

DESCRIPTION

Title of Invention: RESIN MOLDING APPARATUS, MANUFACTURING
METHOD FOR RESIN MOLDED PRODUCT, AND PROGRAM

5 Technical Field

[0001] The present invention relates to a resin molding apparatus, a manufacturing method for a resin molded product, and a program.

Background Art

10 [0002] Patent Document 1 discloses a compression molding apparatus. In this compression molding apparatus, granular resin is dispersed evenly on a sheet film, and the sheet film with the resin dispersed thereon is transported to a press part. In the press part, a workpiece is compression molded using the resin dispersed on the sheet film.

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Citation List

Patent Document

[0003] Patent Document 1: JP 2019-136942A

20 Summary of Invention

Technical Problem

[0004] In a compression molding apparatus such as disclosed in Patent Document 1, the outer appearance of the molded workpiece is affected by how the resin is dispersed on the film. That is, depending on the dispersed state of the resin
25 supplied onto the film, molding defects could possibly occur. For example, molding defects may possibly occur if dispersion of the resin material on the film is very uneven.

[0005] An object of the present invention is to provide a resin molding apparatus that is able to appropriately determine a dispersed state of a resin material supplied onto an object to be use in molding of a resin molded product and appropriately prevent the occurrence of molding defects, and to a manufacturing method for a resin
5 molded product and a program.

Solution to Problem

[0006] A resin molding apparatus according to an aspect of the present invention includes an image shooting part, a molding mechanism, and a controller. The image
10 shooting part shoots an image of a resin material supplied onto an object. The molding mechanism performs molding of a resin molded product, using the resin material supplied onto the object. The controller acquires the image and controls operations of the molding mechanism. The controller calculates, for each of a plurality of blocks included in the image, an occupancy ratio of an area in which the
15 resin material is disposed or an occupancy ratio of an area in which the resin material is not disposed. The controller determines whether the molding by the molding mechanism using the resin material is possible, based on a similarity between a plurality of occupancy ratios respectively calculated for the plurality of blocks and a plurality of reference ratios respectively set in advance for the plurality of blocks.

20 [0007] A method of manufacturing a resin molded product according to another aspect of the present invention is a method of manufacturing a resin molded product using the resin molding apparatus, the method including a step of disposing the resin material within a molding die, and a step of performing mold clamping of the molding die in which the resin material is disposed.

25 [0008] A program according to yet another aspect of the present invention is a program for causing a computer connected to a molding mechanism that performs molding of a resin molded product to execute a step of acquiring an image of a resin

material supplied onto an object, a step of calculating, for each of a plurality of blocks included in the image, an occupancy ratio of an area in which the resin material is disposed or an occupancy ratio of an area in which the resin material is not disposed, and a step of determining whether the molding by the molding mechanism using the resin material is possible, based on a similarity between a plurality of occupancy ratios respectively calculated for the plurality of blocks and a plurality of reference ratios respectively set in advance for the plurality of blocks.

Advantageous Effects of Invention

[0009] According to the present invention, the dispersed state of a resin material supplied onto an object to be used in molding of a resin molded product can be appropriately determined and the occurrence of molding defects can be appropriately prevented.

Brief Description of Drawings

[0010] FIG. 1 is a plan view schematically showing a resin molding apparatus.

FIG. 2 is a side cross-sectional view schematically showing a periphery of a resin material supply mechanism.

FIG. 3 is a diagram for describing an image shooting state of an image shooting part.

FIG. 4 is a flowchart showing an operation procedure of the resin molding apparatus.

FIG. 5 is a diagram for describing blocks set within an image.

FIG. 6 is a diagram comparing an occupancy ratio graph with a reference ratio graph.

FIG. 7 is another diagram comparing an occupancy ratio graph with a reference ratio graph.

Description of Embodiments

[0011] Hereinafter, an embodiment of the present invention will be described in detail using the drawings. Note that the same or equivalent portions in the diagrams will be given the same reference signs and description thereof will not be repeated. Also, for ease of understanding, the diagrams are schematically depicted with objects being omitted or shown in an exaggerated manner as appropriate.

[0012] [1. Configuration of resin molding apparatus]

FIG. 1 is a plan view schematically showing a resin molding apparatus 100 according to the present embodiment. The resin molding apparatus 100 resin-molds objects to be molded. In the description herein, a substrate W1 on which electronic components such as semiconductor chips are mounted is illustrated as an object to be molded. The resin molding apparatus 100 uses a resin material P to create a resin seal on the substrate W1 and manufactures a substrate W2, which is a resin molded product. Although not limited thereto, here, a component mounting surface of the substrate W1 on which electronic components are mounted is resin-sealed.

[0013] Examples of the substrate W1 include a lead frame, a printed wiring board, a metal substrate, a resin substrate, a glass substrate, a ceramic substrate, and a semiconductor substrate such as a silicon wafer. The substrate may be a carrier that is used in FOWLP (Fan Out Wafer Level Packaging) and FOPLP (Fan Out Panel Level Packaging). Wiring may or may not be already installed on the substrate.

[0014] As shown in FIG. 1, the resin molding apparatus 100 includes a master module M1, a mold module M2, and a resin module M3. The mold module M2 includes a molding mechanism 5. The molding mechanism 5 performs resin molding to obtain the substrate W2, by using the resin material P to seal electronic components on the substrate W1 with resin. The master module M1 supplies the

substrate W1, which is the object to be molded, to the molding mechanism 5, collects the molded substrate W2 (resin molded product) from the molding mechanism 5 and stores the substrate W2. The resin module M3 supplies the resin material P to the molding mechanism 5. The above modules M1 to M3 are coupled together as an integrated device in the stated order, with the modules M1 to M3 being detachable and interchangeable with other modules. FIG. 1 shows two modules M2, but only one module M2 or three or more modules M2 may be deployed. This similarly applies to modules M1 and M3, and the number of modules M1 to M3 can be respectively increased or decreased.

10 [0015] The resin molding apparatus 100 further includes a controller 10 and a storage 12. The controller 10 includes a CPU (Central Processing Unit), a RAM (Random Access Memory), and a ROM (Read Only Memory), and the CPU controls the operations of each of the modules M1 to M3, by executing a program 15 stored in the storage 12 and/or the ROM. The controller 10 is connected to various mechanisms included in the modules M1 to M3 such as the molding mechanism 5, and causes these mechanisms to operate in conjunction with each other. The storage 12 includes any type of storage medium such as a hard disk or a flash memory, and may be constituted by combining different types of storage media. The controller 10 may be constituted by a single unit or by a plurality of units disposed so as to be distributed inside or outside the modules M1 to M3. The storage 12 may also be constituted by a single unit or by a plurality of units disposed so as to be distributed inside or outside the modules M1 to M3.

[0016] In the example in FIG. 1, the program 15 is stored in the storage 12. Note that the program 15 may be provided to the resin molding apparatus 100, using a non-transient storage medium 16 that stores the program 15 in a readable manner. The storage medium 16 is, for example, a portable memory. Examples of a portable memory include a CD-ROM, a USB (Universal Serial Bus) memory, an SD card, a

micro SD card, and a compact flash (registered trademark). In the case where the storage medium 16 is a portable memory, the CPU of the controller 10 may read the program 15 from the storage medium 16 using a reader (not shown). The read program 15 is written to the storage 12. Furthermore, the program 15 may be provided to the resin molding apparatus 100 by a communication part (not shown) of the resin molding apparatus 100 communicating with an external device. In this case, the CPU of the controller 10 acquires the program 15 through the communication part. The acquired program 15 is written to the storage 12. The number of CPUs of the controller 10 is not limited to one and may be two or more.

10 If the controller 10 has a plurality of CPUs, the CPUs may cooperate to execute the respective operations of the modules M1 to M3.

[0017] Also, the resin molding apparatus 100 includes an input device, a display device, and the like as a user interface (UI) device 14. The UI device 14 can be realized as a touch panel, for example.

15 [0018] The master module M1 includes a supply mechanism 1, a storage part 2, a loading part 3, and a transport mechanism 4. The supply mechanism 1 supplies the substrate W1 onto the loading part 3. The storage part 2 stores the substrate W2. The loading part 3 moves in a Y direction between a position corresponding to the supply mechanism 1 and a position corresponding to the storage part 2. The transport mechanism 4 is movable in X, Y and Z directions within the master module M1 and the mold module M2. The transport mechanism 4 holds the substrate W1 on the loading part 3, transports the substrate W1 to the mold module M2, and delivers the substrate W1 to the molding mechanism 5. Also, the transport mechanism 4 collects the substrate W2 from the molding mechanism 5, transports the substrate W2 to the master module M1, and loads the substrate W2 onto the loading part 3. Thereafter, the substrate W2 is stored in the storage part 2. The X and Y directions respectively correspond to the left-right direction and the up-down

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direction in FIG. 1. The Z direction corresponds to a direction perpendicular to the surface of FIG. 1.

[0019] The molding mechanism 5 manufactures the substrate W2 by compression molding. Here, the granular resin material P is used. Note that, in compression molding, other forms of the resin material P, such as a liquid resin material P, may be used. The following shows an example in which the granular resin material P is used. The molding mechanism 5 includes a molding die 50 and a mold clamping mechanism 53. The molding die 50 includes an upper die 52 (first mold) and a lower die 51 (second mold) that opposes the upper die 52. The upper die 52 is capable of holding the substrate W1 on a lower surface thereof. The substrate W1 is held with the component mounting surface facing downward. The lower die 51 includes a bottom member and a frame-shaped side member. The bottom member is disposed on the inner side of the frame-shaped side member. A recessed cavity 51A is thereby formed. The bottom member constitutes the bottom surface of the cavity 51A, and the side member constitutes the side surface of the cavity 51A.

[0020] Within the cavity 51A, the resin material P is disposed in a spread out state on a film 73 as described later. The resin material P within the cavity 51A is heated by a heating device (not shown). The mold clamping mechanism 53 clamps the upper die 52 and the lower die 51 so as to close the cavity 51A while the heating device is heating the resin material P, and the resin material P within the cavity 51A is cured. The component mounting surface of the substrate W1 held in the upper die 52 is thereby sealed with the resin material P. Thereafter, the mold clamping mechanism 53 performs mold opening for opening the upper die 52 and the lower die 51, and the substrate W2 is removed from the molding die 50. Note that, in the present embodiment, the resin material P has thermosetting properties, but may have thermoplastic properties. In the case where the resin material P has thermoplastic

properties, the resin material P is firstly melted by being heated, and then the resin material P is cured by being cooled, at the time of resin molding.

[0021] The resin module M3 includes a moving table 6, an accommodating part 7, and a supply mechanism 8. The moving table 6 is movable in the X and Y directions within the resin module M3. FIG. 2 is a side cross-sectional view schematically showing the periphery of the supply mechanism 8. As shown in FIG. 2, the film 73 supplied from a film supply mechanism (not shown) is laid on the moving table 6, and a frame 72 is further placed on this film 73. The accommodating part 7 having a space 71 whose bottom surface and side surface are respectively the film 73 and the frame 72 is thereby formed. The film 73 is a mold release film. The space 71 is open upward and has a shape and size corresponding to the cavity 51A of the lower die 51. In the present embodiment, the frame 72 and the space 71 are rectangular in shape. The resin material P is supplied into the space 71 of the accommodating part 7 from the supply mechanism 8. The resin material P is supplied into the space 71 from above in a spread out manner.

[0022] As shown in FIG. 2, the supply mechanism 8 includes a storage part 80, a transport path 81, and a vibration mechanism 82. The storage part 80 temporarily stores the resin material P. The transport path 81 communicates with the storage part 80 and has a discharge opening 85, and is the path along which the resin material P that flows out of the storage part 80 is transported. The vibration mechanism 82 sends the resin material P out of the storage part 80 and transports the resin material P along the transport path 81 toward the discharge opening 85, by causing the storage part 80 and the transport path 81 to vibrate. After reaching the discharge opening 85, the resin material P drops through the discharge opening 85 and is accommodated within the accommodating part 7. During operation of the vibration mechanism 82, the moving table 6 moves in the X and Y directions relative to the discharge opening 85. The resin material P is thereby evenly spread throughout the accommodating

part 7. The Y direction is perpendicular to the surface of FIG. 2. The X direction is the left-right direction.

[0023] The supply mechanism 8 further includes a weighing mechanism 83 and supplies a preset target amount of the resin material P into the accommodating part 7.

5 For example, the weighing mechanism 83 measures the weight of the resin material P within the storage part 80 and the transport path 81. The controller 10 controls the vibration mechanism 82, such that the amount of resin material P supplied into the accommodating part 7 achieves the target amount, based on the result of weighing by the weighing mechanism 83.

10 [0024] Referring again to FIG. 1, the resin module M3 further includes an image shooting part 20 and a transport mechanism 9. The image shooting part 20 shoots an image of the resin material P supplied onto the film 73 by the supply mechanism 8. In other words, the image shooting part 20 shoots an image of the resin material P that is spread out within the accommodating part 7 in a state of being dispersed on
15 the film 73. The image generated by the image shooting part 20 is transmitted to the controller 10 and stored in the storage 12 as appropriate.

[0025] FIG. 3 is a diagram for describing the image shooting state of the image shooting part 20. As shown in FIG. 3, the image shooting part 20 shoots an image of the resin material P within the accommodating part 7 from above, with the moving
20 table 6 located downward of the image shooting part 20, for example. The image shooting part 20 includes one or a plurality of camera modules 21. Each camera module 21 includes an image sensor such as a CCD (Charge Coupled Device) image sensor or a CMOS (Complementary Metal Oxide Semiconductor) image sensor, for example. Also, the image shooting part 20 includes a light source 22 that is disposed
25 upward of the camera module 21. Note that a backlight may be disposed instead of such a light source 22. That is, a light source, a light-guiding plate or the like may be disposed behind the subject as viewed from the camera module 21, or in other

words, downward of the film 73.

[0026] Referring again to FIG. 1, the transport mechanism 9 is movable in the X, Y and Z directions within the mold module M2 and the resin module M3. The transport mechanism 9 transports the film 73 having the resin material P thereon to the mold module M2. The film 73 with the resin material P thereon is then disposed within the cavity 51A of the lower die 51 of the molding mechanism 5. Note that, after being spread out on the film 73, the resin material P on the film 73 is handled such that the position thereof does not move significantly until the resin material P is set within the cavity 51A after having been shot by the image shooting part 20. In other words, the dispersed state of the resin material P spread out on the film 73 does not change much from when the resin material P is spread out until when the resin material P is set within the cavity 51A.

[0027] [2. Suppression of molding defects in resin molded product]

As described above, in the molding mechanism 5, the substrate W1 is resin-molded, using the resin material P. As aforementioned, the resin material P accommodated in the lower die 51 in a state of being dispersed on the film 73 is melted by a heating device. During mold clamping, the molten resin material covers the component mounting surface of the substrate W1 held in the upper die 52. The temperature of the resin material P rises in this state. The resin material P is thereby cured and a resin layer that seals the component mounting surface of the substrate W1 is formed. As a result, the substrate W2 having a resin layer is manufactured. The film 73 is peeled off the substrate W2.

[0028] According to a molding process such as described above, the outer appearance of the molded substrate W2 will be affected by how the resin material P is dispersed on the film 73. That is, depending on the dispersed state of the resin material P on the film 73, molding defects could possibly occur in the substrate W2. Note that the molding defects referred to here include, for example, large variations

in the thickness of the resin layer in an individual substrate W2. Additionally, various molding defects that occur according to the dispersed state of the resin material P are conceivable, such as chips drifting on the component mounting surface.

[0029] In order to suppress molding defects such as the above, an image showing

5 the resin material P dispersed on the film 73 is shot by the image shooting part 20 in the resin molding apparatus 100. The controller 10 then determines the appropriateness of the dispersed state of the resin material P on the film 73 based on this image, and determines, according to the result thereof, whether resin molding is possible. That is, if molding defects are likely to occur due to the dispersed state of
10 the resin material P, the resin molding is stopped and the occurrence of molding defects is appropriately prevented. Specific processing is described below.

[0030] [3. Operations of resin molding apparatus]

FIG. 4 is a flowchart showing some of the operation procedures in the resin molding apparatus 100. The processing shown in this flowchart is executed
15 by the controller 10.

[0031] First, in step S1, the controller 10 controls the supply mechanism 8 to supply the target amount of the resin material P into the accommodating part 7.

This control is executed with the accommodating part 7 located downward of the discharge opening 85 of the supply mechanism 8. The controller 10 moves the
20 moving table 6 and disposes the accommodating part 7 downward of the discharge opening 85. In this state, the controller 10 causes the vibration mechanism 82 to vibrate to supply the resin material P into the accommodating part 7, while the weighing mechanism 83 measures the amount of resin material P that is supplied. Vibration and weighing are then continued until the supplied amount of resin
25 material P reaches the target amount, and vibration and weighing are stopped when the target amount is reached. Also, the controller 10 moves the moving table 6 such that the resin material P is spread out evenly within the accommodating part 7,

while causing the vibration mechanism 82 to vibrate.

[0032] In the following step S2, the controller 10 moves the moving table 6 and disposes the accommodating part 7 accommodating the resin material P downward of the camera module 21. Image shooting by the image shooting part 20 is then executed in this state. An image of the resin material P supplied into the frame 72 is shot from above by the image shooting part 20. An image (hereinafter referred to as an original image) showing the resin material P dispersed on the film 73 is thereby generated. The controller 10 acquires the original image from the image shooting part 20.

10 [0033] In the following step S3, the controller 10 performs gradation processing and binarization on the original image. As an example, in the present embodiment, it is assumed that the camera module 21 is a monochrome camera and the original image is a grayscale image. In this case, for example, in the gradation processing, each pixel of the original image is classified as one of 256 levels [0 (dark) - 255 (light)]. White pixels are assigned "255" and black pixels are assigned "0". In the binarization, each pixel is classified as "white (1)" or "black (0)". For example, pixels with a value assigned by the gradation processing that is greater than or equal to a threshold value X1 (e.g., 200) are assigned "white", and pixels with a value assigned by the gradation processing that is less than the threshold value X1 are assigned "black". The pixel values included in the original image are thereby converted into binary values, and the original image is converted to a binary image.

[0034] The threshold value X1 used in the binarization can be set by the user as appropriate. For example, the user determines an appropriate threshold value X1 according to factors such as the color of the resin material P, the color of the film 73, the color of the moving table 6 downward of the film 73, and the light intensity of the light source 22, and operates the UI device 14 to input the determined threshold value X1. The controller 10 sets the threshold value X1, based on the input by the user.

The threshold value X1 is saved to the storage 12. The input by the user may be the threshold value X1 itself or may be information for specifying the threshold value X1. Information for specifying the threshold value X1 is, for example, information designating a specific pixel within an image provided for test purposes, and when the user designates a specific pixel, the pixel value of that pixel may be set as the threshold value X1.

[0035] In the following step S4, the controller 10 sets a plurality of blocks T1 to T18 within an image shooting range (entire field of view) A1 of the original image. FIG. 5 is a diagram for illustrating the blocks T1 to T18 included in the original image. A rectangular area A2 included within the image shooting range A1 corresponds to the space within the frame 72, that is, to the space 71 in which the resin material P is accommodated within the accommodating part 7. The blocks T1 to T18 are areas defined in a grid shape within the area A2.

[0036] In the present embodiment, the controller 10 further sets the blocks T1 to T18, by specifying the position of the area A2 within the image shooting range A1 and dividing this area A2. The method of specifying the position of the area A2 is not specifically limited, and, for example, in the case where the position relationship between the camera module 21 and the frame 72 at the time of image shooting is constant, the position of the area A2 can be set in advance. Alternatively, by performing image processing such as processing for detecting the edge of the frame 72 on the original image, the area A2 within the frame 72 in which the resin material P is disposed may be separated from the background and automatically detected. Note that the position of the area A2 may be specified in step S3. In this case, the gradation processing and the binarization of step S3 may be executed only on the image within area A2. The method of dividing the area A2 is also not specifically limited. For example, the controller 10 is able to divide the area A2 uniformly, as shown in the example in FIG. 5, into a predetermined number of blocks. The

controller 10 is able to set parameters such as the number of divisions in order to set the blocks T1 to T18, based on an input by the user.

[0037] In the following step S5, the controller 10 calculates the occupancy ratio in each of the plurality of blocks T1 to T18. In the present embodiment, the occupancy ratio is the proportion of the area in which the resin material P is disposed within each block included in the original image or the binary image.

[0038] As a result of the binarization in step S3, different values among the two values "white" and "black" are assigned to pixels in the area in which the resin material P is disposed and pixels in the area in which the resin material P is not disposed within the area A2. Also, the area in which the resin material P is not disposed within the area A2 is the area in which the film 73 (or moving table 6 downward thereof if film 73 is transparent) appears in the original image. Here, it is assumed, for example, that the resin material P is a blackish color (or deep or dark color) and the film 73 or the moving table 6 is a lighter or brighter color. In this case, the pixels in the area in which the resin material P is disposed are assigned "black" and the pixels in the area in which the resin material P is not disposed are assigned "white" as a result of the binarization.

[0039] In step S5, the controller 10 counts the number of pixels included in each block that are assigned "black" as a result of the binarization. The ratio of the number of pixels assigned "black" to the total number of pixels included in the block is then calculated as the occupancy ratio. Note that, if the resin material P is a lighter or brighter color than the film 73 or the moving table 6, the value obtained by dividing the number of pixels assigned "white" by the total number of pixels can be taken as the occupancy ratio in the present embodiment.

[0040] The above occupancy ratio is calculated for each of the plurality of blocks T1 to T18. Accordingly, a set of values of a plurality of occupancy ratios C1 to C18 is calculated in step S5. The occupancy ratios C1 to C18 respectively correspond to

the blocks T1 to T18.

[0041] In the following step S6, the controller 10 calculates the similarity between the set of values of the plurality of occupancy ratios C1 to C18 and the set of values of a plurality of reference ratios R1 to R18. The reference ratios R1 to R18 are respectively set in advance for the blocks T1 to T18. Although not limited thereto, in the present embodiment, a correlation coefficient is calculated as the similarity. The correlation coefficient is a value obtained by dividing the covariance between the occupancy ratios C1 to C18 and the reference ratios R1 to R18 by the product of the standard deviation of the occupancy ratios C1 to C18 and the standard deviation of the reference ratios R1 to R18.

[0042] FIG. 6 is a diagram comparing a graph of the occupancy ratios C1 to C18 with a graph of the reference ratios R1 to R18. The similarity is the similarity between the set of values of the occupancy ratios C1 to C18 and the set of values of the reference ratios R1 to R18. In other words, the similarity can be said to be the similarity between a graph of the occupancy ratios C1 to C18 and a graph of the reference ratios R1 to R18, such as shown in FIG. 6.

[0043] The reference ratios R1 to R18 are respectively the proportions of the area in which the resin material P is disposed within the blocks T1 to T18 included in a reference image. Note that the reference ratios R1 to R18 can be calculated by the reference image undergoing similar processing to steps S3 to S5 performed on the original image. The reference image is an image whose similarity is compared to the original image. For example, the reference image is an image shot of the resin material P when dispersed on the film 73, before molding of a substrate W2 that is favorably manufactured. The similarity between the reference ratios R1 to R18 and the occupancy ratios C1 to C18 calculated from such a reference image being high means that the dispersed state of the resin material P on the film 73 is similar between the reference image and the original image. Accordingly, the similarity calculated

in step S6 being greater than a predetermined value means that, when the substrate W2 is molded using the resin material P dispersed as appears in the original image, it is highly likely that a favorable substrate W2 will be molded without molding defects.

[0044] Therefore, in the following step S7, the controller 10 determines the appropriateness of molding by the molding mechanism 5 using the resin material P, based on the similarity calculated in step S6. For example, the controller 10 determines whether the similarity is greater than or equal to a threshold value X2, and, if the similarity is greater than or equal to the threshold value X2 (similar), determines that molding by the molding mechanism 5 is possible and proceeds to step S8. On the other hand, if the similarity is less than the threshold value X2 (not similar), the controller 10 determines that molding by the molding mechanism 5 is not possible and proceeds to step S9.

[0045] The threshold value X2 used in step S7 can be set by the user as appropriate. For example, the threshold value X2 of the correlation coefficient is preferably a value not less than 60%, or may be a value not less than 70% or a value not less than 80%. The user is able to input this value by operating the UI device 14. In this case, the controller 10 sets the threshold value X2, based on the input by the user. The threshold value X2 is saved to the storage 12.

[0046] The set of values of the reference ratios R1 to R18 used in step S6 can also be set by the user as appropriate. The user is able to set these values by operating the UI device 14. In this case, the controller 10 sets the set of reference ratios R1 to R18, based on an input by the user to the UI device 14. The set of reference ratios R1 to R18 that is set is saved to the storage 12. Note that the user may designate the values of the reference ratios R1 to R18 themselves or may designate the reference image. In the case where the user designates the reference image, the controller 10 calculates the set of reference ratios R1 to R18 from the reference image and sets the calculated set. Also, the controller 10 may calculate

one set of reference ratios R1 to R18 from a plurality of reference images designated by the user and set the calculated set. In this case, for example, the reference ratios R1 to R18 of one set can be calculated by averaging or taking the median value for each block with respect to the reference ratios R1 to R18 of a plurality of sets respectively calculated from the plurality of reference images.

[0047] Note that a plurality of sets of values of the reference ratios R1 to R18 may be set. For example, in the case where there are a plurality of ways of dispersing the resin material P on the film 73 by which the substrate W2 can be favorably molded, a plurality of sets of reference ratios R1 to R18 respectively corresponding to the plurality of ways can be set. In this case, in step S7, the controller 10 is able to determine that molding is possible, if the similarity with any of the sets among the plurality of similarities calculated between the occupancy ratios C1 to C18 and each of the plurality of sets of the reference ratios R1 to R18 is greater than or equal to the threshold value X2. Conversely, the controller 10 is able to determine that molding is not possible, if the similarity with all the sets is less than the threshold value X2. Also, in this case, the threshold value X2 may be set for each set.

[0048] In step S8 in the case where it is determined that molding is possible, the controller 10 causes the molding mechanism 5 to perform molding, using the resin material P dispersed as appears in the original image. Specifically, the controller 10 controls the transport mechanism 9 to transport the film 73 with the resin material P thereon to the molding mechanism 5, and manufactures the substrate W2 with the molding mechanism 5. Thereafter, the controller 10 controls the transport mechanism 4 to collect the substrate W2 and store the substrate W2 in the storage part 2.

[0049] On the other hand, in step S9 in the case where it is determined that molding is not possible, the controller 10 discards the resin material P dispersed as

appears in the original image. For example, the controller 10 controls the transport mechanism 9 to transport the film 73 with the resin material P thereon to a disposal box (not shown) and discards the resin material P and the film 73.

[0050] The processing in FIG. 4 ends when step S8 or S9 ends. The processing in FIG. 4 is executed repeatedly, and the substrate W2 is thereby continuously manufactured.

[0051] [4. Features]

In the above embodiment, before molding the substrate W2, the appropriateness of the dispersed state of the resin material P supplied onto the film 73 is appropriately determined based on similarity. If the result of the determination is unfavorable, molding using the resin material P in such a dispersed state is stopped. As a result, the occurrence of molding defects can be appropriately prevented.

[0052] Also, even in the case where the resin material P is supplied onto the film 73 in a very uneven manner and is not uniformly dispersed, it is possible for a quality substrate W to be manufactured. In the above embodiment, it is possible to determine that molding is possible even in such cases, and excessive discarding of the resin material P can also be prevented.

[0053] [5. Other embodiments]

Although an embodiment of the present invention is described above, the present invention is not limited to the above embodiment, and various changes can be made without departing from the gist of the invention. For example, the following changes can be made. Also, the gists of the following variations can be combined as appropriate.

[0054] [5-1] In the above embodiment, the correlation coefficient is calculated as the similarity, but the present invention is not limited to this example, and any indicator that is able to represent the similarity between the set of values of the occupancy ratios C1 to C18 and the set of values of the reference ratios R1 to R18

can be used. For example, a configuration can also be adopted in which the similarity is a determination coefficient, which is the square of the correlation coefficient, or the similarity may be calculated by AI (artificial intelligence). Also, similarity serving as a quantitative indicator does not necessarily need to be
5 calculated, in order to determine whether molding is possible based on similarity. For example, AI (artificial intelligence) may determine the similarity between a graph of the occupancy ratios C1 to C18 and a graph of the reference ratios R1 to R18, and determine whether molding is possible according to the result of the similarity determination.

10 [0055] [5-2] In the above embodiment, the frame 72, the space 71 within the accommodating part 7, and the area A2 are rectangular in shape, but can be any shape such as circular. The blocks are also not limited to being rectangular in shape and can be any shape.

[0056] Also, in the above embodiment, the blocks are set by dividing the area A2
15 uniformly. However, the blocks may differ from each other in size and shape. For example, blocks closer to the center of the area A2 may be set larger, and blocks further from the center of the area A2 may be set smaller, or conversely, blocks closer to the center of the area A2 may be set smaller, and blocks further from the center of the area A2 may be set larger. Also, the blocks need not be set without gaps and
20 without overlap within the area A2, and may partially overlap each other. There may be gaps within the area A2 that are not included in the blocks.

[0057] [5-3] In the above embodiment, the occupancy ratios C1 to C18 and the reference ratios R1 to R18 are the proportions of the area in which the resin material P is disposed within the blocks T1 to T18. However, a configuration can also be
25 adopted in which the occupancy ratios C1 to C18 and the reference ratios R1 to R18 are the proportions of the area in which the resin material P is not disposed within the blocks T1 to T18.

[0058] [5-4] In the above embodiment, the reference image is an image of a favorable example. However, the reference image may be an image of an unfavorable example. That is, an image shot of the resin material P when dispersed on the film 73 before molding of a substrate W2 that has molding defects may be used as the reference image. Note that, in the case where an unfavorable example is used as the reference image, the controller 10, in step S7, is able to determine that molding is possible if the similarity is less than or equal to the threshold value X2 (not similar), and that molding is not possible if the similarity is greater than the threshold value X2 (similar). Also, an image of a favorable example and an image of an unfavorable example may both be used as reference images.

[0059] [5-5] In the above embodiment, in step S1, the amount of resin material P supplied into the accommodating part 7 is controlled to achieve a target amount. In this case, it is expected that the total value of the occupancy ratios C1 to C18 and the total value of the reference ratios R1 to R18 will be roughly equal, and the integral value of the two graphs shown in FIG. 6 will also be roughly equal. On the other hand, when an excessive amount or an insufficient amount of resin material P is supplied into the accommodating part 7 in step S1, molding defects could possibly occur. However, even if there is oversupply or undersupply of the resin material P, the shapes of the graph of the occupancy ratios C1 to C18 and the graph of the reference ratios R1 to R18 can be similar, such as shown in FIG. 7. Thus, there can be cases where the determination based on similarity in step S7 alone cannot prevent the occurrence of molding defects.

[0060] In view of such cases, determination such as the following may be performed, in addition to the determination based on similarity in step S7. That is, a threshold value (upper limit value and/or lower limit value) is set for the occupancy ratios C1 to C18 for each block, and if the occupancy ratio corresponding to any of the blocks exceeds the upper limit value or falls below the lower limit value, it can

be determined that molding is not possible, and in other cases, it can be determined that molding is possible. Also, in addition thereto or instead thereof, a threshold value (upper limit value and/or lower limit value) is set for the total value of the occupancy ratios C1 to C18, and if the total value exceeds the upper limit value or
5 falls below the lower limit value, it can be determined that molding is not possible, and in other cases, it can be determined that molding is possible.

[0061] [5-6] In the above embodiment, the original image is a grayscale image, but may be a color image, by using a visible light camera as the camera module 21. A configuration can also be adopted in which, in the case where there is a temperature
10 difference between the resin material P and the film 73 onto which the resin material P is supplied or the moving table 6 downward thereof, an infrared camera is used as the camera module 21 and the original image is an infrared image.

List of Reference Numerals

15	[0062]	100	Resin molding apparatus
		1	Supply mechanism
		2	Storage part
		3	Loading part
		4	Transport mechanism
20		5	Molding apparatus
		50	Molding die
		51	Lower die
		51A	Cavity
		52	Upper die
25		53	Mold clamping mechanism
		6	Moving table
		7	Accommodating part

	71	Space
	72	Frame
	73	Film (object)
	8	Supply mechanism
5	80	Storage part
	81	Transport path
	82	Vibration mechanism
	83	Weighing mechanism
	85	Discharge opening
10	9	Transport mechanism
	10	Controller
	12	Storage
	14	User interface device
	15	Program
15	16	Storage medium
	20	Image shooting part
	21	Camera module
	22	Light source
	M1	Master module
20	M2	Mold module
	M3	Resin module
	P	Resin material
	A1	Image shooting range
	A2	Area
25	T1-T18	Block
	C1-C18	Occupancy ratio
	R1-R18	Reference ratio

- W1 Pre-molding substrate
- W2 Substrate (resin molded product)
- X1 Threshold value (first threshold value)
- X2 Threshold value (second threshold value)

CLAIMS

[Claim 1] A resin molding apparatus comprising:

an image shooting part configured to shoot an image of a resin material
5 supplied onto an object;

a molding mechanism configured to perform molding of a resin molded
product, using the resin material supplied onto the object; and

a controller configured to acquire the image and control operations of the
molding mechanism,

10 wherein the controller

calculates, for each of a plurality of blocks included in the image,
an occupancy ratio of an area in which the resin material is disposed or an occupancy
ratio of an area in which the resin material is not disposed, and

determines whether the molding by the molding mechanism using
15 the resin material is possible, based on a similarity between a plurality of occupancy
ratios respectively calculated for the plurality of blocks and a plurality of reference
ratios respectively set in advance for the plurality of blocks.

[Claim 2] The resin molding apparatus according to claim 1,

20 wherein the controller binarizes the image and calculates, as the
occupancy ratio, a ratio of pixels, included in each block, that are assigned a first
value by the binarization, out of first and second values.

[Claim 3] The resin molding apparatus according to claim 2,

25 wherein the controller sets a first threshold value used in the binarization,
based on an input by a user.

[Claim 4] The resin molding apparatus according to any one of claims 1 to 3,
wherein the controller calculates the similarity, and, when the similarity
is greater than or equal to a second threshold value, causes the molding mechanism
to perform the molding.

5

[Claim 5] The resin molding apparatus according to claim 4,
wherein the controller sets the second threshold value, based on an input
by a user.

10 [Claim 6] The resin molding apparatus according to any one of claims 1 to 5,
wherein the controller sets the plurality of reference ratios, based on an
input by a user.

[Claim 7] The resin molding apparatus according to any one of claims 1 to 6,
15 wherein the similarity is a correlation coefficient or a determination
coefficient.

[Claim 8] The resin molding apparatus according to any one of claims 1 to 7,
wherein the image shooting part shoots the image of the resin material
20 supplied into a rectangular frame disposed on the object, and
the plurality of blocks are an area defined in a grid shape within the frame.

[Claim 9] A method of manufacturing a resin molded product using the resin
molding apparatus according to any one of claims 1 to 8, the method comprising:
25 a step of disposing the resin material within a molding die; and
a step of performing mold clamping of the molding die in which the resin
material is disposed.

[Claim 10] A program for causing a computer connected to a molding mechanism configured to perform molding of a resin molded product to execute:

a step of acquiring an image of a resin material supplied onto an object;

5 a step of calculating, for each of a plurality of blocks included in the image, an occupancy ratio of an area in which the resin material is disposed or an occupancy ratio of an area in which the resin materials is not disposed; and

a step of determining whether the molding by the molding mechanism using the resin material is possible, based on a similarity between a plurality of
10 occupancy ratios respectively calculated for the plurality of blocks and a plurality of reference ratios respectively set in advance for the plurality of blocks.