

APPARATUS FOR SEMICONDUCTOR CHIP ASSEMBLY

FIELD OF INVENTION

The present invention relates to an apparatus for semiconductor chip
5 assembly and in particular, but not exclusively, to a nozzle apparatus and a
method for bonding a semiconductor chip to a mounting surface of a
semiconductor device.

BACKGROUND

10 When assembling a semiconductor device, such as an Integrated Circuit (IC),
semiconductor chips are bonded to a mounting surface by means of an
adhesive material, such as an adhesive paste. In bonding semiconductor
chips to a mounting surface, the mounting surface is coated with an adhesive
paste and a semiconductor chip is pressed thereon to adhere or bond the chip
15 to the mounting surface.

During the bonding process mentioned above, if too much adhesive paste is
applied to the mounting surface, it may overflow the mounting surface when
the chip is pressed thereon and cause problems in subsequent wire bonding
20 work. Conversely, if the application of the adhesive paste is insufficient, the
air (in the form of bubbles) remaining in the adhesive paste is not forced out
completely from the layer of the adhesive paste when the chip is pressed
thereon. As a result, voids may be left in the adhesive paste. With voids
present in the adhesive paste, not only the adhesive strength between the

chip and the mounting surface is weak, but the thermal and electrical conductivity between the chip and the mounting surface is also lowered.

Known bonding methods, such as that shown in FIGS. 1A to 1D, attempt to
5 overcome the voiding problem mentioned above. As shown in FIG. 1A, a plurality of nozzles 10 arranged in a matrix are disposed at one end of a nozzle head 12. The nozzles 10 serve to apply adhesive paste 14 in spots on a mounting surface 16 shown in FIG. 1B. Subsequently, a semiconductor chip is pressed against the mounting surface 16 by means of, for example, a
10 chuck (not shown). When this happens, the spots of the adhesive paste 14 expand and the position of the chip is determined. However, the problem of having voids in the adhesive paste 14 still occurs. FIG. 1C shows an X-ray image of the adhesive paste 14 after the chip has been pressed against the mounting surface 16. It can be seen that voids 18 still remain in the adhesive
15 paste 14. FIG. 1D shows an X-ray image of the adhesive paste 14 that remains on the mounting surface 16 after the semiconductor chip has been removed by sticky tape, after the bonding of the semiconductor chip and the mounting surface 16. It can be seen that voids 18 still remain in the adhesive paste 14.

20

Furthermore, known bonding methods do not address tailing problems that are associated with the bonding process of bonding semiconductor chips to a bonding surface.

Therefore, the present invention seeks to provide an apparatus and a method for semiconductor chip assembly that overcomes, or at least alleviates, the above-mentioned problems.

5 SUMMARY

The present invention relates to an apparatus for semiconductor chip assembly and in particular, but not exclusively, to a nozzle apparatus and a method for bonding a semiconductor chip to a mounting surface of a semiconductor device. The nozzle apparatus comprises a body for holding an
10 adhesive material, a nozzle head and a plurality of nozzles attached to the tip of the nozzle head. The plurality of nozzles is arranged in various patterns for bonding or adhering different sizes of the semiconductor chip to the mounting surface such that voids are prevented from remaining in the adhesive material after the chip has been pressed against the mounting surface.

15

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a plan view of one end of a nozzle head having a plurality of nozzles of a known apparatus for bonding a semiconductor chip to a mounting surface of a semiconductor device;

20

FIG. 1B is a plan view of spots of the adhesive paste on the mounting surface of the semiconductor device after application by the nozzles of FIG. 1A;

FIG. 1C is an X-ray image of the adhesive paste after the semiconductor chip has been pressed against the mounting surface causing the spots of the adhesive paste of FIG. 1B to expand;

5 FIG. 1D is an X-ray image of the adhesive paste that remains on the mounting surface after the semiconductor chip has been removed by sticky tape, after the bonding of the semiconductor chip and the mounting surface as described in FIG. 1C;

10 FIG. 2A is a perspective view of a nozzle apparatus comprising a plurality of nozzles arranged in a simple cross pattern according to a first embodiment of the present invention;

FIG. 2B shows the arrangement of the nozzles in the simple cross pattern with
15 respect to a mounting surface;

FIG. 2C shows the actual result of the dispense pattern, the fillet height and outskirt and the paste coverage of a rectangular die size of about 3.0 mm by 3.2 mm using the nozzle apparatus of FIG. 2A;

20

FIG. 3A is a perspective view of a nozzle apparatus comprising a plurality of nozzles arranged in a cross rotated pattern according to a second embodiment of the present invention;

FIG. 3B shows the arrangement of the nozzles of FIG. 3A in the cross rotated pattern with respect to a mounting surface;

FIG. 3C shows the actual result of the dispense pattern, the fillet height and
5 outskirt and the paste coverage of a rectangular die size of about 4.0 mm by
3.4 mm using the nozzle apparatus of FIG. 3A;

FIG. 4A is a perspective view of a nozzle apparatus comprising a plurality of
nozzles arranged in a double cross pattern according to a third embodiment of
10 the present invention;

FIG. 4B shows the arrangement of the nozzles of FIG. 4A in the double cross pattern with respect to a mounting surface;

15 FIG. 4C shows the actual result of the dispense pattern, the fillet height and
outskirt and the paste coverage of a rectangular die size of about 3.5 mm by
4.0 mm using the nozzle apparatus of FIG. 4A;

FIG. 5A is a perspective view of a nozzle apparatus comprising a plurality of
20 nozzles arranged in a snow pattern according to a fourth embodiment of the
present invention;

FIG. 5B shows the arrangement of the nozzles of FIG. 5A in the snow pattern with respect to a mounting surface; and

25

FIG. 5C shows the actual result of the dispense pattern, the fillet height and outskirt and the paste coverage of a square die size of about 5.9 mm by 5.9 mm using the nozzle apparatus of FIG. 5A.

5 DETAILED DESCRIPTION

The step of applying an adhesive material, such as an adhesive paste, the step of adhering a semiconductor chip to a mounting surface of a semiconductor device, and the step of hardening the adhesive material are basically the same as in the prior art, shown in FIGS. 1A to 1D.

10

A first embodiment of the invention is shown in FIGS. 2A to 2C. FIGS. 2A and 2B show a nozzle apparatus 100 for applying adhesive material (not shown) onto a mounting surface 102 of a semiconductor device for bonding a semiconductor chip (not shown) to the mounting surface 102.

15

The nozzle apparatus 100 comprises a body 104 for holding an adhesive material, a nozzle head 106 and a plurality of nozzles 108 attached to the tip of the nozzle head 106 as shown in FIG. 2A. An example of the adhesive material is silver epoxy paste. Preferably, the silver epoxy paste has a viscosity of $11.5 \pm 2.5 \text{ Pa}\cdot\text{s}$ and a silver content of $70.0 \pm 2.0 \text{ wt } \%$. Typically, the silver epoxy paste is kept in freezers at about minus 20°C before use and the tack free time, which is the time required to defrost the paste before use, is approximately 24 hours.

20

The plurality of nozzles 108 is arranged in a simple cross pattern as shown in FIG. 2A. FIG. 2B shows the arrangement of the nozzles 108 in the simple cross pattern with respect to the mounting surface 102. Nozzle rows 110 and 112 comprise five nozzles each and are arranged along the diagonal lines of symmetry of the mounting surface 102. The distance between nozzles 114 and 116 is denoted by the letter "a" and the distance between the nozzle 116 and nozzle 118 is denoted by the letter "b" as shown in FIG. 2B. The nozzle 114 is spaced from the nozzle 116 at a minimum distance of 0.76 mm and a maximum distance of 0.96 mm, and the nozzle 116 is spaced from the nozzle 118 at a minimum distance of 0.76 mm and a maximum distance of 0.96 mm. Furthermore, the distance "a" is always less than the distance "b". Similarly, the range of distances specified above that separate each nozzle from the next nozzle and the requirement that the distance "a" is always less than the distance "b" is applicable to the remaining two nozzles in the nozzle row 110, as well as the nozzles in the nozzle row 112. In other words, the distance separating the nozzle 114 from each of the next immediate nozzles in the nozzle rows 110, 112 is similarly denoted by the distance "a". Likewise, the distance separating each of the nozzles in the corner of the nozzle rows 110, 112 from each of the next immediate nozzles in their respective nozzle rows is similarly denoted by the distance "b". Distances between nozzles are measured from the centre of one nozzle to the centre of the next nozzle.

The distance from the centre of the nozzle 118 to the adjacent sides of the mounting surface 102 is 0.47 mm as shown in FIG. 2B. Similarly, the distance from the centre of the nozzle located at the opposite end of the nozzle row

112 to the adjacent sides of the mounting surface 102 is 0.47 mm. Likewise, the distance from the centre of each of the nozzles at each end of the nozzle row 110 to their respective adjacent sides of the mounting surface 102 is also 0.47 mm. The diameter of the nozzles is 24G, which has an outer diameter of
5 0.56 mm and an inner diameter of 0.35 mm.

The simple cross pattern described above is preferably used for a square semiconductor chip, also known as a die, of less than 3.0 mm sides. However, the simple cross pattern can also be used for square dies of sides
10 3.0 mm to 3.3 mm and rectangular dies of sides 3.0 mm to 3.3 mm, provided the aspect ratio of the length to the width of each of the rectangular dies is not more than 1.2.

FIG. 2C shows the actual result of the dispense pattern, the fillet height and
15 outskirt and the paste coverage of a rectangular die size of about 3.0 mm by 3.2 mm. The dispense pattern used is the simple cross pattern as described above. It can be seen from FIG. 2C that the simple cross pattern used on a rectangular die size of about 3.0 mm by 3.2 mm has resulted in a good fillet height and outskirt and 100% coverage without voids.

20

A second embodiment of the invention is shown in FIGS. 3A to 3C. FIGS. 3A and 3B show a nozzle apparatus 200 for applying adhesive material (not shown) onto a mounting surface 202 of a semiconductor device for bonding a semiconductor chip (not shown) to the mounting surface 202.

25

The nozzle apparatus 200 comprises a body 204 for holding an adhesive material, a nozzle head 206 and a plurality of nozzles 208 attached to the tip of the nozzle head 206 as shown in FIG. 3A. The adhesive material is a silver epoxy paste. Preferably, the silver epoxy paste has a viscosity of 11.5 ± 2.5 Pa·s and a silver content of 70.0 ± 2.0 wt %.

The plurality of nozzles 208 is arranged in a cross rotated pattern as shown in FIG. 3A. FIG. 3B shows the arrangement of the nozzles 208 in the cross rotated pattern with respect to the mounting surface 202. Nozzle rows 210 and 212 comprise three nozzles each and are arranged along the diagonal lines of symmetry of the mounting surface 202. Nozzle row 214 has three nozzles which are arranged along the vertical line of symmetry of the mounting surface 202. Nozzle row 216 has three nozzles which are arranged along the horizontal line of symmetry of the mounting surface 202. The distance from the centre of nozzle 218 to one side of the mounting surface 202 that is closest to the nozzle 218 is denoted by the letter "c", and the distance between the centre of the nozzle 218 and the centre of nozzle 220 is denoted by the letter "d" as shown in FIG. 3B. Further, the length of one side of the mounting surface 202 is denoted by the letter "L". The minimum distance for "c" is 0.60 mm and the maximum distance for "c" is 0.80 mm. The distance for "d" is equal to 52.5% of L/2. Similarly, the range of distances specified above for the distance "c" and the distance "d" is applicable to the remaining nozzles in the nozzle rows 214, 216. In other words, the distance separating the nozzle 220 from each of the next immediate nozzles in the nozzle rows 214, 216 is similarly denoted by the distance "d". Likewise, the

distance separating each of the said next immediate nozzles in the nozzle rows 214, 216 from the respective side of the mounting surface 202 that is closest thereto is denoted by the distance "c". Should the other two sides of the mounting surface 202 are not of the length "L", the distance "d" will be
5 calculated based on the actual length of each of these two sides. For example, if the length of each of these two sides is denoted by "w", the distance "d" is equal to 52.5% of w/2. Distances between nozzles are measured from the centre of one nozzle to the centre of the next nozzle.

10 The distance from the centre of each of the nozzles at each end of the nozzle rows 210 and 212 to their respective adjacent sides of the mounting surface 202 is 0.47 mm as shown in FIG. 3B. The diameter of the nozzles is 24G, which has an outer diameter of 0.56 mm and an inner diameter of 0.35 mm.

15 The cross rotated pattern described above is preferably used for a square die of sides 3.3 mm to 3.7 mm. However, the cross rotated pattern can also be used for square dies of sides less than 3.3 mm but a minimum of 3.0 mm. The cross rotated pattern can also be used for square dies of sides more than 3.7 mm but a maximum of 4.0 mm. Likewise, the cross rotated pattern can
20 also be used for rectangular dies of sides of 3.0 mm to 4.0 mm, provided the aspect ratio of the length to the width of each of the rectangular dies is not more than 1.2.

FIG. 3C shows the actual result of the dispense pattern, the fillet height and
25 outskirt and the paste coverage of a rectangular die size of about 4.0 mm by

3.4 mm. The dispense pattern used is the cross rotated pattern as described above. It can be seen from FIG. 3C that the cross rotated pattern used on a rectangular die size of about 4.0 mm by 3.4 mm has resulted in a good fillet height and outskirt and 100% coverage without voids.

5

A third embodiment of the invention is shown in FIGS. 4A to 4C. FIGS. 4A and 4B show a nozzle apparatus 300 for applying adhesive material (not shown) onto a mounting surface 302 of a semiconductor device for bonding a semiconductor chip (not shown) to the mounting surface 302.

10

The nozzle apparatus 300 comprises a body 304 for holding an adhesive material, a nozzle head 306 and a plurality of nozzles 308 attached to the tip of the nozzle head 306 as shown in FIG. 4A. The adhesive material is a silver epoxy paste. Preferably, the silver epoxy paste has a viscosity of 11.5 ± 2.5

15 Pa·s and a silver content of 70.0 ± 2.0 wt %.

The plurality of nozzles 308 is arranged in a double cross pattern as shown in FIG. 4A. FIG. 4B shows the arrangement of the nozzles 308 in the double cross pattern with respect to the mounting surface 302. Nozzle rows 310 and 312 comprise seven nozzles each and are arranged along the diagonal lines of symmetry of the mounting surface 302. Nozzle row 314 has three nozzles which are arranged along the vertical line of symmetry of the mounting surface 302. Nozzle row 316 has three nozzles which are arranged along the horizontal line of symmetry of the mounting surface 302.

25

The distance between nozzles 318 and 320 is denoted by the letter "e", the distance between the nozzle 320 and nozzle 322 is denoted by the letter "f", and the distance between the nozzle 322 and nozzle 324 is denoted by the letter "g", as shown in FIG. 4B. The minimum distance for each of "e", "f" and "g" is 0.76 mm and the maximum distance for each of "e", "f" and "g" is 0.96 mm. Each of "e", "f" and "g" can be of any distance within the range as specified above, provided distance "e" $\leq$ distance "f" $\leq$ distance "g". Preferably, distance "e" < distance "f" $\leq$ distance "g". More preferably, distance "e" < distance "f" < distance "g". The advantage of having distance "e" < distance "f" < distance "g" is that this would allow the silver epoxy paste dispensed by the nozzle 318 to come into contact with the silver epoxy paste dispensed by the nozzle 320 first before the silver epoxy paste dispensed by the nozzle 322 comes into contact with the silver epoxy paste dispensed by the nozzle 324, which provides sufficient time for any air present to escape when the semiconductor chip is bonded to the mounting surface 302.

As shown in FIGS. 4A and 4B, there are two nozzles between the nozzle 318 and nozzle 326 in the nozzle row 310. However, for smaller die sizes in which the distance between the nozzle 318 and the nozzle 326 is smaller, there can be one nozzle instead of two nozzles therebetween. In other words, there can be one or two nozzles between the nozzle 318 and the nozzle 326 depending on the distance between them. Similarly, this applies to the nozzles between the nozzle 318 and the last nozzle that is at the opposite end from the nozzle 326 in the nozzle row 310, the nozzles between the nozzle 318 and the nozzle 324 in the nozzle row 312, and the nozzles between the nozzle 318

and the last nozzle that is at the opposite end from the nozzle 324 in the nozzle row 312. Preferably, the distance between adjacent nozzles in the nozzle rows 310 and 312 is between 0.76 mm and 0.96 mm. Distances between nozzles are measured from the centre of one nozzle to the centre of the next nozzle.

The distance from the centre of each of the nozzles at each end of the nozzle rows 310, 312, 314 and 316 to their respective adjacent sides of the mounting surface 302 is 0.47 mm as shown in FIG. 4B. The diameter of the nozzles is 24G, which has an outer diameter of 0.56 mm and an inner diameter of 0.35 mm.

The double cross pattern described above is preferably used for a square die of sides 4.0 mm to 5.0 mm. However, the double cross pattern can also be used for square dies of sides less than 4.0 mm but a minimum of 3.7 mm. The double cross pattern can also be used for square dies of sides more than 5.0 mm but a maximum of 5.2 mm. Likewise, the double cross pattern can also be used for rectangular dies of sides of 3.7 mm to 5.2 mm, provided the aspect ratio of the length to the width of each of the rectangular dies is not more than 1.2.

FIG. 4C shows the actual result of the dispense pattern, the fillet height and outskirt and the paste coverage of a rectangular die size of about 3.5 mm by 4.0 mm. The dispense pattern used is the double cross pattern as described above. It can be seen from FIG. 4C that the double cross pattern used on a

rectangular die size of about 3.5 mm by 4.0 mm has resulted in a good fillet height and outskirt and 100% coverage without voids.

A fourth embodiment of the invention is shown in FIGS. 5A to 5C. FIGS. 5A and 5B show a nozzle apparatus 400 for applying adhesive material (not shown) onto a mounting surface 402 of a semiconductor device for bonding a semiconductor chip (not shown) to the mounting surface 402.

The nozzle apparatus 400 comprises a body 404 for holding an adhesive material, a nozzle head 406 and a plurality of nozzles 408 attached to the tip of the nozzle head 406 as shown in FIG. 5A. The adhesive material is a silver epoxy paste. Preferably, the silver epoxy paste has a viscosity of 11.5 ± 2.5 Pa·s and a silver content of 70.0 ± 2.0 wt %.

The plurality of nozzles 408 is arranged in a snow pattern as shown in FIG. 5A. FIG. 5B shows the arrangement of the nozzles 408 in the snow pattern with respect to the mounting surface 402.

Nozzle rows 410 and 412 comprise nine nozzles and eight nozzles respectively and the nozzles are arranged along the diagonal lines of symmetry of the mounting surface 402. Nozzle row 414 has three nozzles which are arranged along the vertical line of symmetry of the mounting surface 402. Nozzle row 416 has three nozzles which are arranged along the horizontal line of symmetry of the mounting surface 402. Furthermore, nozzle row 418 has four nozzles arranged linearly and nozzle row 420 has also four

nozzles arranged linearly. Nozzle row 422 has four nozzles arranged linearly and is the mirror image of the nozzle row 418. Similarly, nozzle row 424 has four nozzles arranged linearly and is the mirror image of the nozzle row 420.

- 5 The distance between nozzles 426 and 428 is denoted by the letter “e”, the distance between the nozzle 428 and nozzle 430 is denoted by the letter “f”, and the distance between the nozzle 430 and nozzle 431 is denoted by the letter “g”, and the distance between the nozzle 431 and nozzle 432 is denoted by the letter “h”, as shown in FIG. 5B. The minimum distance for each of “e”,
10 “f”, “g” and “h” is 0.76 mm and the maximum distance for each of “e”, “f”, “g” and “h” is 0.96 mm. Each of “e”, “f”, “g” and “h” can be of any distance within the range as specified above, provided distance “e” $\leq$ distance “f” $\leq$ distance “g” $\leq$ distance “h”. Preferably, distance “e” < distance “f” $\leq$ distance “g” $\leq$ distance “h”. More preferably, distance “e” < distance “f” < distance “g” < distance “h”.
15 The advantage of having distance “e” < distance “f” < distance “g” < distance “h” is that this would allow the silver epoxy paste dispensed by the nozzle 426 to come into contact with the silver epoxy paste dispensed by the nozzle 428 first before the silver epoxy paste dispensed by the nozzle 430 comes into contact with the silver epoxy paste dispensed by the nozzle 431
20 and before the silver epoxy paste dispensed by the nozzle 432 comes into contact with the silver epoxy paste dispensed by the nozzle 431, which provides sufficient time for any air present to escape when the semiconductor chip is bonded to the mounting surface 402.

The distance between nozzles 434 and 436 is denoted by the letter "p", the distance between the nozzle 436 and nozzle 438 is denoted by the letter "q", and the distance between the nozzle 438 and the nozzle 432 is denoted by the letter "r", as shown in FIG. 5B. Nozzle 440, which is in the nozzle row 414, forms an angle "x" with the nozzle 436 and the nozzle 438, and the distance from the centre of the nozzle 440 to one side of the mounting surface 402 that is closest to the nozzle 440 is about 1.3 mm. The nozzle 426 forms an angle "z" with the nozzle 434 and the nozzle 432. The minimum angle for "x" is 60 degrees and the maximum angle for "x" is equal to angle "z".

10 Preferably, the angle "x" is formed by setting the distance "p" to be equal to the distance "q", and the distance "q" to be equal to the distance "r". If the distances "p", "q" and "r" are not equidistant in relation to one another, then it is preferable that the angle "x" be equal to the angle "z".

15 As shown in FIGS. 5A and 5B, there are three nozzles between the nozzle 426 and the nozzle 434 in the nozzle row 410. However, for smaller die sizes in which the distance between the nozzle 426 and the nozzle 434 is smaller, there can be two nozzles instead of three nozzles therebetween. In other words, there can be two or three nozzles between the nozzle 426 and the

20 nozzle 434 depending on the distance between them. Similarly, this applies to the nozzles between the nozzle 426 and the last nozzle that is at the opposite end from the nozzle 434 in the nozzle row 410, the nozzles between the nozzle 426 and the nozzle 432 in the nozzle row 412, and the nozzles between the nozzle 426 and the last nozzle that is at the opposite end from

25 the nozzle 432 in the nozzle row 412. Preferably, the distance between

adjacent nozzles in the nozzle rows 410 and 412 is between 0.76 mm and 0.96 mm. Distances between nozzles are measured from the centre of one nozzle to the centre of the next nozzle.

- 5 The distance from the centre of each of the nozzles of the nozzle rows 418, 420, 422 and 424 to their respective adjacent sides of the mounting surface 402 is 0.47 mm as shown in FIG. 5B. The diameter of the nozzles is 24G, which has an outer diameter of 0.56 mm and an inner diameter of 0.35 mm.
- 10 The snow pattern described above is preferably used for a square die of sides 5.2 mm to 6.0 mm. However, the double cross pattern can also be used for square dies of sides less than 5.2 mm but a minimum of 5.0 mm. Likewise, the double cross pattern can also be used for rectangular dies of sides of 5.0 mm to 6.0 mm, provided the aspect ratio of the length to the width of each of
- 15 the rectangular dies is not more than 1.2.

FIG. 5C shows the actual result of the dispense pattern, the fillet height and outskirt and the paste coverage of a square die size of about 5.9 mm by 5.9 mm. The dispense pattern used is the snow pattern as described above. It

20 can be seen from FIG. 5C that the snow pattern used on a square die size of about 5.9 mm by 5.9 mm has resulted in a good fillet height and outskirt and 100% coverage without voids.

Although the foregoing invention has been described in some detail by way of

25 illustration and example, and with regard to one or more embodiments, for the

purposes of clarity of understanding, it is readily apparent to those of ordinary skill in the art in light of the teachings of this invention that certain changes, variations and modifications may be made thereto without departing from the spirit or scope of the invention as described in the appended claims. In
5 particular, the following modifications and improvements may be made without departing from the scope of the present invention:

- The applicant has found that the adhesive material used need not be silver epoxy paste, but can be any adhesive material of similar properties.
- 10 • The distance from the centre of the nozzle at the end of the nozzle row 110, 112, 210, 212, 214, 216, 310, 312, 314, 316, 418, 420, 422 and 424 to the adjacent sides of the mounting surface 102, 202, 302 and 402 is between 0.37 mm to 0.57 mm depending on the adhesive material used, wherein the distance between nozzles will be correspondingly varied.

Claims

1. An apparatus for semiconductor chip assembly and in particular, but not exclusively, to a nozzle apparatus and a method for bonding a semiconductor chip to a mounting surface of a semiconductor device. The nozzle apparatus comprises a body for holding an adhesive material, a nozzle head and a plurality of nozzles attached to the tip of the nozzle head. The plurality of nozzles is arranged in various patterns for bonding or adhering different sizes of the semiconductor chip to the mounting surface such that voids are prevented from remaining in the adhesive material after the chip has been pressed against the mounting surface.