

MOUNTING APPARATUS

BACKGROUND

5 Technical Field

[0001] The present specification discloses a mounting apparatus for mounting a chip component after applying a paste on a substrate.

Related Art

[0002] Conventionally, a mounting apparatus for mounting a chip component such as a
10 semiconductor chip or the like on a substrate has been widely known. Some of these mounting apparatuses have an application part for applying a paste such as NPC or the like on a substrate and a bonding part for bonding a chip component on the paste applied on the substrate. In general, the application part and the bonding part have a camera, and based on images obtained by using the camera, a dispenser and a bonding head are positioned, the quality of a mounting result is
15 judged, or the like.

[0003] However, conventionally, information obtained from images is limited to two-dimensional information, and a three-dimensional shape of an object such as a paste or a chip component cannot be grasped. As a result, there is a problem that the height or the like of the chip component mounted on the paste or the substrate cannot be known, and the quality of the
20 mounting result cannot be accurately grasped.

[0004] Thus, conventionally, many techniques for grasping the three-dimensional shape of the paste or the chip component have been proposed. For example, patent literature 1 discloses a technique for inspecting a solder-joined state by using an X-ray inspection device in a device in which electronic components are solder-joined to a mounted substrate. Further, patent literature
25 2 discloses a technique for measuring the volume of a die bond paste applied on a lead frame by

using a so-called optical cutting method in which the surface of an object is irradiated with light having a geometric shape and then the object is imaged by an image sensor. Further, the imager 38 may not be limited to an imager that acquires only the surface shape of an object, and may be an imager that also acquires the cross-sectional shape of an object. For example, the imager 38 may be an imager that acquires a tomographic image of an object by using X-rays or the like. Hereinafter, an example is described in which the imager 38 acquires an oblique-view image.

[0017] The bonding part 18 mounts the chip component 104 such as a semiconductor chip and the like on the application body 102 applied on the mounted section. In the bonding part 18, a bonding head 30 that sucks and holds the chip component 104 and transfers the chip component 104, a moving mechanism 32 that moves the bonding head 30 in the Y direction and the Z direction, and an imager 34 are arranged. Further, a wafer stage 36 is arranged on the opposite side of the bonding part 18 with the transfer rail 12 sandwiched between the wafer stage 36 and the bonding part 18. The chip components 104 (dies) obtained by dicing a wafer are placed on the wafer stage 36. The bonding head 30 picks up the chip component 104 from the wafer stage 36 and bonds the chip component 104 to a target mounted section. Hereinafter, an object obtained by fixing the chip component 104 via the application body 102 is referred to as a "mounted body 106".

[0018] The imager 34 has substantially the same configuration as the imager 28 arranged in the application part 14, and images the mounted section for mounting and the chip component 104 to be picked up from the vertical direction. Based on the images captured by the imager 34, the control part 22 calculates a relative position between the bonding head 30 and the wafer stage 36 or the substrate 100, and positions the bonding head 30 in accordance with the calculation result. Further, the imager 34 also images the mounted section and the mounted body 106 after bonding. As a second plan-view image, the image of the mounted body 106 is stored in the memory 50 of the control part 22 in association with identification information of the mounted section.

representing the shape of the paste (for example, the paste height h_1 , the paste diameter d_1 , and the like). Further, when the first target shape and the first shape are a collection of coordinate values of surface positions of the paste, the paste error E_1 may be a mean square deviation or a standard deviation of Z coordinate values, or the like.

5 **[0034]** If the paste error E_1 can be calculated, subsequently, the control part 22 calculates a final error E_f which is an error between the calculated second shape and a second target shape stored in the memory 50 (S56). Here, the second target shape is an ideal shape of the mounted body 106. This second target shape is set in advance by a user according to product specifications that are required. Further, if the final error E_f represents the degree of difference between the second
10 target shape and the second shape (measured shape), the calculation method of the final error E_f is not particularly limited. Therefore, the final error E_f may be a deviation of a typical size value representing the shape of the mounted body 106 (for example, the die height h_2 , the mounting diameter d_2 , and the like). Further, when the second target shape and the second shape are a collection of coordinate values of surface positions of the mounted body 106, a mounting error E_2
15 may be a mean square deviation or a standard deviation of Z coordinate values, or the like.

[0035] Next, the control part 22 compares the calculated paste error E_1 with an allowable paste error E_{def1} stored in the memory 50 (S58). The allowable paste error E_{def1} is an allowable value of the paste error E_1 , and is an error value to an extent that the quality of the mounted body 106 cannot be maintained. The allowable paste error E_{def1} may be a fixed value set in advance
20 by a user, or may be a variable value that changes according to fluctuations in various conditions (for example, fluctuations in the viscosity of the paste). As a result of comparison, when the paste error E_1 exceeds the allowable paste error E_{def1} (Yes in S58), it is judged that the application processing is defective (S60).

[0036] Subsequently, the control part 22 corrects the calculated final error E_f by the paste error
25 E_1 to obtain the mounting error E_2 (S62). That is, the calculated final error E_f includes an error

can be used as an evaluation index for the mounting processing.

[0043] If the paste error E3 and the mounting error E4 are obtained, the control part 22 compares the paste error E3 and the mounting error E4 with allowable errors Edef3 and Edef4 stored in the memory 50 (S78, S82). As a result of comparison, if the paste error E3 exceeds the allowable paste error Edef3, it is judged that an application defect has occurred (S80), and if the mounting error E4 exceeds the allowable mounting error Edef4, it is judged that a mounting defect has occurred (S84).

[0044] As described above, according to this example, the target shape of the mounted body 106 is estimated as the estimation shape based on the first shape and the bonding conditions. Here, because the estimation shape is a shape that reflects an actual shape of the application body 102, it is possible to more accurately determine the mounting defect by comparing the estimation shape with the second shape.

[0045] Based on the evaluation result obtained in this way, the control part 22 may perform a feedback control or a feedforward control on the application processing and the mounting processing. For example, the control part 22 may feedback the evaluation index of the application processing to application processing control, or may feedback the evaluation index of the mounting processing to at least one of application processing control and mounting processing control. For example, if the paste errors E1 and E3 are obtained, the control part 22 may adjust an application parameter (for example, a discharge pressure, a discharge height, and the like of the dispenser 24) which is a control parameter involved in the application processing so that the paste errors E1 and E3 can be reduced. Similarly, if the mounting errors E2 and E4 are obtained, the control part may adjust at least one of the application parameter and a bonding parameter (a dropping height, a pressing pressure, a heating temperature, and the like) which is a control parameter involved in the mounting processing so that the mounting errors E2 and E4 can be reduced.

the substrate 100 becomes higher easily as the diameter d1 of the application body 102 increases. Thus, oblique-view images are acquired only for a part of the application bodies 102 among the plurality pastes, and the correlation between the diameter d1 and the height h1 is acquired based on measurement result. FIG. 14 is a diagram showing an example of the correlation, in which the horizontal axis shows the paste diameter d1, the vertical axis shows the paste height h1, and black circles show the measured values. Approximating the measured values gives a correlation curve as shown by a solid line. The control part 22 may calculate the paste diameter d1 from the plan-view image of the application body 102 captured only from the vertical direction instead of being captured from an oblique direction, and compare the paste diameter d1 with the correlation curve, and thereby estimate the paste height h1. Then, with this configuration, the handling amount of the oblique-view image can be significantly reduced, and the time required for calculation can be shortened. As a result, the time required for the mounting processing and the evaluation thereof can be shortened.

[0061] In addition, the configuration described above is an example and other configurations may be changed as appropriate, as long as this configuration has the imagers 38 and 42 for acquiring the first and second oblique-view images, calculates the first shape and the second shape from the first and second oblique-view images, and at least individually evaluates the application processing and the mounting processing based on the first and second shapes. For example, in this example, die bonding apparatus has been described as an example of the mounting apparatus, but other types of mounting apparatus such as a flip-chip bonder device may be used as long as this mounting apparatus fixes a chip component via a paste.

[Reference Signs List]

[0062]	10	mounting apparatus
	12	transfer rail
	14	application part

WHAT IS CLAIMED IS:

1. A mounting apparatus, for mounting a chip component on a substrate via a paste, comprising:

a paste application part that applies the paste on the substrate under predetermined application conditions to form an application body;

a bonding part that forms a mounted body obtained by mounting the chip component on the substrate under predetermined mounting conditions via the application body;

a first imaging part that images the application body after application processing of the paste and before mounting processing of the chip component to acquire first image information;

a second imaging part that images the mounted body after the mounting processing to acquire second image information; and

a control part that controls the paste application part, the bonding part, and the first and second imaging part, and obtains a three-dimensional shape of the application body from the first image information as a first shape and calculates a three-dimensional shape of the mounted body from the second image information as a second shape,

wherein the control part obtains a paste error which is a result of comparison between the first shape and a first target shape that is a target shape of the application body and a final error which is a result of comparison between the second shape and a second target shape that is a target shape of the mounted body, and evaluates the application processing or the mounting processing by a mounting error that is obtained by modifying the final error based on the paste error.

2. The mounting apparatus according to claim 1,

wherein the control part evaluates the application processing based on at least the first shape, and evaluates the mounting processing based on at least an evaluation result of the application processing and the second shape.

3. The mounting apparatus according to claim 1,

wherein the control part estimates the three-dimensional shape of the mounted body as an estimation shape based on at least the first shape and the mounting conditions, evaluates the application processing based on at least the first shape, and evaluates the mounting processing based on at least the estimation shape and the second shape.

5 4. The mounting apparatus according to any one of claims 1 to 3,

wherein the control part acquires physical property information of the paste based on a size of the application body, or a fluctuation amount caused by changes in sizes over time between a plurality of application bodies when applying the plurality of application bodies.

5. The mounting apparatus according to claim 4 that quotes claim 3,

10 wherein the control part estimates the estimation shape based on at least the first shape, the mounting conditions, and the physical property information.

6. The mounting apparatus according to claim 4 or 5,

wherein the control part evaluates the application processing based on the result of comparison between the first target shape which is the target shape of the application body and
15 the first shape, and modifies the first target shape based on the physical property information.

7. The mounting apparatus according to any one of claims 1 to 6,

wherein the control part changes the application conditions based on the evaluation result of the application processing, and changes the application conditions or the mounting conditions based on the evaluation result of the mounting processing.

20 8. The mounting apparatus according to any one of claims 1 to 7,

wherein the control part changes the mounting conditions based on the evaluation result of the application processing.

9. The mounting apparatus according to any one of claims 1 to 8, further comprising:

a first plane imaging part that images the application body from a vertical direction after the
25 application processing and before the mounting processing to acquire a first plan-view image of

the application body; and

a second plane imaging part that images the mounted body from a vertical direction after the mounting processing to acquire a second plan-view image of the mounted body;

wherein the first imaging part images the application body from an oblique direction to
5 acquire a first oblique-view image of the application body,

the second imaging part images the mounted body from an oblique direction to acquire a second oblique-view image of the mounted body, and

the control part estimates a shadow shape of the first oblique-view image from the first plane
10 image, and estimates a shadow shape of the second oblique-view image from the second plane

10. The mounting apparatus according to any one of claims 1 to 8, further comprising:

a first plane imaging part that images the application body from a vertical direction after the
application processing and before the mounting processing to acquire a first plan-view image of
the application body; and

15 a second plane imaging part that images the mounted body from a vertical direction after the mounting processing to acquire a second plan-view image of the mounted body;

wherein the first imaging part images the application body from an oblique direction to
acquire a first oblique-view image of the application body,

the second imaging part images the mounted body from an oblique direction to acquire a
20 second oblique-view image of the mounted body, and

the control part calculates a first correlation between the first plan-view image and the first
oblique-view image and estimates the three-dimensional shape of the application body based on
the first correlation, and calculates a second correlation between the second plan-view image and
the second oblique-view image and estimates the three-dimensional shape of the mounted body
25 based on the second correlation.