

BONDING APPARATUS AND METHOD FOR CORRECTING MOVEMENT AMOUNT OF BONDING HEAD

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BACKGROUND

Technical Field

[0001] The present invention relates to a configuration of a bonding apparatus and a method for correcting a movement amount of a bonding head attached to the bonding apparatus.

Description of Related Art

10 **[0002]** As a part of a process of mounting a semiconductor element such as a semiconductor die or the like on a substrate such as a circuit board, a lead frame, or the like, and assembling a package, there is a die bonding process of adsorbing the die from a wafer and bonding the die to the substrate. In the die bonding process, there is a need to accurately bond the die to a bonding surface of the substrate. However, since the substrate surface is heated to a high temperature of
15 about 80 °C to 250 °C, due to the high temperature or the radiant heat, a positional deviation of the component may occur and the semiconductor element may not be bonded to an accurate position.

[0003] For this reason, the reference member provided in the vicinity of a bonding stage is used as a reference point to detect an amount of heat movement of a bonding head or a variation
20 of an offset volume between a bonding tool and a camera, and correct a bonding position (for example, see Patent Literatures 1 and 2).

[0004] In addition, after bonding the semiconductor die to the substrate, the semiconductor element and the substrate after bonding are imaged to inspect an amount of positional deviation of an actual bonding position (for example, see Patent Literature

15. Then, as shown in step S111 of Fig. 3, the control part 50 images an image of the substrate 30 and the semiconductor element 20 bonded immediately before using the position detection camera 13, and acquires image data as shown in Fig. 6. The acquired image data is input to the control part 50.

5 **[0036]** As shown in Fig. 6, marks 31 and 32 are provided on the substrate 30 on a diagonal line of the target bonding position 34. A line that connects the marks 31 and 32 passes through the center 35 of the target bonding position 34. Here, the center 35 is an intersection between a centerline 30x in the X direction and a centerline 30y in the Y direction of the target bonding position 34. In addition, two marks 21 and 22 are also provided on the semiconductor element
10 20 on the diagonal line. Like the marks 31 and 32, a line that connects the marks 21 and 22 passes through the center 25 of the semiconductor element 20. The center 25 is an intersection between a centerline 20x in the X direction and a centerline 20y in the Y direction of the semiconductor element 20.

[0037] In step S112 of Fig. 3, the control part 50 analyzes the image imaged by the position
15 detection camera 13 to detect XY coordinates of the marks 31 and 32 of the substrate 30, and calculates XY coordinates of the center 35 of the target bonding position 34 from the detected XY coordinates of the marks 31 and 32. Similarly, the XY coordinates of the center 25 of the semiconductor element 20 are calculated from the XY coordinates of the marks 21 and 22 of the semiconductor element 20. Then, the amounts of positional deviation Δx_2 and Δy_2 in the X
20 direction and the Y direction of the center 25 that is the actual bonding position to which the semiconductor element 20 is actually bonded and the center 35 of the target bonding position 34 are calculated from the XY coordinates of the center 35 of the target bonding position 34 and the XY coordinates of the center 25 of the semiconductor element 20.

[0038] Then, the control part 50 advances to step S113 of Fig. 3, and performs actual position

correction is performed. In addition, in (a) of Fig. 7, a solid line a indicates a time variation of the total amount of positional deviation Δy_t between an actual position and a command position of a center of the bonding nozzle 12 in the Y direction, a broken line b indicates a variation of a total amount of positional deviation Δy_{t2} in the Y direction between the bonding nozzle 12 and the optical axis 13z of the position detection camera 13, and a dashed line c indicates a time variation of the total amount of correction ΔA_t in the Y direction. Here, the total amount of positional deviation Δy_t between the actual position and the command position of the center of the bonding nozzle 12 in the Y direction is a total value of a total amount of positional deviation Δy_{t1} between the position of the position command value of the bonding head 11 and the actual position of the bonding head 11 and the total amount of positional deviation Δy_{t2} by a variation of a distance in the Y direction between the optical axis 13z of the position detection camera 13 and the central position of the bonding nozzle 12. Here, the total amount of positional deviations Δy_t , Δy_{t1} and Δy_{t2} and the total amount of correction ΔA_t are cumulative values of the amounts of positional deviation from an initialized state.

[0043] In addition, in (b) of Fig. 7, a solid line d indicates a time variation of the amount of positional deviation Δy_r after correction in the Y direction between the actual position and the command position of the center of the bonding nozzle 12 in the Y direction, and a two-dot chain line e indicates a variation of the amount of positional deviation Δy_{r2} after correction in the Y direction between the bonding nozzle 12 and the optical axis 13z of the position detection camera 13. Here, the amount of positional deviation Δy_r after correction in the Y direction between the actual position and the command position of the center of the bonding nozzle 12 in the Y direction is a total value of the amount of positional deviation Δy_{r1} between the position of the position command value of the bonding head 11 and the actual position of the bonding head 11 and the amount of positional deviation Δy_{r2} by the variation of the distance in the Y direction

between the optical axis 13z of the position detection camera 13 and the central position of the bonding nozzle 12. Here, the amount of positional deviations Δy_r , Δy_{r1} and Δy_{r2} after correction is a cumulative value of the positional deviation amounts after the previous mark correction or the previous actual position correction.

5 **[0044]** The control part 50 at a time 0 shown in (a) of Fig. 7 performs initialization of the amount of movement of the bonding head 11 described with reference to step S101 of Fig. 3 and Fig. 4. Accordingly, at the time 0, the total amount of positional deviation Δy_t is zero. In addition, the total amount of correction ΔA_t and the amount of positional deviation Δy_r after correction are also zero.

10 **[0045]** When the bonding is started from the time 0 as shown in step S102 of Fig. 3, the respective parts start to thermally expand due to influence of heat or the like of a heater of the bonding stage 16. Accordingly, a positional deviation occurs between the position of the position command value of the bonding head 11 and the actual position of the bonding head 11. In addition, the bonding head 11 itself also thermally expands, and thus, a distance in the Y
15 direction between the optical axis 13z of the position detection camera 13 and the central position of the bonding nozzle 12 is varied. For this reason, a positional deviation occurs between the actual position and the command position of the center of the bonding nozzle 12 in the Y direction.

20 **[0046]** When the bonding is started, the total amount of positional deviation Δy_t is increased together with the time as shown by the solid line a of (a) of Fig. 7. In addition, the total amount of positional deviation Δy_{t2} in the total amount of positional deviation Δy_t is also increased together with the time as shown in the broken line b of (a) of Fig. 7.

[0047] Then, when it is the time t_{01} that is a prescribed timing when the mark correction is performed, the control part 50 performs mark correction shown in Fig. 5 in steps S104 to S107 of

to optimize the timing of the actual position correction and improve bonding quality while maintaining productivity.

[0058] When the bonding is executed while correcting the amount of movement of the bonding head 11 using the bonding apparatus 100 described above, making the bonding apparatus 100 operational constitutes a preparing step of a method for correcting an amount of movement as shown in Figs. 1 and 2, an operation of performing the mark correction at every prescribed timing constitutes a mark correction step of the method for correcting the amount of movement as shown in steps S103 to S107 of Fig. 3, and executing the actual position correction whenever the cumulative value $\Sigma\Delta y_1$ of the amounts of correction of the mark correction exceeds the prescribed first threshold Δs constitutes an actual position correction step of the method for correcting the amount of movement as shown in steps S109 to S114 of Fig. 3.

[0059] Further, while the bonding apparatus 100 has been described as bonding the semiconductor element 20 on the substrate 30 in the embodiment, there is no limitation thereto, the semiconductor element 20 is bonded onto the substrate 30, and the other semiconductor element 20 may be bonded onto the semiconductor element 20. In addition, in the actual position correction, while the image in the vicinity of the semiconductor element 20 bonded immediately before has been described as being imaged, there is no limitation thereto, and the image in the vicinity of the bounded semiconductor element 20 may be imaged slightly before the timing when the cumulative value $\Sigma\Delta y_1$ of the amounts of correction of the mark correction exceeds the prescribed first threshold Δs .

[Reference Signs List]

[0060]

11 Bonding head

12 Bonding nozzle

	13 Position detection camera
	13x, 13y, 19x to 19z, 20x, 20y, 30x, 30y Centerline
	13z: Optical axis
	15 Gantry frame
5	16 Bonding stage
	17 Guide
	18 Mark stand
	19 Reference mark
	20 Semiconductor element
10	21, 22, 31, 32 Mark
	25, 35 Center
	30 Substrate
	34 Target bonding position
	40 Visual field
15	41 Reference position
	50 Control part
	100 Bonding apparatus