

ENCAPSULATION OF LEAD FRAMES

The present invention relates to encapsulation of lead frames carrying semiconductor chips.

In know packaging technology lead frames carrying semiconductor chips are encapsulated in epoxy resin for protection.

Figure 1 shows a known apparatus for doing this. The apparatus comprises an upper mould support 2 carrying an upper mould half 4. There is a corresponding lower mould support 6 carrying a lower mould half 8. The upper and lower halves of the mould basically contain a plurality of cavities 10 of a defined products profile and also relief for receiving a lead frame. Each cavity 10 is connected to respective passageway 12 which in turn is linked to the respective pot and plunger mechanism. A pot and plunger mechanism 16 extends through a passageway 14 for urging preheated resin into the cavity 10 when the upper and lower mould halves are clamped together. This is repeated for all other cavities within a mould half. In Figure 1, movement of the plunger is denoted by arrow A. The method is implemented as follows. Firstly a lead frame is placed in the cavity 10. The upper and lower mould halves 4,8 are brought into contact with one another and clamped to hold the lead frame secure in the cavity 10. Preheated epoxy resin is injected into the cavity 10 using the pot/plunger mechanism 16. The mould halves are held together until the epoxy is fully cured. Then, the mould halves 4,8 are released, the encapsulated lead frame is removed and the mould halves are free to receive the next lead frame.

In this process, the mould halves must remain together until the resin has completely cured before they can be released to allow the encapsulated lead frame to be removed. As the pot/plunger mechanism 16 forms part of the lower mould half 8 and its mould support 6 the entire apparatus cannot be used until the end of the curing time of the epoxy resin. Thus, the cycle time of the method is dictated by the curing time of the epoxy resin.

According to the present invention there is provided lead frame encapsulation apparatus comprising:

a mould assembly having first and second mould halves which together define a cavity for receiving a lead frame; and

a resin delivery assembly adapted to be cooperatively connected to one side of the mould assembly to deliver resin to the cavity and subsequently disconnected from the mould assembly,

wherein said mould assembly defines along the parting line between its mould halves a conduit for receiving the resin to which conduit the resin delivery assembly can be connected, said conduit being arranged to extend between said cavity and the resin delivery assembly; and

the conduit is defined partially by the first mould half and partially by the second mould half so that the conduit is only fully defined when the first and second mould halves are held together.

~~Preferably, the mould assembly defines along the parting line between its mould halves a conduit for receiving the resin to which conduit the resin delivery assembly can be connected.~~

With this arrangement the resin delivery assembly can thus be attached to the side of the mould assembly with the mould halves held together for delivering the resin and then removed.

This apparatus has the significant advantage that the resin delivery assembly can be separated from the mould assembly when the resin starts to harden but before it is completely cured. The mould containing the lead frame and the partially

cured resin can remain closed and can be removed to a separate curing station to await complete curing of the resin before the lead frame is removed. Once the mould assembly has been removed from the resin delivery assembly, a second mould assembly with a lead frame can be delivered to the resin delivery assembly. Thus, the cycle time of the method is reduced as compared with the known method.

According to a second aspect of the present invention, there is provided a lead frame encapsulation system comprising a lead frame securement station, an encapsulation station, and a curing station, a mould assembly having first and second mould halves which together define a cavity for receiving a lead frame, means for transferring the mould assembly from the lead frame securement station where a lead frame is inserted into the cavity of the mould assembly to the encapsulation station where a resin delivery assembly is coupled to one side of the mould assembly for delivering resin to the cavity, said mould assembly defining along the parting line between its mould halves a conduit for receiving the resin to which conduit the resin delivery assembly can be connected, said conduit being arranged to extend between said cavity and the resin delivery assembly, the conduit being defined partially by the first mould half and partially by the second mould half so that the conduit is only fully defined when the first and second mould halves are held together, means for disconnecting the resin delivery assembly from the side of the mould assembly when the resin has started to harden but before it is completely cured, and means for transferring the mould assembly from the encapsulation station to the curing station.

The present invention also provides a method of encapsulating lead frames using the lead frame encapsulating apparatus as described above, said method comprising:

at an encapsulation station connecting the resin delivery assembly to the side of the mould assembly containing a lead frame;

delivering resin from the resin delivery assembly to the mould assembly so that the lead frame is surrounded by resin; and

when the resin has started to harden but before it is completely cured, disconnecting the resin delivery assembly from the side of the mould assembly and transferring the mould assembly to a curing station.

In the drawings,

Figure 1 is a diagram showing a known lead frame encapsulation apparatus;

Figure 2 is a side view of a lead frame encapsulation apparatus in accordance with one embodiment of the invention; and

Figure 3 is a diagram illustrating steps of a method according to one embodiment of the invention.

For a better understanding of the present invention and to show how the same may be carried into effect, reference will now be made by way of example to Figures 2 and 3 of the accompanying drawings.

In Figure 2, a mould assembly 1 comprises a lower mould half 20 and an upper mould half 22. The upper and lower mould halves define therebetween a lead frame cavity 24 for receiving a lead frame 26 and, along the parting line 28 of the mould halves a conduit 30 extending sideways for receiving resin. The conduit 30 for receiving resin is formed by a part

30a in the upper mould half and a part 30b in the lower mould half. Thus, it is not fully defined until the upper and lower mould halves 20,22 mate, that is until they adopt the position shown in Figure 2. The apparatus also comprises a resin delivery assembly 3 which comprises a pot 32 and a plunger 34. In Figure 2, resin is indicated by cross hatching. After preheated resin 36 has been placed in the pot 32, the resin delivery assembly is brought into contact with the mould assembly and the plunger 34 is forced to the left in Figure 2 to deliver resin 36 from the resin delivery assembly into the mould assembly.

As shown in Figure 3, the mould assembly 1 and resin delivery assembly 3 are mounted on a common mould support 38. They are shown in Figure 3 at an encapsulation station. The mould support also carries further mould assemblies, for example at 1a and a linking mechanism indicated by dotted line 40 to move the further mould assembly 1a to the encapsulation station and to move the mould assembly 1 from the encapsulation station to a curing station.

Reference is now made to Figure 3 to describe the encapsulation method.

Firstly, the upper and lower mould halves of the mould assembly 1 are opened and a lead frame 26 is inserted into the lead frame cavity 24. The upper and lower mould halves are then closed and clamped to hold the lead frame securely in the cavity 24. This is the state of the mould assembly 1 at the encapsulation station in Figure 3 and of the further mould assembly 1a. At the encapsulation station, the mould assembly 1 is brought into contact with the resin delivery assembly 3. Epoxy resin is delivered from the resin delivery assembly into the mould assembly through the conduit 30 so that epoxy resin completely surrounds the lead frame in the lead frame cavity.

Once the resin has begun to harden but before it is completely cured, the resin delivery assembly is removed from the mould assembly and the mould assembly 1 is moved to a curing station. By this time, a next mould assembly 1a has been located at the encapsulation station for the delivery of resin thereto.

In this way, the cycle time of the encapsulation method can be reduced as compared with known methods since it is not necessary to wait for the resin to be cured completely before the next lead frame can be encapsulated.



CLAIMS:

1. Lead frame encapsulation apparatus comprising:
a mould assembly having first and second mould halves which together define a cavity for receiving a lead frame; and
a resin delivery assembly adapted to be cooperatively connected to one side of the mould assembly to deliver resin to the cavity and subsequently disconnected from the mould assembly,
wherein said mould assembly defines along the parting line between its mould halves a conduit for receiving the resin to which conduit the resin delivery assembly can be connected, said conduit being arranged to extend between said cavity and the resin delivery assembly; and
the conduit is defined partially by the first mould half and partially by the second mould half so that the conduit is only fully defined when the first and second mould halves are held together.
2. Lead frame encapsulation apparatus as claimed in claim 1 wherein the resin delivery assembly comprises a pot and plunger mechanism.
3. Lead frame encapsulation apparatus substantially as hereinbefore described with reference to or as shown in Figure 2 of the accompanying drawings.
4. A lead frame encapsulation system comprising a lead frame securement station, an encapsulation station, and a curing station, a mould assembly having first and second mould halves which together define a cavity for receiving a lead frame, means for transferring the mould assembly from the lead frame securement station where a lead frame is inserted into the cavity of the mould assembly to the encapsulation station where a resin delivery assembly is coupled to one side of the mould assembly for delivering resin to the cavity, said mould



assembly defining along the parting line between its mould halves a conduit for receiving the resin to which conduit the resin delivery assembly can be connected, said conduit being arranged to extend between said cavity and the resin delivery assembly, the conduit being defined partially by the first mould half and partially by the second mould half so that the conduit is only fully defined when the first and second mould halves are held together, means for disconnecting the resin delivery assembly from the side of the mould assembly when the resin has started to harden but before it is completely cured, and means for transferring the mould assembly from the encapsulation station to the curing station.

5. A lead frame encapsulation system substantially as hereinbefore described with reference to and as shown in Figure 3 of the accompanying drawings.

6. A method of encapsulating lead frames using the lead frame encapsulating apparatus as claimed in any one of claims 1 to 3, said method comprising:

at an encapsulation station connecting the resin delivery assembly to the side of the mould assembly containing a lead frame;

delivering resin from the resin delivery assembly to the mould assembly so that the lead frame is surrounded by resin; and

when the resin has started to harden but before it is completely cured, disconnecting the resin delivery assembly from the side of the mould assembly and transferring the mould assembly to a curing station.

7. A method of encapsulating lead frames substantially as hereinbefore described with reference to Figures 2 and 3 of the accompanying drawings.