

Method and device for serial-production mounting and
bonding of electronic components on substrates

Description

The invention relates to a method and a device for serial-production mounting and bonding of electronic components, in particular RFID chips, on substrates, in particular substrates having antennas, according to the preambles of claims 1 and 7.

Electronic components, in particular flip-chips, are usually used for equipping substrates, such as for example substrates provided with antennas, so as to obtain the final chip card or the final smart label therefrom by the cooperation of the chip with the antenna. In such an equipping process, inside a device having a high throughput, the flip-chips are removed individually from a chip composite structure, such as a wafer for example, by means of a flip-chip pick-up device and are turned upside-down by a rotation of this flip-chip pick-up device so that a further pick-up device, which at the same time serves as a transport device, can act on the rear side thereof. The individual chips are usually picked up by means of vacuum pipettes which allow a gentle fixing of the chips on the pick-up device, including during transport.

To date, in order to equip the substrate with the individual chip and to fix the chip in the substrate, which is usually moved continuously or discontinuously on or in a belt, an adhesive is applied exclusively in the region of a placement area of the substrate, into which the chip is to be inserted or placed, in a first process step within a processing module of the machine which is usually provided separately for this purpose. Within a further processing module of the machine in the context of a further process

step, the flip-chip to be inserted is then picked up from the wafer and transported to the placement area in order then to place it on the placement area having the adhesive, which placement area may often also be designed as a cavity within a card body.

During application of the adhesive to the placement area or cavity of the substrate, the adhesive application device, which is known as a so-called shooter, must be suspended above the belt comprising the substrates and must be displaceable in the X and Y direction in order thus to be able to approach the individual cavities or, more generally, the individual placement areas by means of an X and Y rail system and to be able to arrange individual droplets of adhesive in a targeted manner at certain points intended for this purpose within the placement area.

Such a machine comprising two different process steps requires the tailoring of the two process steps to one another and thus the tailoring of the processing modules responsible for these process steps to one another, resulting in a time-intensive and cost-intensive electronic control circuit for controlling and adjusting the processing modules also in conjunction with further processing modules of the machine.

Furthermore, due to the necessary X and Y rail system, there is an increased space requirement for this inside the machine, which prescribes a predefined overall size of the machine.

Accordingly, the object of the following invention is to provide a method and a device for serial-production mounting and bonding of electronic components on substrates, in which a cost-effective and time-reduced

equipping of substrates is possible, along with a reduction in size of the device with a high throughput.

This object is achieved in terms of the device by the features of claim 1 and in terms of the method by the features of claim 7.

One essential aspect of the invention consists in that, in a method for serial-production mounting and bonding of electronic components, in particular flip-chips for the RFID sector, on substrates, in particular substrates having antennas, the following successive steps are carried out:

- pick-up of at least one of the electronic components from a component composite structure by means of a pick-up device;
- transfer of the electronic component from the pick-up device to a displaceable transport device;
- application of an adhesive to an underside of the component attached to the transport device, by means of a stationary adhesive application device;
- measurement of an orientation of the component in relation to the orientation of a placement area arranged on the substrate for placement of the component, by means of a measuring device; and
- placement of the component on the placement area of the substrate by means of the transport device.

By virtue of such a method, the previously described first and second process steps, which usually take place in separate processing modules inside a common machine, can advantageously be combined within one processing module. As a result, both production costs and processing costs can be saved, since there is no need for complicated electronic control circuits for tailoring the two processing modules to one another, or for an X-Y rail system for displacing the adhesive application device.

Due to such a combining of the two process steps, moreover the size of the machine is reduced since there is no need for the X and Y rail system for displacing the shooter, which is usually arranged above a substrate belt.

Due to the successive sequence of steps of picking up and transferring the electronic component, which may be designed as a flip-chip, applying the adhesive, measuring an orientation of the component and placing the component on the placement area, a common transport device can be used for transporting the component from station to station, as a result of which the processing module as a whole is simplified.

The transport device is advantageously equipped with a transport rail fitted on the upper side, along which a vacuum pipette arranged thereon can be displaced. The vacuum pipette has on the underside one or more openings to allow a vacuum that exists within the pipette to act on one side of the chip in order to fix the latter.

The other side, namely the underside of the chip, is in one embodiment shot with a droplet of the adhesive by an adhesive shooter in one of the stations, namely the adhesive application station. This shooter is oriented such that it points upwards from below and shoots the viscous droplet of adhesive towards the underside of the chip. A subsequent transport of the chip to the placement area of the substrate does not bring about any detachment of the adhesive from the underside of the chip, since the adhesive is viscous.

By virtue of such an application of the adhesive to the underside of the component, there is thus no need to apply the adhesive to the placement areas of the substrates and

thus no need for the additional step of treating the individual substrates with adhesive. Instead, in the context of a continuous process, the adhesive application can be integrated in the process of transporting the chip or the electronic component, thereby also resulting in a time saving during the production of smart labels and chip cards and a higher throughput of the entire device for producing the latter.

According to a further embodiment, the adhesive application device is designed in such a way that it is equipped with an upwardly open container with adhesive arranged therein, into which the underside of the component can be briefly dipped.

Preferably, a stamp pad which is impregnated with the adhesive is additionally arranged in the container, so that a limited and metered quantity of adhesive is dispensed by briefly pressing the underside of the component onto the stamp pad. Such a stamp pad moreover has the advantage that the adhesive is at the same time uniformly distributed over the entire surface of the underside of the component.

Between the step of transferring the electronic component and the step of applying the adhesive, the orientation of the component may already be measured a first time in addition to the measuring process which takes place after the step of applying the adhesive, this time in relation to the orientation of the adhesive application device, in order to correctly orient the electronic component for the subsequent adhesive application.

Such a measuring process takes place in both cases by means of an optical measuring method with the aid of a camera for example, and can be matched in terms of its orientation to

the placement area and/or the adhesive application device by means of image data processing.

The pick-up device for picking up the flip-chip from the component composite structure, which may be designed as a wafer, is rotated through 180° about a horizontal axle together with the picked-up chip adhering thereto by means of a vacuum, in order to be able to transfer the electronic component in the upside-down state to the transport device. The transport device then picks up the electronic component, holding it by its opposite, upper side, by applying a vacuum by means of the vacuum pipette.

According to the invention, a device for serial-production mounting and bonding of electronic components on substrates comprises the pick-up device, the transport device, the adhesive application device arranged below the transport device, and one, optionally two, measuring devices, wherein the two measuring devices measure the orientation of the component, which adheres to the transport device throughout the entire method from the time of transfer of the component from the pick-up device to the transport device. The vacuum pipette of the transport device for applying suction to the component thus exerts a vacuum on the component, which may be designed as a flip-chip, during the pick-up thereof from the pick-up device, the transport thereof, the application of adhesive thereto and the placement thereof on the substrate.

The adhesive application device comprises an ejection element for shooting at least one droplet of adhesive upwards from below onto the underside of the component.

As an alternative or in addition, the adhesive application device may be equipped with an adhesive-impregnated stamp

pad for pressing the underside of the chip onto the upper surface thereof in order to transfer the adhesive.

Further advantageous embodiments can be found in the dependent claims.

Advantages and expedient features will emerge from the following description in conjunction with the drawing, in which:

Fig. 1 shows in a first schematic diagram the structure of a device which implements the method, according to a first embodiment of the invention, and

Fig. 2 shows in a schematic diagram the structure of a device which implements the method, according to a second embodiment of the invention.

Fig. 1 shows in a schematic diagram a device according to a first embodiment of the invention, as can be used for carrying out the method according to the invention.

Arranged on a substrate belt conveying element 1 is a substrate belt 2, in which or on which there is arranged a plurality of substrates 3 arranged one behind the other and/or next to one another. The substrates 3 may be provided with an antenna and may have a cavity for receiving a chip.

The substrate belt 2 is moved continuously or discontinuously into the image plane or out of the image plane.

Each individual substrate has a placement area 3a, which may be designed as a cavity, for receiving a chip therein.

A plurality of individual components in the form of flip-chips 5 for example are arranged in a schematically shown component composite structure 4, which may be designed for example as a wafer. These flip-chips are picked up by means of a pick-up device 6-9, which can act as a so-called flipper. To this end, the flipper is pivoted about a horizontal pivot axle 7 which is arranged inside a central element 6, in order thus to pick up individual chips 5 from the chip composite structure 4 by means of rod elements 8 and 9, on which vacuum pipettes (not shown in any greater detail here) are arranged, and to transfer said chips to a further vacuum pipette 11 which belongs to a transport device 11, 12 and 13.

While one of the chips 5 is being picked up from the composite structure by the arm 8, a further chip 10, which has already been picked up by the flipper, is being transferred to the vacuum pipette 11, which has on the underside one or more openings 13 for applying a vacuum to the chip 10.

The vacuum pipette 11 is then transported by a displacement process along a transport rail 12 to the next station, namely an adhesive application station 15, 16, as shown by the arrow 14.

In the adhesive application device 15, 16, an individual droplet of adhesive 17 is shot upwards from below by means of an ejection element 16 at a time at which the vacuum pipette 11 with the chip 10 suspended thereon is moving past the adhesive application device 15, 16. To this end, the rail-type transport device may be briefly slowed or stopped in order to allow a precise positioning of the droplet of adhesive on the underside of the chip 10. In addition, a further measuring device 22, 23, as shown in

Fig. 2, may be provided for detecting the orientation of the chip for a first time.

Then, in a measuring device 18, 19 represented by the next station, the orientation of the chip 10, still adhering to the bottom of the vacuum pipette 11, is measured in order to carry out where necessary a correction of this orientation of the chip, for example by rotating the pipette 11, so that a precise and clean placement of the chip 10 on the placement area 3a of the substrate 3 is possible in a further station section.

Fig. 2 shows a schematic diagram of the device for carrying out the method of the invention, according to a second embodiment of the invention. Components which are identical or which have the same function are provided with identical reference signs.

The device shown schematically in Fig. 2 differs from the device shown in Fig. 1 in that the adhesive application device is designed differently and a further measuring device 22, 23 is provided.

The adhesive application device 20, 21 does not shoot any droplet of adhesive upwards from below onto the underside of the chip 10, but rather has on the upper side a stamp pad 21 which is impregnated with adhesive.

Such a stamp pad 21 is used for pressing the underside of the chip 10 thereon and as a result obtaining a uniform distribution of the adhesive on the underside of the chip 10 in a metered quantity. To this end, either the adhesive application device 20, 21 or the stamp pad 21 per se can be moved upwards when a chip 10 is momentarily positioned thereabove, or the vacuum pipette 11 with the chip 10 adhering thereto can be briefly moved downwards.

The measuring device 22, 23 for optically measuring, for example by means of a camera, the orientation of the chip 10 adhering to the vacuum pipette 11 serves for detecting the orientation of the chip a first time or if necessary for correctly orienting it by means of a subsequent adjustment, for example by rotating the pipette 11 about its longitudinal axis. The measuring device 22, 23 compares the oriented data with the orientation of the adhesive application device 20, 21 and optionally with the orientation of the placement area 3a of the substrate.

The measuring device 22, 23 is arranged upstream of the adhesive application device 20, 21. The further measuring device 18, 19 on the other hand is arranged downstream of the adhesive application device and carries out a further measurement and if necessary a correction of the orientation of the chip 10. Alternatively, only the measuring device 18, 19 may be provided, without the measuring device 22, 23.

All of the features disclosed in the application documents are claimed as essential to the invention in so far as they are novel individually or in combination with respect to the prior art.

List of references

1	substrate belt transport element
2	substrate belt
3	substrate
3a	placement area
4	component composite structure
5	chips
6, 8, 9	flipper
7	pivot axle of the flipper
10	chip
11	vacuum pipette
12	transport rail
13	outlet of the vacuum pipette
14	transport direction
15, 16, 20, 21	adhesive application device
17	droplet of adhesive
18, 19, 22, 23	measuring devices

Claims

1. Method for serial-production mounting and bonding of electronic components (5, 10), in particular RFID chips, on substrates (3), in particular substrates having antennas, characterised by the following steps:

- pick-up of at least one of the electronic components (5, 10) from a component composite structure (4) by means of a pick-up device (6-9);
- transfer of the electronic component (10) from the pick-up device (6-9) to a displaceable transport device (11-13);
- application of an adhesive (17) to an underside of the component (10) attached to the transport device (11-13), by means of a stationary adhesive application device (15, 16; 20, 21);
- measurement of an orientation of the component (10) in relation to the orientation of a placement area (3a) arranged on the substrate (3) for placement of the component (10), by means of a measuring device (18, 19); and
- placement of the component (10) on the placement area (3a) of the substrate (3) by means of the transport device (11-13).

2. Method according to claim 1, characterised in that the adhesive application device (15, 16; 20, 21) shoots the adhesive (17) in droplet form onto the underside of the component (10).

3. Method according to claim 1, characterised in that the underside of the component (10) is dipped into the adhesive application device (15, 16; 20, 21), which is designed as an upwardly open container with adhesive arranged therein.

4. Method according to claim 3, characterised in that the container contains a stamp pad (21) impregnated with the adhesive.

5. Method according to one of claims 1 to 4, characterised in that, between the step of transferring the electronic component (10) and the step of applying the adhesive (17), the orientation of the component (10) in relation to the orientation of the adhesive application device (20, 21) is measured.

6. Method according to one of the preceding claims, characterised in that the pick-up device (6-9) is rotated about a pivot axle in order to transfer the electronic component (10) in the upside-down state to the transport device (11-13).

7. Device for serial-production mounting and bonding of electronic components (5, 10), in particular RFID chips, on substrates (3), in particular substrates having antennas, characterised by:

- a pick-up device (6-9) for picking up at least one of the electronic components (5, 10) from a component composite structure (4) and for rotating the component (10) into an upside-down state by applying a vacuum and for transporting the electronic component (10) from the pick-up device (6-9) to an adhesive application device (15, 16; 20, 21);
- the adhesive application device (15, 16; 20, 21) arranged below the transport device (11-13) for applying adhesive (17) to the downward-pointing underside of the component (10);
- a measuring device (18, 19) for optically measuring an orientation of the component (10) in relation to the orientation of a placement area (3a) arranged on the substrate (3) for placement of the component (10); and

- an adjoining placement position of the transport device (11-13), at which the transporting component (10) can be placed on the placement area (3a) of the substrate (3).

8. Device according to claim 7, characterised in that the transport device (11-13) comprises a displaceable vacuum pipette (11, 13) for applying a suction to the component (10) during the pick-up, transport and placement thereof on the substrate (3).

9. Device according to claim 7 or 8, characterised in that the adhesive application device (15, 16) comprises an ejection element (16) for shooting a droplet of adhesive (17) upwards from below onto the underside of the component (10).

10. Device according to claim 7 or 8, characterised in that the adhesive application device (20, 21) contains an adhesive-impregnated stamp pad (21) for pressing the underside of the component (10) onto the latter.

11. Device according to one of the preceding claims, characterised in that the electronic component is a flip-chip.