

DESCRIPTION

Title of Invention

BONDING APPARATUS AND BONDING METHOD

Technical Field

[0001]

Several aspects of the present invention relates to a bonding apparatus and a bonding method.

Background Art

[0002]

Conventionally, there is known a bonding apparatus of this type including: an intermediate stage on which an electronic component is placed; a transfer unit that picks up an electronic component from an electronic component feeding stage and transfers the electronic component to the intermediate stage; and a bonding unit that holds the electronic component transferred onto the intermediate stage and performs bonding of the electronic component to a circuit substrate on a positioning stage (cf., PTL 1).

Citation List

Patent Literature

[0003]

PTL 1: Japanese Patent No. 4946989

[0004]

Incidentally, it is conceivable that bonding is performed concurrently to a plurality of circuit substrates by providing the bonding apparatus as in PTL 1 with a plurality of sets including an intermediate stage, a transfer unit, and a bonding unit.

[0005]

However, with such a bonding apparatus, as compared to the case in which only one set of an intermediate stage, a transfer unit, and a bonding unit is provided, while processing time per circuit substrate is reduced, a space for the bonding apparatus is considerably increased.

Summary of Invention

Technical Problem

[0006]

Several aspects of the present invention is made in view of the above problem, and an object of the present invention is to provide a bonding apparatus capable of reducing processing time per circuit substrate and suppressing an increase of a space, as well as such a bonding method.

Solution to Problem

[0007]

A bonding apparatus according to one aspect of the present invention includes: an intermediate stage; a transfer unit configured to transfer a semiconductor chip and to place the

semiconductor chip on the intermediate stage; and a first bonding unit and a second bonding unit each configured to pick up the semiconductor chip from the intermediate stage, and to bond the semiconductor chip to a circuit substrate, wherein the intermediate stage moves between a first position and a second position, the first position being a position at which the first bonding unit is allowed to pick up the semiconductor chip, the second position being a position at which the second bonding unit is allowed to pick up the semiconductor chip.

[0008]

In the bonding apparatus described above, it is preferable that one of the first position and the second position is a position at which the transfer unit is allowed to place the semiconductor chip on the intermediate stage.

[0009]

In the bonding apparatus described above, it is preferable that the first bonding unit and the second bonding unit are arranged side by side in a first direction, and the intermediate stage moves along the first direction.

[0010]

In the bonding apparatus described above, it is preferable that the intermediate stage is disposed between the transfer unit and the first and the second bonding unit.

[0011]

It is also preferable that the bonding apparatus described above further includes: a camera for chip configured to take an image of the semiconductor chip.

[0012]

A bonding method according to one aspect of the present invention includes: a transfer step of transferring a semiconductor chip and placing the semiconductor chip on an intermediate stage; and a bonding step of causing a first bonding unit and a second bonding unit to pick up the semiconductor chip from the intermediate stage and to perform bonding of the semiconductor chip to a circuit substrate; and a moving step of moving the intermediate stage between a first position and a second position, the first position being a position at which the first bonding unit is allowed to pick up the semiconductor chip, the second position being a position at which the second bonding unit is allowed to pick up the semiconductor chip.

Advantageous Effects of Invention

[0013]

According to the present invention, by providing the first bonding unit and the second bonding unit that pick up the semiconductor chip from the intermediate stage and bond the semiconductor chip to the circuit substrate, it is possible to allow the first bonding unit and the second bonding unit to concurrently perform bonding to different circuit substrates,

respectively. Therefore, as compared to a case in which only one bonding unit is provided, it is possible to reduce processing time per circuit substrate. Further, by moving the intermediate stage between the first position at which the first bonding unit is allowed to pick up the semiconductor chip and the second position at which the second bonding unit is allowed to pick up the semiconductor chip, the intermediate stage is able to pass (feed) the semiconductor chip placed by the transfer unit to both the first bonding unit and the second bonding unit. Therefore, it is not necessary, unlike the first and the second bonding unit, to provide two transfer units and two intermediate stages, and only one transfer unit and only one intermediate stage are sufficient. Thus, it is possible to suppress an increase of a space for a transfer unit and an intermediate stage, to reduce a number of the components for the bonding apparatus, and thus to reduce manufacturing costs.

Brief Description of Drawings

[0014]

Fig. 1 is a schematic plan view for illustration of one example of a bonding apparatus according to this embodiment.

Fig. 2 is a schematic side view for illustration of a wafer holder unit and a transfer unit.

Fig. 3 is a schematic side view for illustration of the transfer unit and an intermediate stage unit.

Fig. 4 is a schematic side view for illustration of the intermediate stage unit and a first bonding unit.

Fig. 5 is a flowchart showing one example of a bonding method according to this embodiment.

Fig. 6 is a diagram for illustration of one example of processing time in the bonding method according to this embodiment.

Description of Embodiment

[0015]

Hereinafter an embodiment of the present invention will be described. In the following description of the drawings, like or identical components are denoted by like or identical reference numerals. However, the drawings are schematic. Therefore, specifics such as dimensions should be determined in the light of the following description. It should also be understood that the drawings include sections having different relations and proportions of dimensions between the drawings. Further, the technical scope of the invention of the present application should not be interpreted as being limited to this embodiment. Note that, in the following description, an upper side, a lower side, a left side, and a right side in the drawings are respectively referred to as "upper side", "lower side", "left", and "right". Further, in the drawings, a direction along and parallel to an X axis is referred to as an X-axis

direction, a direction along and parallel to a Y axis is referred to as a Y-axis direction, and a direction along and parallel to a Z axis is referred to as a Z-axis direction.

[0016]

Fig. 1 to Fig. 6 are diagrams for illustration of one embodiment of a bonding apparatus and a bonding method according to the present invention. Fig. 1 is a schematic plan view for illustration of one example of the bonding apparatus according to this embodiment. A bonding apparatus 1 according to this embodiment is an apparatus used to perform bonding.

[0017]

Referring to Fig. 1, the bonding apparatus 1 includes: a wafer holder unit 20, a transfer unit 30, an intermediate stage unit 40, a first bonding unit 50A, a second bonding unit 50B, a substrate carrying unit 60, and a controller 80.

[0018]

The wafer holder unit 20 is for holding a semiconductor wafer 10. The wafer holder unit 20 is configured to hold the semiconductor wafer 10 divided into a plurality of semiconductor chips 11 onto a wafer stage 21 by such a method as vacuum-suctioning.

[0019]

Fig. 2 is a schematic side view for illustration of the wafer holder unit and the transfer unit. As illustrated in Fig. 2, a plunge-up unit 22 is provided within the wafer stage 21.

The plunge-up unit 22 is configured to plunge up one of the plurality of semiconductor chips 11 of the semiconductor wafer 10 upwardly (in the Z-axis direction) so as to make a difference in levels between this chip and the remaining semiconductor chips 11. Further, a rotational drive mechanism 23 is provided under the wafer stage 21. The rotational mechanism 23 is configured to make the wafer stage 21 rotate about the Z-axis direction.

[0020]

The transfer unit 30 illustrated in Fig. 1 is for transferring the semiconductor chip 11 and placing the semiconductor chip 11 on an intermediate stage 41 that will be later described. The transfer unit 30 includes a Y-drive mechanism 31 and a transfer head 32.

[0021]

The Y-drive mechanism 31 includes drive means such as a linear motor, and is capable of moving the transfer head 32 in the Y-axis direction.

[0022]

As illustrated in Fig. 2, a transfer tool 33 is attached to the transfer head 32. In addition, within the transfer head 32, there is provided a drive mechanism 34 capable of moving the transfer tool 33 in the X-axis direction and in the Z-axis direction.

[0023]

The transfer tool 33 is configured to pick up the semiconductor chip 11. When the semiconductor chip 11 is picked up, as illustrated in Fig. 2, the Y-drive mechanism 31 illustrated in Fig. 1 moves the transfer head 32 above the wafer stage 21 on which the semiconductor chip 11 is placed. The rotational drive mechanism 23 of the wafer holder unit 20 causes the semiconductor wafer 10 to rotate along with the wafer stage 21, and places the semiconductor chip 11 to be picked up under the transfer head 32. The drive mechanism 34 moves the transfer tool 33 down to a position with a predetermined distance from the semiconductor chip 11 to be picked up.

[0024]

The transfer tool 33 can be configured to include a suctioning collet, for example. In the case of such an example, the suctioning collet is able to pick up the semiconductor chip 11 by suctioning the semiconductor chip 11 plunged up by the plunge-up unit 22 of the wafer stage 21 using vacuum or the like.

[0025]

Further, the transfer tool 33 is configured to place the semiconductor chip 11. This will be described later in detail.

[0026]

In this embodiment, the example in which the transfer unit 30 includes the Y-drive mechanism 31, and the Y-drive mechanism 31 moves the transfer head 32 in the Y-axis direction is described. However, the present invention is not limited to

such an example. The transfer unit 30 include an XY-drive mechanism, for example, capable of moving the transfer head 32 in the X-axis direction and the Y-axis direction, so that the transfer head 32 can be moved in the X-axis direction in addition to the Y-axis direction.

[0027]

The intermediate stage unit 40 illustrated in Fig. 1 is for temporarily holding the semiconductor chip 11. The intermediate stage unit 40 includes the intermediate stage 41 and an X-drive mechanism 42.

[0028]

On the intermediate stage 41, the semiconductor chip 11 is placed by the transfer tool 33. The intermediate stage 41 is configured to fixedly hold the placed semiconductor chip 11 by vacuum-suctioning, for example.

[0029]

Fig. 3 is a schematic side view for illustration of the transfer unit and the intermediate stage unit. As illustrated in Fig. 3, the X-drive mechanism 42 is disposed under the intermediate stage 41. The X-drive mechanism 42 includes drive means such as a linear motor, and is capable of moving the intermediate stage 41 in the X-axis direction (first direction).

[0030]

By the X-drive mechanism 42, the intermediate stage 41 is moved between a first position P1 indicated by a solid line and a second position P2 indicated by an alternate long and short dash line, as illustrated in Fig. 1. The first position P1 of the intermediate stage 41 is a position at which the first bonding unit 50A is allowed to pick up the semiconductor chip 11 placed on the intermediate stage 41, the second position P2 of the intermediate stage 41 is a position at which the second bonding unit 50B is allowed to pick up the semiconductor chip 11 placed on the intermediate stage 41.

[0031]

When the semiconductor chip 11 is placed on the intermediate stage 41, the X-drive mechanism 42 moves the intermediate stage 41 to the first position P1 shown in Fig. 1, for example. The Y-drive mechanism 31 illustrated in Fig. 1 moves the transfer head 32 above the intermediate stage 41, as illustrated in Fig. 3. A drive mechanism 44 moves the transfer tool 33 that has picked up the semiconductor chip 11 down to a position with a predetermined distance from an upper surface of the intermediate stage 41. If the transfer tool 33 includes a suctioning collet, it is possible to place the semiconductor chip 11 on the intermediate stage 41 by the suctioning collet releasing suctioning of the semiconductor chip 11.

[0032]

Further, as illustrated in Fig. 1, the intermediate stage unit 40 is disposed between the transfer unit 30 and the first and the second bonding unit 50A and 50B, for example. With this, for example, the transfer unit 30, the intermediate stage unit 40, and the first and the second bonding unit 50A and 50B can be arranged in the Y-axis direction as illustrated in Fig. 1, thus in a compact manner.

[0033]

Each of the first bonding unit 50A and the second bonding unit 50B illustrated in Fig. 1 is for picking up the semiconductor chip 11 from the intermediate stage 41 and bonding the semiconductor chip 11 to a circuit substrate 15.

[0034]

The first bonding unit 50A includes a Y-drive mechanism 51A, a bonding head 52A, and a camera for chip 56A. Similarly, the second bonding unit 50B includes a Y-drive mechanism 51B, a bonding head 52B, and a camera for chip 56B.

[0035]

It should be noted that the configuration of the second bonding unit 50B is the same as the configuration of the first bonding unit 50A, and therefore in the following, only the configuration of the first bonding unit 50A will be described, and a description of the configuration of the second bonding unit 50B shall be omitted as appropriate.

[0036]

The Y-drive mechanism 51A includes drive means such as a linear motor, and is capable of moving the bonding head 52A in the Y-axis direction.

[0037]

Fig. 4 is a schematic side view for illustration of the intermediate stage unit and the first bonding unit. As illustrated in Fig. 4, a bonding tool 53A is attached to the bonding head 52A. In addition, within the bonding head 52A, there is provided a drive mechanism 54A capable of moving the transfer tool 33 in the X-axis direction and in the Z-axis direction, and a camera for substrate 55A capable of taking an image of the circuit substrate 15.

[0038]

The bonding tool 53A is configured to pick up the semiconductor chip 11. When the semiconductor chip 11 is picked up, the X-drive mechanism 42 moves the intermediate stage 41 to the first position P1 shown in Fig. 1. As illustrated in Fig. 4, the Y-drive mechanism 51A illustrated in Fig. 1 moves the bonding head 52A above the intermediate stage 41 on which the semiconductor chip 11 is placed. The drive mechanism 54A moves the bonding tool 53A down to a position with a predetermined distance from the semiconductor chip 11 to be picked up.

[0039]

The bonding tool 53A can be configured to include a vacuum hole for suctioning, for example. In the case of such an example, the semiconductor chip 11 can be picked up by the semiconductor chip 11 being vacuum-suctioned through the vacuum hole.

[0040]

Further, the bonding tool 53A is configured to perform bonding of the semiconductor chip 11. This will be described later in detail.

[0041]

The camera for chip 56A is for taking an image of the semiconductor chip 11. The camera for chip 56A is disposed between the intermediate stage unit 40 and the substrate carrying unit 60, and configured to take an image of a back surface of the semiconductor chip 11 picked up by the bonding tool 53A from a lower side of the semiconductor chip 11 (in the Z-axis direction).

[0042]

As illustrated in Fig. 1, the first bonding unit 50A and the second bonding unit 50B are arranged side by side, for example, in the X-axis direction (first direction). With this, the first bonding unit 50A and the second bonding unit 50B can be arranged in a compact manner, and it is possible to suppress an increase of a space.

[0043]

In this embodiment, the example in which the first bonding unit 50A includes the Y-drive mechanism 51A, and the Y-drive mechanism 51A moves the bonding head 52A in the Y-axis direction is described. However, the present invention is not limited to such an example. The first bonding unit 50A include an XY-drive mechanism, for example, capable of moving the bonding head 52A in the X-axis direction and the Y-axis direction, so that the bonding head 52A can be moved in the X-axis direction in addition to the Y-axis direction. Similarly, it is also preferable that the second bonding unit 50B includes an XY-drive mechanism, so that the bonding head 52B can be moved in the X-axis direction in addition to the Y-axis direction.

[0044]

Further, in this embodiment, the example in which the first bonding unit 50A includes the camera for chip 56A, and the second bonding unit 50B includes the camera for chip 56B is described. However, the present invention is not limited to such an example. For example, it is preferable that the bonding apparatus 1 includes the camera for chip 56A and the camera for chip 56B. Moreover, the bonding apparatus 1 is not limited to the example in which the camera for chip 56A and the camera for chip 56B are provided. For example, it is preferable that the camera for chip 56A and the camera for chip 56B is configured as a single camera for chip, and the bonding apparatus 1 includes this single camera for chip.

[0045]

The substrate carrying unit 60 illustrated in Fig. 1 carries the circuit substrate 15. The substrate carrying unit 60 includes a substrate stage 61 and a carrier rail 62.

[0046]

To the substrate stage 61, the circuit substrate 15 is fed by substrate feed means that is not illustrated. The substrate stage 61 is configured to fixedly hold the circuit substrate 15 by vacuum-suctioning, for example.

[0047]

The carrier rail 62 is configured to move the substrate stage 61 in a predetermined direction, for example, in the X-axis direction. Further, as illustrated in Fig. 1, the carrier rail 62 is able to move a plurality of substrate stages 61.

[0048]

When bonding of the semiconductor chip 11 to the circuit substrate 15 is performed, the carrier rail 62 moves the substrate stage 61 to a position at which the bonding tool 53A illustrated in Fig. 4 is able to perform bonding. The Y-drive mechanism 51A moves the bonding head 52A above the substrate stage 61 on which the circuit substrate 15 is placed. The drive mechanism 54A illustrated in Fig. 4 moves the bonding tool 53A downward. In the case in which the bonding tool 53A includes a vacuum hole, it is possible to perform bonding of the

semiconductor chip 11 to the circuit substrate 15 by the drive mechanism 54A pressing the semiconductor chip 11 suctioned through the vacuum hole against the circuit substrate 15 at a predetermined load.

[0049]

In this embodiment, the example in which the substrate carrying unit 60 includes a single carrier rail 62 is described. However, the present invention is not limited to such an example. For example, it is preferable that the substrate carrying unit 60 includes a plurality of carrier rails 62. In the case of such an example, the plurality of sets of carrier rails 62 are arranged in the Y-axis direction, and the Y-drive mechanism 51A is configured to move the bonding head 52A above the substrate stage 61 that is moved by any of the plurality of carrier rails 62. Further, the Y-drive mechanism 51B is also configured to move the bonding head 52A above the substrate stage 61 that is moved by any of the plurality of carrier rails 62.

[0050]

The controller 80 is connected to the wafer holder unit 20, the transfer unit 30, the intermediate stage unit 40, the first bonding unit 50A and the second bonding unit 50B, and the substrate carrying unit 60. The controller 80 is configured to control operations of these components and thus to be able to perform necessary processes for bonding. The controller 80 includes, for example, an interface (not shown) through which

transmission and reception of signals to and from the components described above such as the wafer holder unit 20, the transfer unit 30, the intermediate stage unit 40, the first bonding unit 50A, bonding unit 50B, and the substrate carrying unit 60. The controller 80 records a previously determined schedule, and is configured to perform control relating to the bonding operation based on the schedule (program).

[0051]

Further, the controller 80 is connected to an operation unit 82 through which control information is input and a display unit 84 on which the control information is output. With this, an operator is able to input necessary control information through the operation unit 82 while looking at a screen on the display unit 84. The controller 80 can be configured, for example, as a computer device having a CPU and a memory, and the memory records programs and data necessary for execution of processing necessary for bonding.

[0052]

Next, a method of bonding a semiconductor chip to a circuit substrate will be described with reference to Fig. 5 and Fig. 6.

[0053]

Fig. 5 is a flowchart showing one example of the bonding method according to this embodiment. As illustrated in Fig. 5, upon starting of a bonding process S10, the controller 80

first causes the Y-drive mechanism 31 to move the transfer head 32 to the wafer holder unit 20, and then the transfer tool 33 picks up the semiconductor chip 11 plunged up by the plunge-up unit 22 of the wafer stage 21 (S11).

[0054]

With this, the controller 80 determines whether or not movement of the intermediate stage 41 is necessary based on the previously determined schedule (S12).

[0055]

As a result of the determination in S12, if the movement of the intermediate stage 41 is necessary, the controller 80 causes the X-drive mechanism 42 to move the intermediate stage 41 (S13). In contrast, if the movement of the intermediate stage 41 is not necessary, the controller 80 does not perform the step in S13.

[0056]

Next, the controller 80 causes the Y-drive mechanism 31 to move the transfer head 32 from the wafer holder unit 20 to the intermediate stage unit 40, and the semiconductor chip 11 picked up by the transfer tool 33 is placed on the intermediate stage 41 (S14).

[0057]

Specifically, for example, when the first position P1 of the intermediate stage 41 is a position at which the semiconductor chip 11 can be placed on the intermediate stage

41 by the transfer tool 33, and if a current position of the intermediate stage 41 is the second position P2, the controller 80 moves the intermediate stage 41 from the second position P2 to the first position P1. However, if the current position of the intermediate stage 41 is the first position P1, the controller 80 does not move the intermediate stage 41, and leaves the intermediate stage 41 at the first position P1.

[0058]

As in the example described above, it is preferable that one of the first position P1 and the second position P2 is a position of the intermediate stage 41 at which placement by the transfer tool 33 of the transfer unit 30 is allowed. With this, in the placement of the semiconductor chip 11 on the intermediate stage 41, the intermediate stage 41 is required to be moved only when the position of the intermediate stage 41 is the other of the first position P1 and the second position P2. Therefore, it is possible to reduce a number of times of the movement of the intermediate stage 41.

[0059]

Next, the controller 80 determines whether or not movement of the intermediate stage 41 is necessary based on the previously determined schedule (S15).

[0060]

As a result of the determination in S15, if the movement of the intermediate stage 41 is necessary, the controller 80

causes the X-drive mechanism 42 to move the intermediate stage 41 (S16). In contrast, if the movement of the intermediate stage 41 is not necessary, the controller 80 does not perform the step in S15

[0061]

Next, based on the previously determined schedule, one of the first bonding unit 50A and the second bonding unit 50B picks up the semiconductor chip 11 placed on the intermediate stage 41 (S17).

[0062]

Specifically, for example, when the semiconductor chip 11 placed on the intermediate stage 41 is to be picked up by the first bonding unit 50A, based on the determination in S15, the controller 80 does not move the intermediate stage 41, and leaves the intermediate stage 41 at the first position P1. Then, in Step S17, the controller 80 causes the Y-drive mechanism 51A of the first bonding unit 50A to move the bonding head 52A to the intermediate stage unit 40, and the bonding tool 53A picks up the semiconductor chip 11 placed on the intermediate stage 41.

[0063]

In contrast, for example, when the semiconductor chip 11 placed on the intermediate stage 41 is to be picked up by the second bonding unit 50B, based on the determination in S15, the controller 80 moves the intermediate stage 41 from the first

position P1 to the second position P2 in the step in S16. Then, in Step S17, the controller 80 causes the Y-drive mechanism 51B of the second bonding unit 50B to move the bonding head 52B to the intermediate stage unit 40, and a bonding tool 53B picks up the semiconductor chip 11 placed on the intermediate stage 41.

[0064]

It should be noted that as an operation of the second bonding unit 50B is the same as an operation of the first bonding unit 50A, in the following description, the operation in which the first bonding unit 50A picks up the semiconductor chip 11 in the step in S17 will be described, and a description of the operation of the second bonding unit 50B shall be omitted as appropriate.

[0065]

Next, the controller 80 performs preprocessing for bonding (S18). In the preprocessing for bonding, for example, the controller 80 performs back surface recognition processing of causing the Y-drive mechanism 51A to move the bonding head 52A to a position of the camera for chip 56A, causing the camera for chip 56A to recognize a back surface of the semiconductor chip 11 picked up by the bonding tool 53A to detect a position of the back surface, and correcting a position, a posture, and the like of the semiconductor chip 11 based on a result of the detection. In the case of such an example, before the bonding

tool 53A picks up the semiconductor chip 11, the controller 80 performs substrate recognition processing of causing the Y-drive mechanism 51A moves the camera for substrate 55A of the bonding head 52A to a position of the substrate stage 61, and causing the camera for substrate 55A to recognize the circuit substrate 15 and a lead frame (not shown) on the substrate stage 61 to detect their positions.

[0066]

Next, the controller 80 causes the Y-drive mechanism 51A to move the bonding tool 53A of the bonding head 52A to the position of the substrate stage 61, and the bonding tool 53A performs bonding of the picked-up semiconductor chip 11 to the circuit substrate 15 placed on the substrate stage 61 (S19).

[0067]

Next, the controller 80 performs postprocessing for bonding (S20). In the postprocessing for bonding, for example, the controller 80 performs post-bonding processing of causing the Y-drive mechanism 51A to move the camera for substrate 55A of the bonding head 52A to the position of the substrate stage 61, and causing the camera for substrate 55A to recognize the semiconductor chip 11 bonded to the circuit substrate 15 to detect a position of the semiconductor chip 11.

[0068]

After the postprocessing for bonding in S20, the controller 80 terminates the bonding process S10.

[0069]

It should be noted that when bonding of a plurality of semiconductor chips 11 is performed to a single circuit substrate 15 by stacking or the like, the controller 80 repeats the steps from S11 to S20 until bonding of a predetermined number of semiconductor chips 11 is performed, and terminates the bonding process S10 upon completion of the bonding of the predetermined number of semiconductor chips 11.

[0070]

The controller 80 performs a processing cycle (unit processing cycle) of the bonding process S10 to the single circuit substrate 15, and performs the bonding process S10 to each of the plurality of circuit substrates 15.

[0071]

Here, the inventors of the present invention have found that a time period during which the transfer unit 30 and the intermediate stage unit 40 do not operate is long in the processing time of the bonding process S10. It is considered one reason of this is that as the operations of the first bonding unit 50A and the second bonding unit 50B, in particular, bonding in the step in S19, take remarkably long time as compared to the operations of the transfer unit 30 and the intermediate stage unit 40, the transfer unit 30 and the intermediate stage unit 40 need to wait for end of the operations of the first bonding unit 50A and the second bonding unit 50B.

[0072]

The inventors of the present invention have also found that the transfer unit 30 and the intermediate stage unit 40, in particular, the transfer unit 30, are considerably large in size, and the transfer unit 30 takes a large part in the space for the bonding apparatus 1.

[0073]

As a result, the inventors of the present invention have arrived at an idea of moving the intermediate stage 41 between the first position P1 at which the first bonding unit 50A is allowed to pick up the semiconductor chip 11 and the second position P2 at which the second bonding unit 50B is allowed to pick up the semiconductor chip 11. With this, as the intermediate stage 41 is able to pass (feed) the semiconductor chip 11 placed by the transfer unit 30 to both the first bonding unit 50A and the second bonding unit 50B, it is not necessary, unlike the first bonding unit 50A and the second bonding unit 50B, to provide two transfer units 30 and two intermediate stages 41, and only one transfer unit 30 and only one intermediate stage 41 are sufficient.

[0074]

Fig. 6 is a diagram for illustration of one example of the processing time in the bonding method according to this embodiment. In Fig. 6, it is assumed that at the start of the operation, the intermediate stage 41 is at the first position

P1, and the semiconductor chip 11 is already placed on the intermediate stage 41. Further, in Fig. 6, a lateral axis indicate time, and processing time of each of the transfer unit 30, the intermediate stage unit 40, the first bonding unit 50A, and the second bonding unit 50B in each step of the bonding process S10 shown in Fig. 5 is represented by a length of a corresponding rectangular (square) block. As illustrated in Fig. 6, in the bonding process S10 shown in Fig. 5, processing time T1 in which bonding is performed using the first bonding unit 50A is 3600 [ms]. Out of the processing time T1, processing time T30 for processing relating to the first bonding unit 50A is 2200 [ms], and processing time T33 for processing relating to bonding in Step S19 is 1000 [ms]. In contrast, processing time T2 in which bonding is performed using the second bonding unit 50B is 3600 [ms], and out of the processing time T2, processing time T40 for processing relating to the second bonding unit 50B is 2200 [ms], and processing time T43 for processing relating to bonding in Step S19 is 1000 [ms]. As described above, it is clear that the processing time T30 for processing relating to the first bonding unit 50A and the processing time T40 for processing relating to the second bonding unit 50B respectively take more than a half of the processing time T1 and T2 in the bonding process S10, and the processing time T33 for processing relating to bonding in Step S19 and the processing time T43 for processing relating to

bonding in Step S19 respectively take more than a quarter of the processing time T1 and T2 in the bonding process S10.

[0075]

Therefore, by providing the first bonding unit 50A and the second bonding unit 50B that pick up the semiconductor chip 11 from the intermediate stage 41 and bond the semiconductor chip to the circuit substrate 15, it is possible to allow the first bonding unit 50A and the second bonding unit 50B to concurrently perform bonding to different circuit substrates 15, respectively, as illustrated in Fig. 6.

[0076]

It should be noted that Fig. 6 shows that at 2100 [ms] and 4300 [ms], the placement by the transfer unit 30 in Step S14 is completed before the movement of the intermediate stage 41 in Step S13 is completed. However, in practice, the placement by the transfer unit 30 in Step S14 is completed only after the movement of the intermediate stage 41 in Step S13 is completed.

[0077]

As described above, according to this embodiment, by providing the first bonding unit 50A and the second bonding unit 50B that pick up the semiconductor chip 11 from the intermediate stage 41 and bond the semiconductor chip to the circuit substrate 15, it is possible to allow the first bonding unit 50A and the second bonding unit 50B to concurrently perform

bonding to different circuit substrates 15, respectively, as illustrated in Fig. 6. Therefore, as compared to a case in which only one bonding unit is provided, it is possible to reduce processing time for each of the circuit substrates 15. Further, by moving the intermediate stage 41 between the first position P1 at which the first bonding unit 50A is allowed to pick up the semiconductor chip 11 and the second position P2 at which the second bonding unit 50B is allowed to pick up the semiconductor chip 11, the intermediate stage 41 is able to pass (feed) the semiconductor chip 11 placed by the transfer unit 30 to both the first bonding unit 50A and the second bonding unit 50B. Therefore, it is not necessary, unlike the first bonding unit 50A and the second bonding unit 50B, to provide two transfer units 30 and two intermediate stages 41, and only one transfer unit 30 and only one intermediate stage 41 are sufficient. Thus, it is possible to suppress an increase of the space for the transfer unit 30 and the intermediate stage 41, to reduce a number of the components for the bonding apparatus 1, and thus to reduce manufacturing costs.

[0078]

It should be understood that the present invention can be applied with various modifications without being limited to the above embodiment, and.

[0079]

Further, the practical examples and application examples described by means of the embodiment of the present invention can be used in combinations, or with alterations or improvements as appropriate depending on the intended use, and the present invention is not limited to the above description of the embodiment. It is clear from the appended claims that aspects in such combinations, or with such alterations or improvements can also be included in the technical scope of the present invention.

Reference Signs List

[0080]

- 1: bonding apparatus
- 11: semiconductor chip
- 15: circuit substrate
- 30: transfer unit
- 41: intermediate stage
- 50A: first bonding unit
- 50B: second bonding unit
- S10: bonding process

CLAIMS

1. A bonding apparatus comprising:

an intermediate stage;

a transfer unit configured to transfer a semiconductor chip and to place the semiconductor chip on the intermediate stage; and

a first bonding unit and a second bonding unit each configured to pick up the semiconductor chip from the intermediate stage, and to bond the semiconductor chip to a circuit substrate, wherein

the intermediate stage moves between a first position and a second position, the first position being a position at which the first bonding unit is allowed to pick up the semiconductor chip, the second position being a position at which the second bonding unit is allowed to pick up the semiconductor chip.

2. The bonding apparatus according to claim 1, wherein

one of the first position and the second position is a position at which the transfer unit is allowed to place the semiconductor chip on the intermediate stage.

3. The bonding apparatus according to claim 1 or 2,

wherein

the first bonding unit and the second bonding unit are arranged side by side in a first direction, and

the intermediate stage moves along the first direction.

4. The bonding apparatus according to claim 1 or 2, wherein

the intermediate stage is disposed between the transfer unit and the first and the second bonding unit.

5. The bonding apparatus according to claim 1, further comprising:

a camera for chip configured to take an image of the semiconductor chip.

6. A bonding method comprising:

a transfer step of transferring a semiconductor chip and placing the semiconductor chip on an intermediate stage; and

a bonding step of causing a first bonding unit and a second bonding unit to pick up the semiconductor chip from the intermediate stage and to perform bonding of the semiconductor chip to a circuit substrate; and

a moving step of moving the intermediate stage between a first position and a second position, the first position being a position at which the first bonding unit is allowed to pick up the semiconductor chip, the second position being a position

at which the second bonding unit is allowed to pick up the semiconductor chip.