Device and method for encapsulating electronic components mounted on a carrier

The invention relates to a method and device for encapsulating an electronic component, in particular a semiconductor, mounted on a carrier.

Encapsulating of electronic components, particularly chips mounted on a lead frame or BGA, takes place on large scale by placing the carrier with electronic component mounted thereon in a mould cavity between two mould parts. Liquid moulding material is then pressed into the mould cavity. The drawbacks of encapsulation according to the prior art arise due to the guiding of the liquid moulding material over the edge of the carrier to a mould cavity situated closer to the middle of the carrier. This entails the danger of moulding material coming into contact with the side of the carrier remote from the mould cavity. This is highly undesirable because this side generally serves for electrical connection of the assembly to the ground. Another drawback is that after the encapsulation the edge of the carrier contains remnants of moulding material, which may be a drawback in further processing of the carrier with encapsulated component. A solution for this latter problem is to provide a part of the edge of the carrier with a layer to which the moulding material does not adhere or does so only very poorly (for instance a gold layer), whereby the moulding material located on the edge after encapsulation can be easily removed. A significant drawback of applying a poorly adhesive layer is that this has a considerable cost increase effect.

The present invention has for its object to provide an improved device and method of the type stated in the preamble, with which an encapsulation can be arranged without the danger of fouling the edge and the side of the carrier remote from the mould cavity and without the drawbacks of the prior art.

The invention provides for this purpose a device for encapsulating an electronic component, in particular a semiconductor, mounted on a carrier, comprising an upper and a lower mould part, which mould parts are displaceable relative to each other between an encapsulating position in which the mould parts take a position enclosing at least one carrier between the mould parts and, connecting onto the enclosed carrier, defining at least one mould cavity, and an opened position in which the mould parts are

situated at a greater mutual distance than in the encapsulating position, a holder member displaceable between the mould parts for urging at least an edge part of the carrier against one of the mould parts in the encapsulating position, and supply means for feeding liquid moulding material to the mould cavity. In preference the supply means for moulding material herein connect onto the holder member in order to carry the moulding material over the holder member to the mould cavity. A first advantage of the device according to the invention is that the position of the carrier is fully controlled, which enhances the quality of the encapsulation. Because the side remote from the mould cavity is urged against a mould part, the danger of fouling of this side of the carrier is considerably reduced, which is particularly advantageous since this side is generally utilized for electrical connection of the encapsulated component to the ground. Since the holder member engages on an edge part of the carrier, this part of the carrier also remains free of moulding material. When the moulding material is further carried over the holder member to the mould cavity, it is thus possible to bring about that the edge of the carrier remains wholly free of moulding material without costly measures having to be taken for this purpose in respect of the construction of the carrier or finishing processes for the carrier being necessary after the encapsulating process. The edge of the carrier remaining free of moulding material also has the advantage that it is unnecessary to detach a gate from the carrier and from the part of the moulding material ("package") which must be left behind on the carrier. Because no remnants of moulding material have to be removed, the chance of the package of the carrier coming loose (so-called delaminating) is also reduced considerably. Thus also realized is that the quality of the assembly of an encapsulated electronic component on a carrier is improved relative to electronic components encapsulated in the usual manner.

In order to define the mould cavity, at least one of the mould parts is preferably provided with a recess. For good operation of the device a passage for moulding material is left clear in an encapsulating position between the holder member and one of the mould parts, which passage extends from the supply means to the mould cavity. The moulding material will hereby be carried from the supply means directly between the holder member and one of the mould parts to the mould cavity. Both holder member and mould parts can take a wear-resistant and easily cleanable form.

For guiding of the moulding material from the supply means to the mould cavity, one of the mould parts can be provided with a runner located on the contact side for passage of moulding material, although it is also possible for the passage for moulding material to be arranged in the holder member. It is also possible to arrange runners in both the holder member and a mould part which connect to each other.

For a mechanized or an automated operation of the device it is necessary that the device be provided with drive means for displacing the mould parts and the holder member relative to each other. The supply means for moulding material can in conventional manner comprise a plunger with which a pellet of moulding material is heated and placed under pressure such that liquid moulding material is guided to the mould cavity. It is possible to embody the holder member displaceably relative to the supply means, but, in a simplified construction, supply means and holder member are combined, which also limits the danger of leakage between supply means and holder member.

The invention further provides a method of encapsulating an electronic component, in particular a semiconductor, mounted on a carrier, comprising the steps of: A) placing the carrier with electronic component mounted thereon on a mould part, B) urging at least an edge part of the carrier against the mould part with a holder member C) causing the mould part and holder member to connect onto a counter-mould part such that a mould cavity is created which fits on the carrier, and D) feeding moulding material to the mould cavity.

During step D) the moulding material is herein preferably carried over the holder member to the mould cavity. By applying the method according to this invention the advantages as described above can be realized on the basis of the device according to the invention.

After step D) and after at least partial curing of the moulding material, the counter-mould part is preferably moved back to an opened position and the holder member is displaced to a position in which it releases the carrier. The carrier with encapsulated electronic component can thus be taken out of the device and a carrier with electronic

component which is not yet encapsulated can be placed in accordance with step A so that the process can be carried out once again. In order to shorten the cycle time it is possible to perform process steps B and C simultaneously.

The present invention will be further elucidated with reference to the non-limitative embodiment shown in the following figures. Herein:
figure 1 shows a detail view of a cross-section through the device according the invention in a fully opened position,
figure 2 shows a detail of the device in cross-section corresponding with that shown in figure 1 in a partly closed position,
figure 3 shows a detail view of the device according the invention corresponding with that shown in figures 1 and 2 in an encapsulating position and
figure 4 shows a detail view of a cross-section through an alternative embodiment of the device according the invention in a fully opened position.

Figure 1 shows a detail of an encapsulating device 1 with an upper mould part 2 and a lower mould part 3 which are placed in moved-apart position. Arranged in upper mould part 2 is a mould cavity 4, which in this figure is only partly shown. In the shown position a carrier 5 in the form of a lead frame, BGA etc. can be placed on lower mould part 3. On carrier 5 is mounted an electronic component 6 which has to be encapsulated.

A pellet of moulding material 7 is placed in an opening arranged for this purpose in lower mould part 3, which pellet rests on the top part of a plunger 8. Helical grooves 9 are arranged in plunger 8.

Situated between upper mould part 2 and lower mould part 3 is a holder member 10, the operation of which will be explained in the following figures. For the sake of clarity holder member 10 is shown in this figure such that it is completely clear of lower mould part 3, but in practice it will be moved less far upward so that it still remains in contact with lower mould part 3.

Figure 2 shows the detail of encapsulating device 1 of figure 1 in a position where holder member 10 has been moved so far toward lower mould part 3 that a chamfered

outer end 11 thereof engages on an edge of carrier 5. Carrier 5 is hereby clamped between holder member 10 and lower mould part 3.

Recessed into holder member 10 is a runner 12 which connects on one side onto the pellet of moulding material 7 and debouches on the other side at carrier 5.

In figure 3 the upper mould part 2 and lower mould part 3 are closed together, wherein mould cavity 4 in upper mould part 2 encloses electronic component 6 on the carrier. After closing of mould parts 2, 3 plunger 8 is displaced in the direction of upper mould part 2, preferably while pellet 7 is simultaneously heated. Liquid moulding material then flows into runner 12 of holder member 10 and into mould cavity 4. A package 14 of moulding material, on which the whole process is focussed, is hereby formed on carrier 5. It can clearly be seen here that the injection into mould cavity 4 via runner 12 takes place such that the edge of the carrier remains free of liquid moulding material 13, since the chamfered end 11 of holder member 10 shields the edge of carrier 5.

After at least partial curing of the liquid moulding material 13, mould parts 2, 3 can be moved apart and the cured moulding material in runner 12 can be broken off the package of moulding material 14 on carrier 5. For this purpose the connection of runner 12 to mould cavity 4 is designed such that this separation can be realized without this in any way resulting in an uncontrolled form of the package of moulding material 14.

Figure 4 shows a detail of an encapsulating device 15 which shows a great resemblance with the encapsulating device 1 showed in figure 1. Alternative from figure 1 is a sleeve 16 rigidly linked with a holder member 17 (also referred to as "sleeve holder strip"). The sleeve 16 does move with the holder member 17.

Although the invention is elucidated with reference to only a single embodiment, it will be apparent to all that the invention is in no way limited to the described and shown embodiment. On the contrary, many variations are still possible for the skilled person within the scope of the invention.

Claims

1. Device for encapsulating an electronic component, in particular a semiconductor, mounted on a carrier, comprising:
- an upper and a lower mould part, which mould parts are displaceable relative to each other between an encapsulating position in which the mould parts take a position enclosing at least one carrier between the mould parts and, connecting onto the enclosed carrier, defining at least one mould cavity, and an opened position in which the mould parts are situated at a greater mutual distance than in the encapsulating position,
- a holder member displaceable between the mould parts for urging at least an edge part of the carrier against one of the mould parts in the encapsulating position, and
- supply means for feeding liquid moulding material to the mould cavity.

2. Device as claimed in claim 1, wherein the supply means for moulding material connect onto the holder member in order to carry moulding material over the holder member to the mould cavity.

3. Device as claimed in claim 1, wherein at least one of the mould parts is provided with a recess defining the mould cavity.

4. Device as claimed in any of the foregoing claims, wherein in an encapsulating position a passage for moulding material is left clear between the holder member and one of the mould parts, which passage extends from the supply means to the mould cavity.

5. Device as claimed in claim 4, wherein one of the mould parts is provided with a runner located on the contact side for defining the passage for moulding material.

6. Device as claimed in claim 5, wherein the runner defining the passage of moulding material connects onto a recess defining the mould cavity.

7. Device as claimed in claim 4, wherein the holder member is provided with a runner defining the passage for moulding material.

8. Device as claimed in any of the foregoing claims, wherein the device also comprises drive means for displacing the mould parts between the encapsulating position and the opened position and for displacing the holder member .

9. Device as claimed in any of the foregoing claims, wherein the supply means for moulding material comprise at least one plunger.

10. Device as claimed in any of the foregoing claims, wherein the supply means are assembled with the holder member.

11. Method of encapsulating an electronic component, in particular a semiconductor, mounted on a carrier, comprising the steps of:
A) placing the carrier with electronic component mounted thereon on a mould part,
B) urging at least an edge part of the carrier against the mould part with a holder member,
C) causing the mould part and holder member to connect onto a counter-mould part such that a mould cavity is created which fits on the carrier, and
D) feeding moulding material to the mould cavity.

12. Method as claimed in claim 11, wherein during step D) the moulding material is carried over the holder member to the mould cavity.

13. Method as claimed in claim 11 or 12, wherein after step D) and after at least partial curing of the moulding material the counter-mould part is moved back to an opened position and the holder member is displaced to a position in which it releases the carrier.

14. Method as claimed in any of the claims 11-13, wherein steps B and C are performed simultaneously.