

DESCRIPTION

Title of Invention

SEMICONDUCTOR MANUFACTURING DEVICE, METHOD FOR MANUFACTURING
5 SEMICONDUCTOR DEVICE, AND PICKUP METHOD

Technical Field

[0001]

The present disclosure relates to a semiconductor
10 manufacturing device and can be applied to, for example, a
die bonder having a peeling unit.

Background Art

[0002]

Semiconductor device manufacturing steps include, as
15 one step, a step of peeling dies, which have been divided
from a wafer, from a dicing tape. In the peeling step, for
example, dies that have been pushed up from the reverse side
of the dicing tape by a pushup unit are peeled one by one
from the dicing tape held in a wafer supply unit and then,
20 are picked up by a suction nozzle such as collet provided in
a pickup head or bond head.

[0003]

The die pickup performance is improved by extending
the dicing tape held in a wafer ring and thereby expanding
25 the distance between the dies (Patent Literature 1).

Citation List

Patent Literature

[0004]

PTL 1: Japanese Unexamined Patent Application

5 Publication No. 2013-172122

Summary of Invention

Technical Problem

[0005]

As the pickup of the dies progresses, there occurs a
10 difference in the tension of the dicing tape between the
position of it from which the dies have been picked up and
the position on which the dies remain. Therefore, depending
on the peeling conditions of a peeling unit, such as pickup
unit, that assists in picking up dies from the dicing tape,
15 pickup failures may occur.

[0006]

The present disclosed object is to provide a
technology capable of reducing an occurrence of pickup
errors. The other objects and novel features other than the
20 above will be apparent from the description of the present
specification and accompanied drawings.

Solution to Problem

[0007]

Among this disclosure, a typical one of summary is
25 briefly described as follows.

That is, a semiconductor manufacturing device includes: a wafer holding table that holds a wafer ring holding a dicing tape attached to a wafer divided into dies; a peeling unit that assists in picking up the die from the dicing tape; and a control unit configured to set peeling conditions that are operation conditions of the peeling unit on the basis of peripheral information which is a die arrangement information in a peripheral region of a die to be picked up.

10 Advantageous Effects of Invention

[0008]

According to the present disclosure, it is possible to reduce the occurrence of pickup errors.

Brief Description of Drawings

15 [0009]

FIG. 1 is a schematic upper view showing a configuration example of a die bonder of an embodiment.

FIG. 2 is a view that describes a schematic configuration when viewed from an arrow A direction of FIG.

20 1.

FIG. 3 is a schematic cross-sectional view showing a main part of a wafer supply unit shown in FIG. 1.

FIG. 4 is a block diagram showing a schematic configuration of a die bonder control system shown in FIG. 1.

FIG. 5 is a flow chart showing a method for manufacturing a semiconductor device using the die bonder shown in FIG. 1.

FIG. 6 is an upper view of a peeling unit shown in FIG. 2.

FIG. 7 is a view schematically showing a fragmentary cross-section of the peeling unit shown in FIG. 2.

FIG. 8 is a view that describes a pushup sequence in one operation example of the peeling unit shown in FIG. 6.

FIG. 9 is a view showing one example of a block operation timing of the sequence of FIG. 8.

FIG. 10 is a view showing one example of a parameter table corresponding to the block operation timing of FIG. 9.

FIG. 11 is a view showing one example of a wafer map data in the embodiment.

FIG. 12 is a view showing wafer map data after dies of a first category are picked up from a wafer corresponding to the wafer map data of FIG. 11.

FIG. 13 is a view showing a pickup flow in the present embodiment.

FIG. 14 is a view that describes a peripheral information.

FIG. 15 is a view that describes a relationship between a visual field of a wafer recognition camera shown in FIG. 2 and the wafer.

FIG. 16 is a view showing examples of a peripheral information pattern.

Description of Embodiments

[0010]

5 Hereinafter, embodiments will be described with reference to the drawings. It should be noted that in the following description, the same components are indicated by the same reference numerals, and the repeated description thereof may be omitted. It should be noted that to make the
10 description more clearly, the drawings may be schematically represented for the widths, thicknesses, shapes, and the like of the respective portions as compared with the actual form. In addition, also between a plurality of mutual drawings, the dimension relationships between the respective
15 elements, the ratios between the respective elements, and the like do not always coincide with each other.

[0011]

 The configuration of a die bonder which is one embodiment of a semiconductor manufacturing device will be
20 described referring to FIG. 1 to FIG. 3. FIG. 1 is a schematic upper view showing a configuration example of the die bonder of the embodiment. FIG. 2 is a view that describes a schematic configuration when viewed from an arrow A direction of FIG. 1. FIG. 3 is a schematic cross-

sectional view showing a main part of a wafer supply unit shown in FIG. 1.

[0012]

A die bonder 1 roughly has a wafer supply unit 10, a pickup unit 20, an intermediate stage unit 30, a bonding unit 40, a carrier unit 50, a substrate supply unit 60, a substrate unloading unit 70, and a control unit (controller) 80. The Y2-Y1 direction is a front-back direction of the die bonder 1, the X2-X1 direction is a left-right direction, and the Z1-Z2 direction is a vertical direction. The wafer supply unit 10 and the bonding unit 40 are placed on the front side and the back side of the die bonder 1, respectively.

[0013]

The wafer supply unit 10 has a wafer cassette lifter 11, a wafer holding table 12, a peeling unit 13, and a wafer recognition camera 14.

[0014]

The wafer cassette lifter 11 moves up and down a wafer cassette (not shown) for housing therein a plurality of wafer rings WR to a wafer transfer height. A wafer correction chute (not shown) carries out alignment of the wafer rings WR to be supplied from the wafer cassette lifter 11. A wafer extractor (not shown) takes out the wafer rings WR from the wafer cassette and supplies them on the wafer

holding table 12 or takes them out from the wafer holding table 12 and houses them in the wafer cassette.

[0015]

The wafer holding table 12 has an expand ring 121 that
5 holds the wafer rings WR therein and a support ring 122 which is held by the wafer ring WR and horizontally positions a dicing tape DT. The peeling unit 13 is placed inside the support ring 122.

[0016]

10 The wafer W is caused to adhere (attached) onto the dicing tape DT and the wafer W is divided into a plurality of dies D. Between the wafer W and the dicing tape DT, an adhesive material DF in film form, which is called "die attach film (DAF)", has been attached. The adhesive material
15 DF cures by heating.

[0017]

The wafer holding table 12 moves in the X1-X2 direction and the Y1-Y2 direction by means of a drive unit not shown and moves the picked-up die D to the position of
20 the peeling unit 13. In addition, the wafer holding table 12 turns the wafer ring WR in the XY plane by means of the drive unit not shown. The peeling unit 13 moves up and down by means of the drive unit not shown. The peeling unit 13 peels the die D from the dicing tape DT. The wafer holding
25 table 12 and the peeling unit 13 configure a pickup device

(semiconductor manufacturing device). The pickup device may include the pickup unit 20.

[0018]

The wafer holding table 12 lowers the expand ring 121
5 having the wafer ring WR therein at the time of pushing up
the die D. At this time, since the support ring 122 does
not lower, the dicing tape DT held in the wafer ring WR
extends to widen the distance between the dies D. This
prevents the interference or contact between the dies D and
10 create the conditions that facilitate separation and pushup
of individual dies. Combination of the expand ring 121 and
the support ring 122 is called "expander". The peeling unit
13 pushes up the die D from underneath thereof to proceed
the peeling of the die D and thereby improves the die-D
15 pickup performance of the collet.

[0019]

The wafer recognition camera 14 recognizes the pickup
position of a die D to be picked up from the wafer W or
carries out surface inspection of the die D.

20 [0020]

The pickup unit 20 has a pickup head 21 and a Y drive
unit 23. The pickup head 21 is provided with a collet 22
that adsorbs and holds the peeled die D at the tip thereof.
The pickup head 21 picks up the die D from the wafer supply
25 unit 10 and places it on the intermediate stage 31. The Y

drive unit 23 moves the pickup head 21 in the Y1-Y2 direction. The pickup unit 20 has drive units (not shown) that carry out lifting/lowering, rotation, and X-direction move of the pickup head 21, respectively.

5 [0021]

The intermediate stage unit 30 has an intermediate stage 31 on which the die D is placed and a stage recognition camera 34 for recognizing the die D on the intermediate stage 31. The intermediate stage 31 is
10 equipped with a suction port that adsorbs the die D placed on the stage. The die D placed on the intermediate stage 31 is temporarily held thereon. The intermediate stage 31 is a stage on which the die D is placed and at the same time, is a pickup stage from which the die D is picked up.

15 [0022]

The bonding unit 40 has a bond head 41, a Y drive unit 43, a substrate recognition camera 44, and a bond stage 46. The bond head 41 is provided with a collet 42 that adsorbs and holds the die D at the tip thereof. The Y drive unit 43
20 moves the bond head 41 in the Y1-Y2 direction. The substrate recognition camera 44 picks up the image of a position recognition mark (not shown) of a substrate S and recognizes the bond position. The substrate S described herein has a plurality of product areas (hereinafter be
25 called "package areas P") which will finally be one package.

The position recognition mark is provided in each of the package areas P. The bond stage 46 is elevated when the die D is placed on the substrate S and it supports the substrate S from below. The bond stage 46 can fix the substrate S thereto by means of a suction port (not shown) for vacuum adsorption of the substrate S. The bond stage 46 has a heating unit (not shown) that heats the substrate S. The bonding unit 40 has drive units (not shown) that carry out lifting/lowering, rotation, and X-direction move of the bond head 41, respectively.

[0023]

By such a configuration, the bond head 41 corrects the pickup position or posture based on the image pickup data of the stage recognition camera 34 and picks up the die D from the intermediate stage 31. Then, the bond head 41 bonds the die on the package area P of the substrate S or bonds it in stack form to another die already bonded onto the package area P of the substrate S based on the image pickup data of the substrate recognition camera 44.

[0024]

The carrier unit 50 has a carrying claw 51 that grasps and carries the substrate S and a carrying lane 52 through which the substrate S moves. The substrate S moves in the X direction by driving a nut, which is not shown, of the carrying claw 51 provided in the carrying lane 52 with a

ball screw, which is not shown, provided along the carrying lane 52. By such a configuration, the substrate S moves from the substrate supply unit 60 to the bond position along the carrying lane 52 and after bonding, moves to the
5 substrate unloading unit 70 and is delivered to the substrate unloading unit 70.

[0025]

The substrate supply unit 60 takes out the substrate S, which has been housed in a carrying jig and loaded, from the
10 carrying jig and supplies the carrier unit 50 with it. The substrate unloading unit 70 houses the substrate S, which has been carried by the carrier unit 50, in the carrying jig.

[0026]

Next, the control unit 80 will be described referring
15 to FIG. 4. FIG. 4 is a block diagram showing a schematic configuration of the die bonder control system shown in FIG. 1.

[0027]

A control system 8 is equipped with the control unit
20 (controller) 80, a drive unit 86, a signal unit 87, an optical system 88, and the like. The control unit 80 roughly has a control processing device 81 mainly comprised of CPU (Central Processing unit), a memory device 82, an input/output device 83, a bus line 84, and a power supply
25 unit 85. The memory device 82 has a main memory device 82a

and an auxiliary memory device 82b. The main memory device 82a is comprised of RAM (Random Access Memory) that stores therein a processing program and the like. The auxiliary memory device 82b is comprised of HDD (Hard Disk Drive), SSD (Solid State Drive), or the like that stores therein control data, image data, and the like necessary for the control.

[0028]

The input/output device 83 has a monitor 83a that displays the condition of the device, information, and the like, a touch panel 83b from which the instruction of an operator is input, a mouse 83c for operating the monitor 83a, and an image pickup device 83d that captures therein the image data from the optical system 88. The input/output device 83 further has a motor control device 83e and an I/O signal control device 83f. The motor control device 83e controls the XY table (not shown) of the wafer supply unit 10, the ZY drive shaft of a bond head table, the drive unit of the peeling unit 13, and the like. The I/O signal control device 83f introduces or controls a signal from the signal unit 87 including various sensors and a switch, a volume, and the like that control the brightness of a lighting devices. The optical system 88 includes a wafer recognition camera 14, a stage recognition camera 34, and a substrate recognition camera 44. The control processing device 81 takes therein necessary data via the bus line 84,

carries out calculation, and controls the pickup head 21 or the like or sends information to the monitor 83a or the like.

[0029]

A part of the semiconductor device manufacturing steps
5 (method for manufacturing a semiconductor device) using the die bonder 1 will hereinafter be described referring to FIG. 5. FIG. 5 is a flow chart showing method for manufacturing the semiconductor device using the die bonder shown in FIG. 1. In the following description, operation of the
10 individual units configuring the die bonder 1 is controlled by the control unit 80.

[0030]

(Wafer loading step: Step S1)

A wafer cassette (not shown) having the wafer ring WR
15 housed therein is put in the wafer cassette lifter 11. The wafer supply unit 10 takes out the wafer ring WR from the wafer cassette filled with the wafer ring WR and loads it in the wafer holding table 12. It is to be noted that with regard to the wafer W, dies are each inspected in advance by
20 an inspection device such as prober and wafer (category) map data showing the grade of the dies different in electrical properties and defective dies have been formed in advance. This wafer map data is stored in the memory device of the control unit 80.

25 [0031]

(Substrate loading step: Step S2)

A carrying jig having the substrate S housed therein is put in the substrate supply unit 60. The substrate supply unit 60 takes out the substrate S from the carrying
5 jig. The substrate S thus taken out is loaded in the bonding unit 40 via the carrier unit 50.

[0032]

(Pickup step: Step S3)

After Step S1, the wafer holding table 12 is moved to
10 allow a desired die D to be picked up from the dicing tape DT. The die D is photographed by the wafer recognition camera 14 and based on the image data thus obtained by photographing, the positioning and surface inspection of the die D are performed. By the image processing of the image
15 data, deviation amounts (X, Y, and θ directions) of the die D on the wafer holding table 12 from the die position reference point of the die bonder are calculated and positioning is performed. With regard to the die position reference point, a predetermined position of the wafer
20 holding table 12 is retained in advance as an initial setting. The surface inspection of the die D is achieved by the image processing of the image data.

[0033]

The positioned die D is peeled from the dicing tape DT
25 by means of the peeling unit 13 and the pickup head 21. The

die D peeled from the dicing tape DT is carried to and placed on the intermediate stage 31 while being adsorbed and held by the collet 22 provided on the pickup head 21.

[0034]

5 The die D on the intermediate stage 31 is photographed with the stage recognition camera 34 and the positioning and surface inspection of the die D are performed based on the image data obtained by photographing. By image processing of the image data, the deviation amounts (X, Y, and θ

10 directions) of the die D on the intermediate stage 31 from the die position reference point of the die bonder are calculated, followed by positioning. With regard to the die position reference point, a predetermined position on the intermediate stage 31 is retained in advance as an initial

15 setting of the device. The surface inspection of the die D is achieved by the image processing of the image data.

[0035]

 The pickup head 21 that has carried the die D to the intermediate stage 31 is returned to the wafer supply unit

20 10. A next die D is peeled from the dicing tape DT according to the procedure described above and then dies D are peeled one by one from the dicing tape DT according to the similar procedure.

[0036]

25 (Bonding step: Step S4)

The substrate S is carried to the bond stage 46 by the carrier unit 50. The substrate S placed on the bond stage 46 is photographed with the substrate recognition camera 44 and positioning and surface inspection of the substrate S are performed based on the image data obtained by photographing. The deviation amounts (X, Y, and θ directions) of the substrate S from the substrate position reference point of the die bonder 1 are calculated by image processing of the image data. With regard to the substrate position reference point, the predetermined position of the bonding unit 40 is retained in advance as an initial setting of the device. By image processing of the image data, the surface inspection of the substrate S is performed.

[0037]

The adsorption position of the bonding head 41 is corrected based on the deviation amounts of the die D on the intermediate stage 31, which have been calculated in the step S3, and the die D is adsorbed by the collet 42. The die D is bonded to a predetermined position of the substrate S supported on the bond stage 46 by means of the bond head 41 which has adsorbed the die D from the intermediate stage 31. The predetermined position of the substrate S described herein is any of a package area P of the substrate S, an area on which an element has already been placed and another element is added by bonding, and a bond area of elements to

be bonded in stack form. The die D bonded to the substrate S is photographed with the substrate recognition camera 44 and based on the image data thus obtained by photographing, an inspection is performed to find whether the die D is
5 bonded to a desired position or not.

[0038]

The bond head 41 that has bonded the die D to the substrate S is returned to the intermediate stage 31. According to the procedure described above, a next die is
10 picked up from the intermediate stage 31 and bonded to the substrate S. The aforesaid procedure is repeated to bond a die D to all the package areas P of the substrate S.

[0039]

(Substrate unloading step: Step S5)

15 The substrate S to which the die D has been bonded is carried to the substrate unloading unit 70. In the substrate unloading unit 70, the substrate S is taken out from the carrying claw 51 and is housed in a carrying jig. From the die bonder 1, the carrying jig having the substrate
20 S housed therein is unloaded.

[0040]

As described above, the die D is mounted on the substrate S and is unloaded from the die bonder 1. Then, for example, the carrying jig having, housed therein, the
25 substrate S on which the die D has been mounted is carried

to a wire bonding step and the electrode of the die D is electrically connected to the electrode of the substrate S via an Au wire or the like. Then, the substrate S is carried to a molding step and the die D and the Au wire are
5 sealed with a molding resin (not shown) to complete a semiconductor package.

[0041]

Next, the peeling unit 13 will be described referring to FIG. 6 and FIG. 7. FIG. 6 is an upper view of the
10 peeling unit shown in FIG. 2. FIG. 7 is a view schematically showing a fragmentary cross-section of the peeling unit shown in FIG. 2.

[0042]

In the peeling unit 13, a cylindrical dome 132 is
15 provided with a block unit 131. The dome 132 has, at the upper-surface center portion thereof, an opening 1321 that allows the up-and-down movement of the block unit 131. The dome 132 has, in the outside periphery of the upper-surface opening 1321 thereof, a plurality of suction ports 1322 and
20 a plurality of grooves 1323 that link the suction ports 1322 to each other. When the peeling unit 13 is elevated to bring the upper surface thereof into contact with the back surface of the dicing tape DT, the pressure in the suction port 1322 is reduced by a suction mechanism not shown. At

this time, the back surface of the dicing tape DT is sucked downwards to adhere to the upper surface of the dome 132.

[0043]

The block unit 131 has blocks BLK1 to BLK4 that push
5 the dicing tape DT upwards. The outer three blocks BLK1 to BLK3 are rectangular and have a rectangular opening that penetrates in the Z1 to Z2 direction. The innermost block BLK4 has a quadrangular prism form. The first block BLK1 has, inside thereof, the second block BLK2 smaller in size
10 than the first block. The second block BLK2 has, inside thereof, the third block BLK3 smaller in size than the second block BLK2. The third block BLK3 has, inside thereof, the fourth block BLK4 smaller in size than the third block BLK3.

15 [0044]

Among the four blocks BLK1 to BLK4, the outermost peripheral block BLK1 has a shape slightly smaller in size than the periphery of the die D to be peeled. Since the corner portion which will be the upper surface periphery of
20 the block BLK1 is slightly inside the outer edge of the die D, the force for peeling the die D from the dicing tape DT can be concentrated on the position (outermost peripheral portion of the die D) which will be a starting point of their peeling.

25 [0045]

As shown in FIG. 7, the blocks BLK1 to BLK4 can move up and down independently by drive shafts ND1 to ND4 of the drive unit 133. For example, the drive shafts ND1 to ND4 are each comprised of a motor and a plunger mechanism that
5 converts the rotation of the motor into up-and-down movement.
[0046]

Next, a setting method and control of the operation of the peeling unit 13 will be described.
[0047]

10 Based on a parameter table, the control unit 80 is configured to control the drive shafts ND1 to ND4 that drive the blocks BLK1 to BLK4, respectively. The operation of the blocks BLK1 to BLK4 is controlled according to push-up conditions (peeling conditions) such as the time or time lag
15 (TL) of the step, lifting or lowering speed (V) of the block, height (H) of the block, and the like, each set for each step in the parameter table. The term "time lag" as used herein means an operation time lag (interval time) for adjusting the processing time between the blocks. In other
20 words, the time lag is a period of time from completion of the lifting or lowering of the block in each step to starting of the lifting or lowering of a block in the next step.
[0048]

A user may set the parameter table, for example, by inputting a setting value in the item of a time chart recipe by using a GUI (Graphical User Interface). The user may also set the parameter table by preparing a plurality of time chart recipes different in setting item in advance, selecting one time chart recipe from the plurality of time chart recipes by using GUI, and inputting a setting value in the item of the selected time chart recipe. The user may also set the parameter table by sending, by data communication, a time chart recipe in which a setting value has been input in advance from an external device to a semiconductor manufacturing device such as die bonder; or installing the time chart recipe from an external memory device to the semiconductor manufacturing device. Examples of the external memory device include magnetic tapes, magnetic disks such as flexible disk and hard disk, optical disks such as CD and DVD, magneto-optical disks such as MO, and semiconductor memories such as USB memory and memory card. The control unit 80 can rewrite (set) the parameter table in real time based on the information obtained from a sensor or an image of a recognition camera to change the push-up operation (pickup conditions).

[0049]

As described above, the operation of each of the blocks BLK1 to BLK4 of the peeling unit 13 can be set freely

in the push-up operation step according to the setting of the parameter table and therefore the peeling unit 13 can perform various operations.

[0050]

5 For example, the peeling unit 13 can perform a pyramid-shape forming operation by pushing up the blocks BLK1 to BLK4 simultaneously, then pushing up the blocks BLK2 to BLK4 simultaneously, then pushing up the blocks BLK3 and BLK4 simultaneously, and then pushing up the block BLK4. In
10 addition, the peeling unit 13 can perform an operation of pushing up the blocks BLK1 to BLK4 simultaneously and then lowering the block BLK1, the block BLK2, and the block BLK3 in order of mention.

[0051]

15 An operation example of the peeling unit 13 will next be described referring to FIG. 8 to FIG. 10. FIG. 8 is a view that describes the pushup sequence in one operation example of the peeling unit shown in FIG. 6. FIG. 9 is a view showing one example of the block operation timing of
20 the sequence of FIG. 8. FIG. 10 is a view showing one example of a parameter table corresponding to the block operation timing of FIG. 9.

[0052]

 The pickup operation starts with a target die D on the
25 dicing tape DT being positioned by the peeling unit 13 and

the collect 22. After completion of the positioning, the dicing tape DT is adsorbed to the upper surface of the peeling unit 13 by vacuuming via spaces between the suction port 1322 of the peeling unit 13 and the blocks BLK1 to BLK4.

5 At this time, the height of the upper surface of the blocks BLK1 to BLK4 is the same (initial position) as the height of the upper surface of the dome 132. Under the above state, vacuum is supplied from a vacuum supply source not shown in this drawing and the collet 22 lowers toward the device
10 surface of the die D while vacuuming to land on the upper surface of the die D.

[0053]

Then, the blocks BLK1 to BLK4 simultaneously rise to a predetermined height (h_1) at a predetermined speed (s_1) and
15 reach the first state shown in A of FIG. 8. As shown in FIG. 9, supposing that the time necessary for the blocks BLK1 to BLK4 to reach h_1 is t_1 , the following equation holds: $t_1 = h_1/s_1$. Then, the blocks wait for a predetermined time (t_2). Although the die D elevates while being sandwiched between
20 the collect 22 and the blocks BLK1 to BLK4, there occurs tension around the die D because the vacuum adsorption of the peripheral portion of the dicing tape DT to the suction port 1322 of the dome 132, which is the periphery of the peeling unit 13, still continues. This results in starting
25 of the peeling of the dicing tape DT around the die D.

[0054]

Subsequently, the outermost peripheral block BLK1 lowers to the height equal to or lower than the height of the upper surface of the dome 132 at a constant speed (s_2) into a second state shown in B of FIG. 8. Here, as shown in FIG. 9, supposing that the time necessary for the block BLK1 to reach a predetermined height ($-h_2$) is t_3 , the following equation holds: $t_3 = (h_1 + h_2) / s_2$.

[0055]

10 After a predetermined time (T_{10}) has passed since lowering of the outermost peripheral block BLK1 is started, the second block BLK2, together with the lowering of the outermost peripheral block BLK1, lowers at a constant speed (s_2) to the height equal to or lower than the height of the upper surface of the dome 132 into a third state shown in C of FIG. 8. Here, since the second block BLK2 lowers to the height of the upper surface of the dome 132, it loses the support by the dicing tape DT and peeling of the dicing tape DT proceeds further by the tension of the dicing tape DT.

20 [0056]

After a predetermined time (t_{11}) has passed since the lowering of the second block BLK2 is started, the third block BLK3, together with the lowering of the second block BLK2, lowers at a constant speed (s_2) to the height equal to or lower than the height of the upper surface of the dome

25

132 into a fourth state shown in D of FIG. 8. Here, since the third block BLK3 lowers to the height of the upper surface of the dome 132, it loses the support by the dicing tape DT and the peeling of the dicing tape DT proceeds further by the tension of the dicing tape DT. By the aforesaid operation, the die D is peeled from the dicing tape DT except for a place where the dicing tape DT is in contact with the block BLK4.

[0057]

10 After a predetermined time (t_6) has passed since the lowering of the third block BLK3 is stopped, the blocks BLK1 to BLK3 rise at a constant speed (s_3) and with the rise of the collet 22, the fourth block BLK4 lowers at a constant speed (s_4) into the initial position. Here, supposing that
15 the time necessary for the blocks BLK1 to BLK3 to reach the initial position is t_8 , the following equation holds: $t_8 = h_2/s_3$, while supposing that the time necessary for the block BLK4 to reach the initial position is t_9 , the following equation holds: $t_9 = h_1/s_4$. By the aforesaid operation, the
20 peeling operation of the die D from the dicing tape DT is completed. The peeling unit 13 assists in peeling some of the dies D from the dicing tape DT and picking up the dies D from the dicing tape DT by means of the collet 22.

[0058]

The operation based on the parameter table shown in FIG. 10 will next be described in detail. In FIG. 10, TL means a time lag, V means a speed, and H means a height.

[0059]

5 (1) Block BLK1

The time lag of the first step (STEP1) is t_2 and the block BLK1 rises to a height h_1 at a speed s_1 from the start of the first step and keeps its state at the height h_1 . The first step (STEP1) of the block BLK1 corresponds to the first state shown in FIG. 8.

[0060]

The time lag of the second step (STEP2) is $(t_4+t_5+t_6)$ and the block BLK1 lowers to a height $-h_2$ at a speed s_2 from the start of the second step and keeps its state at the height $-h_2$. The second step (STEP2) of the block BLK1 corresponds to the second state to the fourth state shown in FIG. 8.

[0061]

The time lag of the third step (STEP3) is t_9 and the block BLK1 rises to the initial position (height is 0) at a speed s_3 from the start of the third step.

[0062]

(2) Block BLK2

The time lag of the first step (STEP1) is (t_2+t_{10}) and the block BLK2 rises to the height h_1 at the speed s_1 from

the start of the first step and keeps its state at the height h_1 . The first step (STEP1) of the block BLK2 corresponds to the first state and the second state shown in FIG. 8.

5 [0063]

The time lag of the second step (STEP2) is (t_5+t_6) and the block BLK2 lowers to the height $-h_2$ at the speed s_2 from the start of the second step and keeps its state at the height $-h_2$. The second step (STEP2) of the block BLK2
 10 corresponds to the third state and the fourth state shown in FIG. 8.

[0064]

The time lag of the third step (STEP3) is t_9 and the block BLK2 rises to the initial position (height is 0) at a
 15 speed s_3 from the start of the third step.

[0065]

(3) Block BLK3

The time lag of the first step (STEP1) is $(t_2+t_{10}+t_{11})$ and the block BLK3 rises to the height h_1 at the speed s_1
 20 from the start of the first step and keeps its state at the height h_1 . The first step (STEP1) of the block BLK3 corresponds to the first state, the second state, and the third state shown in FIG. 8.

[0066]

The time lag of the second step (STEP2) is t_6 and the block BLK3 lowers to the height $-h_2$ at the speed s_2 from the start of the second step and keeps its state at the height $-h_2$. The second step (STEP2) of the block BLK3 corresponds
5 to the fourth state shown in FIG. 8.

[0067]

The time lag of the third step (STEP3) is t_9 and the block BLK3 rises to the initial position (height is 0) at the speed s_3 from the start of the third step.

10 [0068]

(4) Block BLK4

The time lag of the first step (STEP1) is $(t_2+t_3+t_4+t_5+t_6)$ and the block BLK4 rises to the height h_1 at the speed s_1 from the start of the first step and keeps
15 its state at the height h_1 . The first step (STEP1) of the block BLK4 corresponds to the first state, the second state, the third state, and the fourth state shown in FIG. 8.

[0069]

The time lag of the second step (STEP2) is 0 and the
20 block BLK4 lowers to the initial position (height is 0) at the speed s_4 from the start of the second step.

[0070]

The wafer map data will next be described referring to FIG. 11 and FIG. 12. FIG. 11 is a view showing one example
25 of wafer map data in the embodiment. FIG. 12 is a view

showing wafer map data after dies of the first category are picked up from the wafer corresponding to the wafer map data of FIG. 11.

[0071]

5 As described above, the wafer map data include, as shown in FIG. 11, data showing the grade of the die and the defective die. The grades discriminated here are, on the drawing, the first category denoted with "1" and the second category denoted with "2". The die denoted with "9" on the
10 drawing is a defective one.

[0072]

When the dies are picked up in grades (categories), for example, all the dies of the first category may be picked up and then, the dies of the second category may be
15 picked up. The wafer map data after the pickup of the dies of the first category is completed are as shown in FIG. 12. In other words, at the start of picking up the dies of the second category, the wafer has many spaces and the tension of the dicing tape around the dies to be picked up decreases.
20 When after completion of the pickup of the dies of the first category, the dies of the second category are picked up under conditions similar to those for the dies of the first category, pickup errors may happen.

[0073]

Not only in the case where the dies are picked up in groups but also in any case where the dies are picked up under similar peeling conditions from start (there are many dies) to finish (there are fewer dies), pickup errors are likely to happen. For example, pickup errors are likely to happen when dies are picked up under similar peeling conditions from start to finish, though the number of the dies decreases as the pickup operation progresses. There may be a case where a wafer is unloaded during the pickup operation for it and then, it is loaded again. In the aforesaid case, a ratio of the dies which have been loaded decreases. When pickup is performed under peeling conditions similar to those for a wafer having a larger die ratio, pickup errors are likely to occur.

15 [0074]

In the embodiment, therefore, pickup may be performed under peeling conditions changed based on the peripheral information of a die to be picked up. This will hereinafter be described referring to FIG. 11 to FIG. 16. FIG. 13 is a view showing a pickup flow in the present embodiment. FIG. 14 is a view that describes the peripheral information. FIG. 15 is a view that describes the relationship between the visual field of the wafer recognition camera shown in FIG. 2 and the wafer. FIG. 16 is a view showing examples of the

peripheral information pattern. The steps described below are performed in the control unit 80.

[0075]

(Step S11: setting of peripheral information)

5 The pickup information showing which position of a die of a wafer is picked up is set and is retained in a memory device. The pickup information is set or renewed before pickup operation for each pickup. The pickup information is set based on the wafer map data.

10 [0076]

 The pickup information immediately after a die is picked up is information on the position having no die thereon. For example, suppose that a die Ds on the upper right of the wafer map data shown in FIG. 11 is picked up.

15 The die Ds belongs to the first category and the pickup information immediately after the die Ds is picked up is information on the position of the die Ds. Then, whenever pickup of the die of the first category is repeated, the pickup information is renewed and after the pickup of the

20 dies of the first category is finished, the pickup of dies of the second category is started. The pickup information immediately before the dies of the second category are picked up is information on the dies of the first category shown in FIG. 11. In other words, the pickup information is

25 information on the blank (white) position of the wafer map

data shown in FIG. 12. The wafer map data shown in FIG. 12 is also pickup information. The pickup information varies with the pickup operation.

[0077]

5 Based on the pickup information, the peripheral information of a die Dp (a die to be picked up) which will be picked up is set. The peripheral information includes arrangement information of dies in a peripheral region of the die Dp to be picked up, such as number, ratio, or
10 position. For example, the peripheral information on the die Dp to be picked up which is shown in FIG. 12 is presence or absence of a die in a peripheral region of the die Dp to be picked up and it is shown in FIG. 14. In FIG. 14, dies are present at three hatched places and there are no dies at
15 un-hatched five places. In FIG. 14, the peripheral region of the die Dp to be picked up is a region adjacent to the die Dp to be picked up and it corresponds to a range of 3×3 with the die Dp to be picked up as the center. The peripheral region of the die Dp to be picked up may
20 correspond to a range of 5×5 or 7×7 with the die Dp to be picked up as the center.

[0078]

A setting example of the peripheral information based on the pickup information has been described above, but it
25 may be set based on the presence or absence of a die

recognized using the image data of the wafer recognition camera.

[0079]

As shown in FIG. 15, when the die Dp to be picked up
5 is placed at the center of a visual field IF of the wafer
recognition camera 14, at least dies adjacent to the die Dp
to be picked up are included in the visual field IF of the
wafer recognition camera 14. The die Dp to be picked up is
10 photographed with the wafer recognition camera 14 to obtain
image data. By recognizing the presence or absence of a die
based on the image data thus obtained, the information on
the presence or absence of dies around the die Dp to be
picked up can be obtained. In such a manner, the peripheral
information can be set.

15 [0080]

(Step S12: setting of peeling conditions)

Peeling conditions are set based on the peripheral
information. The pickup conditions are set for each die to
be picked up. The peeling conditions are sometimes not
20 changed, depending on the peripheral information. The term
"peeling conditions" as used herein means, for example, the
height (h1), speed (s1), and time lag (t2, t2+t10,
t2+t10+t11, or t2+t3+t4+t5+t6) of the blocks BLK1 to BLK4,
as shown in FIG. 10.

25 [0081]

When the number of dies around the die Dp to be picked up is small, the tension of the dicing tape DT around the die Dp to be picked up decreases. In this case, a change in the peeling conditions is required. For example, the

5 tension of the dicing tape DT around the die Dp to be picked up can be increased by raising the pushup height (h1) or increasing the speed (s1). The die Dp to be picked up can be peeled from the dicing tape DT even if the tension is small, by prolonging the time lag (t2, t2+t10, t2+t10+t11,

10 or t2+t3+t4+t5+t6). In other words, peeling conditions are set to facilitate peeling of the die Dp to be picked up.

[0082]

The peeling conditions may be changed based on the arrangement pattern (patterned peripheral information) of a

15 die as shown in FIG. 16. In FIG. 16, an un-hatched place around the die Dp to be picked up has no die thereat and a hatched place has a die thereat. FIG. 16 does not include all the die arrangement patterns. A change in the peeling conditions is not required for each of the die arrangement

20 patterns shown in FIG. 16.

[0083]

A1 is an arrangement pattern in which the die Dp to be picked up has no die at the adjacent periphery thereof. E5

is an arrangement pattern in which the die Dp to be picked

25 up has a die at any adjacent periphery thereof.

[0084]

A2 to A5 is an example of an arrangement pattern in which the die Dp to be picked up has a die in the periphery adjacent to the corner thereof and the number of the dies is
 5 larger in the order of A2 to A5. In other words, the tension of the dicing tape DT in the periphery of the die Dp to be picked up is larger in the order of A2 to A5.

[0085]

Compared with A1, B1, C1, D1, and E1 are examples of
 10 an arrangement pattern having a die in the periphery adjacent to the side of the die Dp to be picked up and the number of dies is larger in the order of B1, C1, D1, and E1. In other words, the tension of the dicing tape DT in the periphery of the die Dp to be picked up is larger in the
 15 order of B1, C1, D1, and E1.

[0086]

In the A1 pattern, the tension of the dicing tape DT in the periphery of the die Dp to be picked up is smallest and in the E5 pattern, the tension of the dicing tape DT in
 20 the periphery of the die Dp to be picked up is largest.

[0087]

(Step S13: pickup)

Under the pickup conditions thus set, the block unit
 131 of the peeling unit 13 is actuated to peel the die D

from the dicing tape DT and the die D is picked up by means of the pickup head 21.

[0088]

(Step S14: determination)

- 5 Determine whether all the dies to be picked up are picked up or not (the pickup is completed). When the pickup is not completed (in the case of NO), return to Step S12. When the pickup is completed (YES), finish this procedure.

[0089]

- 10 According to the present embodiment, the peeling conditions are changed based on the peripheral information showing the peripheral state of the die Dp to be picked up. The peeling conditions of each die to be picked up are optimized so that pickup errors can be reduced.

15 [0090]

Due to a reduction in pickup errors, the shutdown frequency of the device can be reduced. This enables an increase in the device operation time and improvement in MTBA (Mean Time Between Attentions).

20 [0091]

The disclosure made by the present disclosers has been described above specifically based on the embodiment, but it is needless to say that the present disclosure is not limited to the aforesaid embodiment but can be changed in
25 various ways.

[0092]

In the embodiment, an example of a peeling unit comprised of pushing blocks that move blocks up and down has been described. The peeling unit is not limited to the
5 aforesaid one but it may be a unit that assists pickup and can change peeling conditions. For example, the block may be replaced by a needle. The peeling unit may also be a unit that slides a block or a plate.

[0093]

10 The peeling unit may also be a unit that peels a die from a dicing tape by heat (heating and melting), an ultraviolet (UV) light (chemical modification by light irradiation), or a laser light (heating and melting by light irradiation). When the die D_p to be picked up has fewer
15 dies in the periphery thereof, the peeling may be achieved by increasing the heating temperature, increasing the irradiation intensity of a UV light or a laser light, or prolonging an irradiation time.

[0094]

20 In the embodiment, an example where the number of blocks is four has been described, but the number of blocks may be less than or more than four, depending on the die size or the like.

[0095]

In the embodiment, an example of using a die attach film has been described, but the die attach film may be replaced by a preform unit that applies an adhesive to a substrate.

5 [0096]

In the embodiment, a die bonder that places, on the intermediate stage, a die picked up from the wafer supply unit by means of the pickup head and bonds the die placed on the intermediate stage to the substrate by means of the bonding head. But the present invention can be applied to not only the aforesaid device but also a die bonding device that picks up a die from the wafer supply unit.

[0097]

For example, the present invention can also be applied to a die bonder that lacks an intermediate stage and a pickup head and bonds a die of the wafer supply unit to a substrate by means of the bonding head.

[0098]

It can also be applied to a flip chip bonder that lacks an intermediate stage, picks up a die from the wafer supply unit, turns a die pickup head upwards, delivers the die to the bonding head, and bonds it to the substrate by means of the bonding head.

[0099]

The die bonder has been described as an example in the embodiment, but the present invention can also be applied to a semiconductor manufacturing device that places a picked-up die on a tray.

5 Reference Signs List

[0100]

- 1: die bonder (semiconductor manufacturing device)
- 12: wafer holding table
- 13: peeling unit
- 10 80: control unit

Claims

[Claim 1]

A semiconductor manufacturing device, comprising:
a wafer holding table that holds a wafer ring holding
5 a dicing tape attached to a wafer divided into dies;
a peeling unit that assists in picking up the die from
the dicing tape; and
a control unit configured to set peeling conditions
that are operation conditions of the peeling unit on the
10 basis of peripheral information which is a die arrangement
information in a peripheral region of a die to be picked up.

[Claim 2]

The semiconductor manufacturing device according to
Claim 1, wherein
15 the peripheral information is on whether there is a
die or not in a region adjacent to the die to be picked up.

[Claim 3]

The semiconductor manufacturing device according to
Claim 2, wherein
20 the control unit is configured to set the peripheral
information based on pickup information showing which
position of a die on the wafer has been picked up.

[Claim 4]

The semiconductor manufacturing device according to
25 Claim 2, wherein

the control unit is configured to photograph the die to be picked up and the periphery thereof to obtain image data, and set the peripheral information on the basis of the image data thus obtained.

5 [Claim 5]

The semiconductor manufacturing device according to Claim 2, wherein

the control unit is configured to obtain a plurality of patterns of the peripheral information and set the
10 peeling conditions for each pattern.

[Claim 6]

The semiconductor manufacturing device according to Claim 1, wherein

the peeling unit is any of a pushup unit that pushes
15 up a block or a needle, a unit that slides the block or a plate, and a unit of peeling a die from a dicing tape by heat, an ultraviolet light, or a laser light.

[Claim 7]

The semiconductor manufacturing device according to
20 Claim 6, wherein

the pushup unit has a block unit and a dome, the dome having an opening that allows up and down movement of the block unit and a suction port provided in the outside vicinity of the opening, and is configured to come into
25 contact with the dicing tape.

[Claim 8]

The semiconductor manufacturing device according to Claim 7, wherein

the peeling conditions include a block pushup height,
5 a block pushup speed, and a period of time between cessation
of the movement of the block and start of the next movement,
each in the block unit.

[Claim 9]

The semiconductor manufacturing device according to
10 Claim 8, wherein

the control unit is configured to increase the pushup
height, increase the pushup speed, and prolong the period of
time as the die to be picked up has less dies in the
periphery thereof.

15 [Claim 10]

The semiconductor manufacturing device according to
Claim 1, further comprising:

a head that picks up the die.

[Claim 11]

20 A method for manufacturing a semiconductor device,
comprising:

a step of loading the wafer ring in the semiconductor
manufacturing device as claimed in Claim 1; and

a step of picking up the die by means of a pickup head
25 in cooperation with the peeling unit.

[Claim 12]

A pickup method, comprising:

holding a wafer ring that holds a dicing tape attached
to a wafer divided into dies:

- 5 setting peeling conditions which are operation
conditions of a peeling unit on the basis of peripheral
information which is arrangement information of dies in a
peripheral region of a die to be picked up; and
picking up the die by means of a collet in cooperation
10 with the peeling unit that operates based on the peeling
conditions.