

The invention relates to a method according to the precharacterizing clause of Claim 1, and to a device according to the precharacterizing clause of Claim 5.

5 It is known for a so-called die bonder or chip bonder to be used for automatic mounting of semiconductor chips and monolithic microchips on a mounting carrier. This bonder operates in accordance with the "pick up" principle, that is to say the semiconductor chip, which is already separated but is still located in the wafer
10 array and is attached to a self-adhesive foil, is raised from below by means of a "pick up" needle. The raised chip is then lowered by means of vacuum suction forceps in the direction of the Z-axis, that is to say vertically, and is moved with a linear and/or rotary movement
15 into the position of the mounting carrier, for example a lead frame. The chip is then placed on the mounting carrier or the carrier system by means of a further downward movement in the Z-direction. The bonding is carried out by alloying, soldering or glueing.

20 However, longer or shorter distances are required from the chip position to the mounting position as a result of this principle, depending on the application. The shortest cycle now known is 0.4 s to 0.6 s per chip. In addition, suction forceps are required to position and
25 transfer a respective chip. Damage to the semiconductor crystal and disturbances resulting from particles and wear of the bonding head are caused by this principle. Seen overall, this chip transfer system is too complex, particularly with regard to time, costs and material
30 wear.

Further methods and devices are described in FR-A-2313772 and US-A-3887996.

The invention is based on the object of specifying a method and a device according to which the fitting
35 of the semiconductor chip on a carrier system manages with a considerably reduced time and investment outlay.

This object is achieved according to the invention by a method having the features of Claim 1 and a device having the features of Claim 5.

Advantageous refinements and developments of the invention are the subject-matter of additional claims.

In the case of the invention, it is assumed that a semiconductor chip which has already been separated but
5 is still located in the wafer array on a self-adhesive foil is moved to a short distance above the mounting carrier or the carrier system. The wafer array on the self-adhesive film is aligned or adjusted such that that surface of the chip which is to be bonded is opposite the
10 bonding location of the carrier. The chip is pushed out of the wafer array using a "push down pin" and is moved over a short distance of ≤ 0.2 mm to the carrier system, which is preferably printed with adhesive as the bonding material in the bonding region. The adhesion forces of
15 the adhesive are sufficient to take over the chip, which is still adhering only slightly to the foil during the ejection process. This method is particularly suitable for two types of chip bonding to a carrier system, namely, on the one hand, to face-up or upside-up mounting
20 and, on the other hand, to upside-down or face-down mounting or flip-chip bonding.

In the case of one method variant, the chip is bonded by means of the rear side to the semiconductor carrier or carrier system. For this purpose, the wafer is
25 sawn using conventional methods, to be precise to a residual thickness of 10 μm to 30 μm . The wafer, which is located on a foil, is now cut, together with the foil, out of a ring into which the foil is clamped and is glued by means of the top to a self-adhesive foil which has
30 been made ready. The foil which is still located on the rear side is now pulled off in a "peeling" process. Methods for reduction of the adhesive force, for example by UV irradiation, are also possible. The wafer prepared in this way is moved onto a wafer holder on a motor-
35 driven X/Y table. The wafer is aligned and the first chip moved into the bonding position using an optoelectronic system. The optoelectronic axis must be matched in advance to the mechanical bonding position. The mounting carrier or the carrier system is now moved into the

bonding position, centred and fixed. The first chip is then pushed on and fixed on the carrier system. Further alignment of the chip over the carrier system is subsequently no longer necessary since the group spacing
5 predetermined by the sawing process and the step accuracy of the X/Y table of $\pm 2.5 \mu\text{m}$ are adequate to bond the chips "blindly". If "inked" wafers, that is to say wafers provided with defective, marked chips, are processed, then so-called "wafer mapping" is provided here, that is
10 to say the positions of "good" and "poor" chips are transferred during final measurement to a data carrier assigned to the wafer. The die bonder then requires a corresponding device in order to process this information.

15 In the case of the other method variant, the chip is bonded by means of the front to the semiconductor carrier or carrier system. This type of chip mounting is also called flip-chip bonding. Here, the said wafer can be inserted directly face down into the wafer holder of
20 the X/Y table. In the case of a suitably designed carrier system (mounting carrier), the chip can be aligned directly above the connecting positions of the carrier system (semiconductor carrier) by means of an optoelectronic system. For this purpose, the chips are
25 expediently provided with an alignment mark. This measure is used to improve the accuracy of positioning of the semiconductor chip on the connecting contact bumps of the carrier system, in order to keep the chip size and contact (pad) size as small as possible. If the fitted
30 flip chip is not surrounded by a housing, then mechanical stabilization is produced by means of plastic potting (for example epoxy resin).

The advantages achieved by the invention are, in particular, that cycle times of $\leq 0.1 \text{ s/chip}$ can be
35 achieved using this method and this device. The previously normal bonding head, one of the most complex parts and, because of the high acceleration forces, that which is most subject to wear, of the bonding device can thus be omitted. Suction forceps for transferring the

semiconductor chip from the self-adhesive foil to the carrier system are likewise no longer required.

The invention is explained in more detail in the following text with reference to an exemplary embodiment which is illustrated in the figures of the drawing, in which:

Fig. 1 shows a device for bonding a semiconductor chip to a carrier system and

Fig. 2 shows a detail of the device in the operating state of pushing out the chip.

The device which is illustrated in Fig. 1 and Fig. 2 for bonding a semiconductor chip 1 to a carrier system 3 essentially comprises an X/Y table 6 for holding and guiding the carrier system 3, which table 6 is coupled to an optoelectronic alignment device 7, and said bonding device also comprises a pushing device 5 for pushing in each case one already separated semiconductor chip 1 out of a wafer array which is mounted on a self-adhesive foil 2. The self-adhesive foil 2 is firmly clamped in a clamping ring 8 by means of the semiconductor chips 1, which are still located in the wafer array. The carrier system 3, for example, a ladder strip, a so-called lead frame or a flip-chip carrier, is provided at predetermined bonding locations with a bonding material 4 (Fig. 2), preferably a conductive adhesive, for example a silver conductive adhesive. The separated semiconductor chip 1, which is located in the wafer array on the self-adhesive foil 2, is moved to a short distance of ≤ 0.2 mm above the carrier system 3, guided on the X/Y table, in such a manner that that surface of a semiconductor chip 1 which is to be bonded is opposite a location of the carrier system 3 provided with adhesive as bonding material 4. The pushing device 5 is arranged above the X/Y table in order to push the semiconductor chip 1 out of the wafer array in the direction of that location or those locations of the carrier system 3 which is or are provided with adhesive 4, the wafer array and the chip arrangement and carrier system 3 being arranged in between.

Fig. 2 shows the ejection process. The adhesion

forces of the adhesive 4 are sufficient to transfer the chip 1, which still adheres only slightly to the foil 2, by means of the ejection process. The pushing device 5 expediently comprises a pressure pin, that is to say a so-called push down pin, which is driven electromechanically.



Patent claims

1. Method for bonding a semiconductor chip to a carrier system, in which the semiconductor chip, which is already separated, is still in the wafer array and is attached to a self-adhesive foil, is detached from the latter and is applied to a predetermined bonding location on the carrier system and is bonded to it, the carrier system (3) being provided with a bonding material (4) at the predetermined bonding location, the separated semiconductor chip (1), located on self-adhesive foil (2) in the wafer array, being moved to a short distance of ≤ 0.2 mm above the carrier system (3), the wafer array being aligned in such a manner that that surface of a semiconductor chip (1) which is to be bonded is opposite a location of the carrier system (3) provided with bonding material (4), and the semiconductor chip (1) being pushed by means of a pushing device (5) out of the wafer array onto the bonding location, provided with bonding material (4), of the carrier system (3) and being bonded to it.
2. Method according to Claim 1, characterized in that an adhesive is used as bonding material (4).
3. Method according to Claim 1 or 2, characterized in that a conductive adhesive is used as bonding material (4).
4. Method according to one of Claims 1 to 3, characterized in that a semiconductor chip (1), which is located in the wafer array on the self-adhesive foil (2), is aligned by means of an optoelectronic alignment device (7) and an X/Y table (6) in such a manner that that surface of the semiconductor chip (1) which is to be bonded is opposite a location of the carrier system (3) provided with bonding material (4).
5. Device in connection with a carrier system which is provided with a bonding material (4) at the predetermined bonding location and with semiconductor chips which are already separated, are still in the wafer array and are attached to a self-adhesive foil, in order to detach in each case one single chip from the



- self-adhesive foil and to apply it to a predetermined bonding location on the carrier system and to bond it thereto, the separated semiconductor chip (1) located in the wafer array on self-adhesive foil (2) being moved to
- 5 a short distance of ≤ 0.2 mm above the carrier system (3), guided on an X/Y table (6), the wafer array being aligned with respect to the carrier system (3) guided on the X/Y table (6) by means of an optoelectronic alignment device (7) in such a manner that that surface of the
- 10 semiconductor chip (1) which is to be bonded is opposite the location of the carrier system (3) provided with bonding material (4), and a pushing device (5) is provided for pushing the semiconductor chip (1) out of the wafer array onto the location of the carrier system
- 15 (3) provided with bonding material (4).
6. Device according to Claim 5, characterized in that the carrier system (3) is a ladder strip.
7. Device according to Claim 5, characterized in that the carrier system (3) is a flip chip carrier.
- 20 8. Device according to one of Claims 5 to 7, characterized in that the pushing device (5) is a pressure pin.