanism 6 may, for instance, include a plate 61 over the resin supply mechanism 26 (that is, in the +Z direction) or over the path on which the X-Y table 21 moves. With this configuration, lowering the plate 61 easily covers the resin containing section 24 on the X-Y table 21 from above. The resin collecting mechanism 6 may include a film collector 67 partway along the path on which the X-Y table 21 moves.

[0047]

15 <6> The first and second embodiments are each configured as described above such that the control section 5 determines whether the resin containing section 24 has received powder resin R appropriately on the basis of whether the resin containing section 24 has received a predetermined amount (weight) of powder resin R on the release film F. This disclosure is, however, not limited to such a configuration. The basis of the determination may be, for instance, whether the resin supply mechanism 26 is supplying powder resin R at a flow rate higher than a threshold value. In this case, the control section 5 determines if the flow rate is higher than the threshold value that the resin supply mechanism 26 has received powder resin R inappropriately. The basis of the determination may be whether the resin containing section 24 has received powder resin R on the release film F with even distribution. In this case, the control section 5 determines if the distribution is uneven that the resin supply mechanism 26 has received powder resin R inappropriately. The basis of the determination may be any basis that allows the resin molding apparatus 1 to produce a non-defective molded substrate Sb with use of powder resin R on the release film F.

[0048]

30 <7> The first and second embodiments are each configured as described above such that the resin conveying mechanism 25 conveys to the film collector 67 the release film F from which the resin collecting mechanism 6 has collected powder resin R. This disclosure is, however, not limited to such a configuration. The first and second embodiments may alternatively be each configured in any other manner, and may be each configured, for instance, such that after the resin collecting mechanism 6 has collected powder resin R, the air pump 65 sucks the release film F onto the plate 61, and the plate

61 conveys the release film F to the film collector 67 so that the film collector 67 collects the release film F.

[0049]

<8> The first and second embodiments described above are each a resin molding apparatus 1 configured for resin molding of such substrates to be molded Sa as semiconductor substrates (for example, silicon wafers), metal substrates (for example, lead frames), glass substrates, ceramic substrates, resin substrates, and wiring substrates.

[0050]

[Summary of Above Embodiments]

The description below summarizes the resin molding apparatus 1 and the method for producing a resin molded product (Sb) each described above as an embodiment.

[0051]

(1) A resin molding apparatus (1) characteristically includes: a resin supply mechanism (26) configured to supply powder resin (R) to a resin containing section (24) including a release film (F) and a frame (24a) placed on the release film (F); a resin molding mechanism (3) including a molding die (M) that includes an upper die (UM) and a lower die (LM) facing the upper die (UM) and configured to place between the upper die (UM) and the lower die (LM) the release film (F) with the powder resin (R) on the release film (F) for resin molding; and a resin collecting mechanism (6) configured to suck the powder resin (R) from the resin containing section (24) for collection before the resin molding mechanism (3) places the release film (F) on the molding die (M).

[0052]

The resin molding apparatus (1) characteristically configured as above includes a resin collecting mechanism (6) for separating the powder resin (R) from the release film (F) of the resin containing section (24) for collection. This leaves the release film (F) alone of the resin containing section (24) and allows the release film (F) alone to be collected. The resin molding apparatus (1) thereby automatically separates the powder resin (R) and the release film (F) from each other for collection.

[0053]

(2) The resin molding apparatus (1) described in item (1) above may be further configured such that the resin collecting mechanism (6) includes: a plate (61) having a first hole (61a) and configured to cover the resin containing section (24), which includes the frame (24a), from above to define a resin containing space (62) together with the release film (F) and the frame (61); a collection path (63) having a first end connected to the first hole (61a) and a second end connected to a suction source (65); and a collector (66) connected to the second end.

[0054]

With the above configuration, covering the resin containing section (24) with the plate (61) from above to form a resin containing space (62) and activating the suction source (65) sucks the powder resin (R) from the resin containing section (24) through the first hole (61a) and the collection path (63) to the collector (66).

[0055]

(3) The resin molding apparatus (1) described in item (2) above may be further configured such that the plate (61) has at least one second hole (61b) connecting the resin containing space (62) to an outside space to supply gas into the resin containing space (62).

[0056]

The suction source (65) sucks the powder resin (R) together with gas (air) through the first hole (61a). The above configuration allows gas to be supplied through the second hole (61b) into the resin containing space (62) and thereby prevents gas in the resin containing space 62 from decreasing. This in turn prevents the release film (F) from being lifted and the suction source (65) from failing to sufficiently suck the powder resin (R).

[0057]

(4) The resin molding apparatus (1) described in item (3) above may be further configured such that the at least one second hole (61b) includes a plurality of second holes (61b) around the first hole (61a).

[0058]

Sucking resin from the resin containing space (62) with use of the suction source (65) applies a suction force to the release film (F). With the above configuration, the plate (61) has two or more second holes (61b) around the first hole (61a). This allows gas to be supplied through the second holes (61b) into the resin containing space (62) to press that portion of the release film (F) which is around that portion of the release film (F) which receives a suction force. This effectively prevents the suction force from sucking the release film (F). Further, gas stirs up the powder resin (R). This allows the suction source (65) to easily suck that portion of the powder resin (R) which is around the first hole (61a), and thereby allows the resin collecting mechanism (6) to collect the powder resin (R) within a short time period.

[0059]

(5) The resin molding apparatus (1) described in item (3) or (4) above may be further configured such that the plate (61) is configured to come into contact with the frame (24a) to cover the resin containing section (24) from above.

[0060]

The suction source (65) sucks the powder resin (R) together with gas (air) through the first hole (61a). This causes a negative pressure in the resin containing space (62) with the plate (61) in contact with the frame (24a) to cover the resin containing section (24) from above, unless no gas is supplied through the second hole(s) (61b) into the resin containing space (62). The above configuration allows gas to be supplied through the second hole(s) (61b) into the resin containing space (62) such that, for instance, the resin collecting mechanism (6) adjusts the amount of gas that the suction source (65) sucks from the resin containing space (62) through the first hole (61a) over a unit time so that the amount is equal to the amount of gas supplied through the second hole(s) (61b) into the resin containing space (62) over the unit time. This allows the resin collecting mechanism (6) to collect powder resin (R) while maintaining the pressure (air pressure) in the resin containing space (62) at a particular level.

[0061]

(6) The resin molding apparatus (1) described in any one of items (2) to (4) above may be further configured such that the plate (61) is configured to cover the resin containing section (24) from above with a gap (G) between the frame (24a) and the plate (61).

[0062]

The above configuration allows gas in the resin containing space (62) to constantly have a pressure equal to the pressure of gas outside the resin containing section (24). This in turn allows the suction source (65) to easily suck that portion of the powder resin (R) which is around the first hole (61a), and thereby allows the resin collecting mechanism (6) to collect the powder resin (R) within a short time period.

[0063]

(7) A method for producing a resin molded product (Sb) characteristically includes: supplying a predetermined amount of powder resin (R) to a resin containing section (24) including a release film (F) and a frame (24a) on the release film (F); determining whether the resin containing section (24) has received the powder resin (R) appropriately; if it has been determined during the determining that the resin containing section (24) has received the powder resin (R) inappropriately, sucking the powder resin (R) from the resin containing section (24) for collection; and if it has been determined during the determining that the resin containing section (24) has received the powder resin (R) appropriately, placing between an upper die (UM) and a lower die (LM) the release film (F) with the powder resin (R) on the release film (F) and an object to be molded (Sa) and molding in the powder resin (R) the object to be molded (Sa).

[0064]

The method characteristic as above for producing a resin molded product (Sb) includes determining whether the resin containing section (24) has received the powder resin (R) appropriately through the supplying. This makes it possible to place between the upper die (UM) and the lower die (LM) only powder resin (R) determined as appropriate during the determining for resin molding. The method also includes, if it has been determined during the determining that the resin containing section (24) has received the powder resin (R) inappropriately, collecting the powder resin (R) from the resin containing section (24) as separated from the release film (F). The method thereby automatically separates the powder resin (R) and the release film (F) from each other for collection.

[0065]

(8) The method described in item (7) above may be further configured such that the determining includes determining that the resin containing section (24) has received the powder resin (R) inappropriately if the resin containing section (24) has received the powder resin (R) (i) in an amount larger than the predetermined amount, (ii) at a flow rate higher than a threshold value, or (iii) with uneven distribution.

[0066]

The above feature makes it possible to reliably collect powder resin (R) that may fail to produce a non-defective product through the molding.

Industrial Applicability

[0067]

This disclosure is applicable to a resin molding apparatus and a method for producing a resin molded product.

Reference Signs List

[0068]

1	Resin molding apparatus
30 3	Resin molding module (resin molding mechanism)
6	Resin collecting mechanism
24	Resin containing section
24a	Frame
26	Resin supply mechanism
35 61	Plate
61a	First hole

	61b	Second hole
	62	Resin containing space
	63	First hose (collection path)
	65	Air pump (suction source)
5	66	Resin collector (collector)
	F	Release film
	G	Gap
	LM	Lower die
	M	Molding die
10	R	Powder resin
	Sa	Substrate to be molded (object to be molded)
	Sb	Molded substrate (resin molded product)
	UM	Upper die

Claims

1. A resin molding apparatus, comprising:
 - a resin supply mechanism configured to supply powder resin to a resin
 - 5 containing section including a release film and a frame placed on the release film;
 - a resin molding mechanism including a molding die that includes an upper die and a lower die facing the upper die and configured to place between the upper die and the lower die the release film with the powder resin on the release film for resin molding;
 - and
 - 10 a resin collecting mechanism configured to suck the powder resin from the resin containing section for collection before the resin molding mechanism places the release film on the molding die.
2. The resin molding apparatus according to claim 1, wherein
 - 15 the resin collecting mechanism includes:
 - a plate having a first hole and configured to cover, from above, the resin containing section, including the frame, from above to define a resin containing space together with the release film and the frame;
 - a collection path having a first end connected to the first hole and a second end
 - 20 connected to a suction source; and
 - a collector connected to the second end.
3. The resin molding apparatus according to claim 2, wherein
 - the plate has at least one second hole connecting the resin containing space to an
 - 25 outside space to supply gas into the resin containing space.
4. The resin molding apparatus according to claim 3, wherein
 - the at least one second hole includes a plurality of second holes around the first
 - 30 hole.
5. The resin molding apparatus according to claim 3 or 4, wherein
 - the plate is configured to come into contact with the frame to cover the resin
 - containing section from above.
6. The resin molding apparatus according to any one of claims 2 to 4, wherein
 - 35 the plate is configured to cover the resin containing section from above with a

gap between the frame and the plate.

7. A method for producing a resin molded product,
the method comprising:

- 5 supplying a predetermined amount of powder resin to a resin containing section
including a release film and a frame on the release film;
determining whether the resin containing section has received the powder resin
appropriately;
if it has been determined during the determining that the resin containing section
10 has received the powder resin inappropriately, sucking the powder resin from the resin
containing section for collection; and
if it has been determined during the determining that the resin containing section
has received the powder resin appropriately, placing between an upper die and a lower
die the release film with the powder resin on the release film and an object to be molded
15 and molding in the powder resin the object to be molded.

8. The method according to claim 7, wherein

- the determining includes determining that the resin containing section has
received the powder resin inappropriately if the resin containing section has received the
20 powder resin (i) in an amount larger than the predetermined amount, (ii) at a flow rate
higher than a threshold value, or (iii) with uneven distribution.