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Device and method for checking and rotating electronic components

Description

The invention relates to a device and a method for checking and rotating electronic components, in particular flip chips, with a pivoting part attached to a pivotal point for rotating the electronic components, a first pickup element being fixed on the exterior of the part for picking up a single electronic component from a substrate and keeping hold of it during a rotational movement of the part, according to the preambles of Claims 1 and 7.

For methods that are based on a flip chip principle, it is known that individual electronic component parts arranged in a sandwich separated from one another, such as semiconductor chips arranged in a wafer, the wafer in turn being set on an extensible carrier sheet, are picked up from this carrier sheet and rotated, i.e. turned upside down, in order to deposit them in the rotated position for the subsequent die bond or die sort. For this purpose, the single chip is first detached from the reverse side of the carrier sheet with a needle, the so-called die ejector, and transferred with a pickup element, such as a vacuum pipette, advanced from the front or from above. For this, the vacuum pipette is usually

arranged as a flip tool on a flip head of a part pivoting about a pivotal point, and keeps hold of the selected chip during a 180° rotation of the pivoting part. After the 180° rotation has taken place, the chip turned round in this way is picked up by a pick-and-place element on its reverse side, in order then to transport the chip in this rotated situation to the desired position, for example within a smart card module.

In order to check the surface of the individual chip still arranged on the substrate for intactness before it is picked up, and at the same time to be able to check that it is in the correct position before it is picked up, a first optical facility, for example a camera, is arranged above the pivoting part for the inspection of the wafer. Since an optical connection line set up perpendicular to the surface of the wafer and the chip between the first optical facility and the wafer surface is important for an optimized check, the camera is arranged directly over the chip to be picked up. For this reason, the pivoting part must be rotated out of the perpendicularly running optical connection line each time before a chip is picked up, in order that a so-called wafer inspection can be performed.

This results in the following sequentially occurring method sequence for each flip chip: First, a check of the surface of the chip to be picked up must be performed using the camera. The flip head is then rotated into the optical connection line, in order to pick up the chip by its upper surface using the vacuum pipette attached to the flip head. By means of the pivoting part, whose rotational axis is arranged outside the optical connection line, the chip is now rotated through 180° in such a way that the flip head is now in a rotated position outside the optical connection line. A further check performed on the chip's position by means of a second optical facility in the form of a camera should supply data on a flip offset of the flipped chip. The flipped or rotated chip is then transferred to a placing facility in the form of a place head, and a correction is made to the flip offset based on transferred correction values.

Such a sequence of successive steps leads to a high time requirement for the overall process of checking and rotating a chip, and thereby reduces the throughput of the device. It therefore also results in higher operating costs.

The present invention is therefore based on the object of providing a device and a method for checking and rotating electronic component parts, in particular flip chips, with a pivoting part for rotating the components, the device and the method being time- and cost-saving. This object is achieved in respect of the device in accordance with the features of Claim 1, and in respect of the method in accordance with the features of Claim 7.

An essential point of the invention is that in a device for checking and rotating electronic components, such as flip chips, with a pivoting part attached to a pivotal point for rotating the electronic components, on the exterior of which part a first pickup element is fixed for taking up a single component from a substrate and keeping hold of it during a rotational movement, a second pickup element is arranged externally on the part opposite the first pickup element in relation to the pivotal point in such a way that in each case one pickup element is facing the substrate for each rotation of the part through 180°. The part further has a through opening between the pickup elements such that the through opening is facing the substrate for a rotation of the pivoting part through 90° or 270°. In this way, during a 180° rotation of the pivoting part, first the chip can be picked up from the substrate by the first pickup element, developed for example as a vacuum pipette, after a rotation through the first 90° an optical connection line between a first optical facility arranged above the pivoting part for checking the surface and the correct position of a further chip arranged on the substrate based on the vertically aligned through opening, and a depositing of the chip on a placing facility likewise arranged relocatably above the pivoting part can take place, the chip meanwhile turned round after an executed 180° rotation. At the same time, by means of the second pickup element which can likewise be developed as a vacuum pipette, the further component is picked up from the substrate, since the second pickup element is now arranged over the wafer

surface. A subsequent 180° rotation in the reverse direction of the pivoting part results in a further execution of the process described above.

Since a wafer inspection, a pickup and a deposit of the chip can occur within a single 180° rotation of the pivoting part developed according to the invention, as well as the turning round of the chip and also the picking up of a further chip, a considerable saving of time is hereby achieved. This considerably increases the throughput of the device as a whole, thereby reducing the operating costs of the device.

According to a preferred embodiment, the first pickup element is fixed to a first projection of the part, and the second pickup element to a second projection. The through opening can then be developed between the projections as a through channel open on one of its long sides. A consequence of this that not only can the vacuum pipettes be fixed optimally to the pivoting part, but a simple manufacture of the through channel by a milling process is also possible, thus enabling economical manufacture. In addition, such a design of the pivoting part means that a rotational axis extending perpendicular to the course of the through channel is arranged not blocking the view for the first optical facility within the through channel.

A second optical facility is preferably arranged in the form of a camera for checking a correct position of the previously rotated and possibly deposited chip, in order that a flip offset can be determined and correction data can accordingly be passed to the placing facility for correcting the chip's position.

The first optical facility is activated with a predefinable time delay after a rotation or swivel of the through opening into the optical connection line between the first optical facility and the chip to be checked, arranged on the substrate. By this means, partially blurred images caused by the projections rotating with the part can reliably be avoided.

Further advantageous embodiments will become apparent from the subclaims.

Advantages and expediencies can be taken from the following description in conjunction with the drawing. Shown are:

Fig. 1 in a schematic front view, a device for checking and rotating semiconductor chips according to prior art;

Fig. 2 in a schematic front view, a device for checking and rotating semiconductor chips according to an embodiment of the present invention;

Fig. 3 in a perspective view a pivoting part for the device for checking and rotating semiconductor chips according to an embodiment of the invention;

Fig. 4 in a schematic side view the pivoting part shown in Fig. 3;

Fig. 5 in a schematic front view a representation of the principle of the method according to the invention; and

Fig. 6 in a schematic representation, checking areas for a through opening rotated to the left and to the right within the pivoting part.

As can be seen from Fig. 1 in a schematic front view, previously according to prior art a pivoting part 3 was used for detaching individual semiconductor chips, not shown here, from a wafer or from its substrate 1 by means of a die ejector 2, this part 3 enabling, by the design of a rotational axis projecting into the drawing plane to form a pivotal point 4 at the left-hand end of the part, a swivelling in and out of a flip head 5 with arranged on it a pickup element 6, out of an optical connection line between a first optical facility 7 and the wafer surface. The solid lines of the flip head represent a pickup or pick position of the chip to be picked

up, while the dotted lines of flip head 5 reflect a deposit or place position on a placing facility 8 following the pickup process. The placing facility 8 likewise has a pickup element 9, for example in the form of a vacuum pipette, in order to place the now turned chip within a smart card module, for example, by moving the placing facility 8.

A pivoting part of this nature has only one pickup element, for one thing, and for another requires the time-consuming sequential method sequence that has already been described.

In Fig. 2, a device for checking and rotating semiconductor chips according to an embodiment of the present invention is shown in a schematic front view. It can be seen in this representation that above a wafer and an associated substrate 11 with a wafer surface 11a, from which individual semiconductor chips are ejected with a die ejector 12 from below upwards, a pivoting part 14 is arranged in such a way that it rotates in an executed rotation 15, 16 about a pivotal point 17, which is arranged above the chip to be picked up. The wafer can be moved with the substrate 11 in the x or y direction, as is indicated by the double arrow 13.

On cheek projections 18a and 18b the pivoting part 14 has two opposite pickup elements 19, 20 – for example in the form of vacuum pipettes -, which enable simultaneous picking up and depositing of two semiconductor chips. The first vacuum pipette 19 can pick up a semiconductor chip from the substrate 11, while the second vacuum pipette 20 deposits a further semiconductor chip on a placing facility 21, which can for example be equipped with a further vacuum pipette 22. The placing facility 21 is then moved sideways as indicated by the double arrow 24.

At almost the same time the pivoting part 14 rotates about is pivotal point 17 – this time in the opposite direction to the preceding rotation -, and after a 90° rotation a through opening not shown here arranged in the pivoting part 14 generates a sight channel 23a from a first optical facility 23 running vertically

through the part 14 to the surface 11a of the substrate 11 covered with the wafer to a further semiconductor chip.

This sight channel is used for carrying out a short-time recording by the first optical facility 23 developed as a camera, of the further semiconductor chip to be picked up in the future on the substrate 11, for checking of the surface and the correct position.

As soon as the pivoting part 14 has finished its 180° rotation after a further 90°, the pickup of the further semiconductor chip is executed by the second vacuum pipette 20.

A second optical facility in the form of a die on the fly camera 25 is arranged for checking a flip offset of the previously rotated chip. In the event that there is a flip offset, this facility calculates corresponding correction data and passes this to the self-adjusting place element 21. The place element 21 then deposits the chip in an indexer 26, its position being checked by a further camera 27.

Fig. 3 shows in a perspective view a possible embodiment of a pivoting part 14 for its arrangement in a device according to the invention for checking and rotating electronic components. As can be seen from the representation, the pivoting part is equipped at is pivotal point 17 with a hole to accommodate a rotational axis, not shown here, around which the pivoting part 14 rotates.

The projections 18a and 18b developed as cheeks are used to accommodate and attach pickup elements, not shown here, which can be developed as vacuum pipettes, for example.

The through opening 28 is developed in this case as a through channel open on one long side, and milled into the part in a simple manner.

As can be seen from a side view of the pivoting part in Fig. 4, during its rotation around a rotational axis arranged in a drilled hole 29 the part 14 permits a maximum inspection window of a distance between the projections 18a and 18b. This distance can have a dimension of about 20 mm, for example. In a further rotation beyond the 90° setting of the pivoting part 14, the inspection window then shrinks again, and vanishes entirely at a 180° setting of the pivoting part 14.

Fig 5 shows in a simple schematic front view the functioning of the device according to the invention. The pivoting part, not shown here in detail, which is arranged between the camera 23 and the substrate 11, contains among other features the through opening 28, which moves in a circuit 15a.

As soon as the through opening 28 is in a vertical position, meaning that the pickup elements not shown here are aligned horizontally, the optical connection line 23a can be set up from the camera 23 to the semiconductor chip to be removed on the substrate 11. Within this brief swivelling in of the through opening 28 into the optical connection line 23a, a short-time recording takes place of the surface and the position of the semiconductor chip to be removed. A further rotation of the part in a counter-clockwise direction, as indicated by the arrow 15, allows the pickup element not shown here to sweep to the chip to be removed and pick it up. A 180° rotation of the part then takes place in the opposite direction, i.e. clockwise as indicated by the arrow 16.

In Fig. 6 there is a schematic representation of the observation/inspection areas that are available to the camera 23 during a rotation of the part 14 developed with the through opening 28. For a total 360° rotation of the part and the through opening counter-clockwise (reference label 31) and clockwise (reference label 32), as also indicated by arrows 33 and 34, available inspection areas 35 and 36 are formed at an approximate 90° setting of the part.

In order not to cause any blurred images in swivelling the through opening into the optical connection line between the camera and the wafer, the camera is

activated with a time delay of about 10 msec, as represented by the angle sections 37 and 38.

All features disclosed in the application documents are claimed as essential for the invention, provided they are novel individually or in combination in the light of the prior art. All features disclosed in the application documents are regarded individually or in combination as essential for the invention. Variations of these are familiar to the person skilled in the art.

Reference Label List

1, 11	Substrate
2, 12	Die ejector
3	Pivoting part
4, 17	Pivotal point
5	Flip head
6	Pickup element
7, 23	Wafer optics camera
8	Placing facility
9	Pickup element
11a	Surface of the substrate
13	Direction of movement of the substrate
14	Pivoting part
15, 15a, 16	Rotational movement
18a, 18b	First and second projections
19	First pickup element
20	Second pickup element
21	Placing facility
22	Vacuum pipette
23	Camera
23a	Optical connection line
24	Direction of movement of the placing facility
25	Die on the fly camera
26	Indexer
27	Place optics camera
28	Through channel
29	Drilled hole
30	Maximum size of the inspection window
31, 32	Total rotation of the part
33, 34	Directions of rotation

35, 36	Inspection areas
37, 38	Angle sections

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Claims

1. A device for checking and rotating electronic components, in particular flip chips, with a pivoting part (14) attached to a pivotal point (17) for rotating the electronic components, on the exterior of which part (14) a first pickup element (19) is fixed for taking up a single electronic component from a substrate (14) and keeping hold of it during a rotational movement (15, 16; 15a) of the part (14), characterized in that a second pickup element (20) is arranged externally on the part (14) opposite the first pickup element (19) in relation to the pivotal point (17) in such a way that in each case one pickup element (19, 20) is facing the substrate (11) for each rotation (15, 16) of the part (14) through 180°, and that in the part (14) a through opening (28) is arranged between the pickup elements (19, 20) in such a way that the through opening (28) is facing the substrate (11) for a rotation (15, 16) of the pivoting part (14) through 90° or 270°.

2. Device according to Claim 1, characterized in that the first pickup element (19) is attached on a first projection (18a) and the second pickup element (20) on a second projection (18b) of the part (14).

3. Device according to Claim 2, characterized in that the through opening (28) is developed between the projections (18a, 18b) as a through channel (28) open on one long side.

4. Device according to one of the preceding claims, characterized in that on a side of the pivoting part (14) facing the substrate (11) a first optical facility (23) is arranged for optical checking of surfaces and correct positions of the electronic components arranged on the substrate (11) before being picked up.

5. Device according to Claim 4, characterized in that the through opening (28) is formed in such a way that it permits an optical connection between the first optical facility (23) and an electronic component arranged on the substrate (11) during a rotational movement (15, 16) of the pivoting part (14).

6. Device according to one of the preceding claims, characterized by a second optical facility (25) for checking a correct position of the rotated and deposited electronic component.

7. Method for checking and rotating electronic components, in particular flip chips, which are picked up individually from a sandwich of electronic components arranged on a substrate (11), by means of a first pickup element (19) arranged on a pivoting part (14) and are deposited in a rotated position, the pivoting part (14) being placeable between the substrate (11) and a first optical facility (23) for checking the surface and the correct position of a single component arranged on the substrate (11), characterized in that during a 180° rotation (15, 16) of the pivoting part (14) a pickup by the first pickup element (19) of a single electronic component arranged on the substrate (11), a check of a surface and the correct position of a further electronic component arranged on the substrate (11), by means of the optical facility (23) and a through opening

(28) arranged in the pivoting part (14), a depositing of the electronic component held by the first pickup element (19) on a placing facility (21) after a 180° rotation (15, 16) of the pivoting part (14) and at the same time a further pickup of the further individual electronic component arranged on the substrate (11), by a second pickup element (20) arranged externally opposite the first pickup element (19) on the pivoting part (14), are executed.

8. Method according to Claim 7, characterized in that after the 180° rotation (15) a 180° rotation (16) going in the other direction is executed.

9. Method according to Claim 7 or 8, characterized in that by means of a second optical facility (25), a correct position of the turned and deposited component is checked and adjusted during or after its transport.

10. Method according to one of the claims 7 – 9, characterized in that the first optical facility (23) is activated with a predefinable time delay (37, 38) after a rotation of the through opening (28) into an optical connection line (23a) between the first optical facility (23) and the electronic component still arranged on the substrate (11).