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LEADFRAME MANUFACTURE

Field of the Invention

- 5 The invention relates to the manufacture of leadframes for electronic devices.
- Specifically, the method relates to the process leading to the attachment of wires from the electronic device to the leadframe through bond wires.

Background

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A leadframe is used to support and house a microelectronic device. The leadframe is typically a molded plastic member, which has a layer of copper, copper alloy or silver plated onto the member. It is characterized by being low cost, easy to assembly and provides a support top protect the device and platform upon which the device can be

15 isolated from moisture.

On mounting the device to the leadframe, a water-proofing resin is applied over the assembly, forming a barrier against the intrusion of water.

- 20 It follows that any delamination between the package and the resin will lead to moisture entering the package along the delaminated interface, causing damage to the device. It is therefore imperative that the resin and package have a high degree of bond to prevent such delamination.



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An alloy of zinc and chromium (Zn/Cr) has been developed which provides superior bonding with the resin. Commonly referred to as Olin A2 (or just A2), a thin layer of the material is placed over the package to provide a better surface upon which the resin can adhere, and so prevent delamination.

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The layer is typically plated electrolytically, with the thickness of the A2 layer varying, but is typically less than 1 μ . In practice, it has been found that the greater the thickness of the A2 layer, the better adhesion of the resin to the package.

- 10 However, the A2 coating is non-conductive and so prevents, or severely limits the attachment of the wires through high temperature process, such as soldering or fusing. As such, whilst essential for the adhesion of the resin layer, the prevention of wire bonding means that either the A2 layer is masked from the wire bonding regions, and so providing a moisture path to the device, or must be stripped prior to wire bonding. A2
- 15 stripping involves the removal of the A2 layer plus under-cutting the layer of Silver plating. Under-cutting the Silver plating is necessary to ensure that the A2 layer is completely removed and make wire bonding possible on the selected areas.

- It follows that a compromise must be met between a high thickness A2 layer for resin
- 20 adhesion, or limiting the cost and difficulty in stripping the A2 layer by having it as thin as possible.

Summary of Invention

In a first aspect, the invention provides a method for processing metal plated leadframes, the method comprising the steps of: placing Zn/Cr alloy layer on said plated leadframes; masking discrete portions of said leadframes, so as to expose wire connectable portions; simultaneously immersing the leadframes in an electrolytic fluid and applying a current
5 across said leadframes; and consequently stripping the Zn/Cr layer from the wire connectable portions, so as to expose a plated metal surface of said leadframe.

It follows that the invention provides for a second electrolytic process that reverses the plating of the Zn/Cr layer, preferably A2, but only at unmasked portions and so
10 facilitating wire bonding at the designated portions.

Basic Description of Drawings

It will be convenient to further describe the present invention with respect to the
15 accompanying drawings that illustrate possible arrangements of the invention. Other arrangements of the invention are possible, and consequently the particularity of the accompanying drawings is not to be understood as superseding the generality of the preceding description of the invention.

20 Figure 1 is a schematic view of the plating and stripping process according to one embodiment of the present invention;

Figure 2A and 2B are SEM scans views of a leadframe following plating of the A2 layer and the leadframe following stripping process of the A2 layer, according to a further embodiment of the present invention;

- 5 Figure 3 is a schematic elevation view of a stripping system according to a further embodiment of the present invention.

Detailed Description

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Figure 1 illustrates the over-all schematic view of the plating and stripping process 5. At the first stage 10, the silver layer 25 is deposited selectively on the copper leadframe 30. In the next stage 15, to facilitate adhesion of the resin to the package, a coating of A2 40, 45 is applied so as to encapsulate at least a substantial part of the leadframe, so as to correspond to those areas that require to enhance adhesion.

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In the last stage 20, the leadframe 30 is prepared for the wire bonding stage. A mask (not shown) is applied to the leadframe 30, so as to only expose those portions of the leadframe 30 that are intended to receive the wire bonding.

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In the final stage 20, the leadframe is immersed in an electrolytic fluid, possibly as a result of a flow of the electrolytic fluid 50. Simultaneously, the leadframe has a current applied which, together with the electrolytic fluid 50, forms an electrolytic cell with the leadframe 30 acting as the anode. This leads to the unmasked areas being stripped of the

A2. To ensure full removal of the A2 layer, in a further embodiment, a portion of the Ag-plating 25 may also be removed 55, such as approximately 10 to 20% of the full thickness of the plating thickness. The time taken to complete the stripping process, and so the time required to operate the electrolytic cell may be in the range 3.0 to 9.0 seconds. It will be appreciated that the electrolytic cell will operate until either the leadframes are no longer immersed (or the fluid stops flowing) or the current is stopped.

Figure 2A scan view shows the A2-plated lead frame where the presence of “hooks” structure indicate the A2 layer while Figure 2B scan view shows the leadframe surface following stripping of the A2 layer where only the silver layer is visible.

Figure 3 illustrates the schematic view of the A2 stripping station 60. The A2-plated lead frame 70 is indexed onto a stripping tool, which comprises a mask 85, a top sparger plate 75 and a bottom sparger plate 105. Once the A2-plated lead frame (3) is positioned on the stripping tool, pressure is applied to the mask 85 and leadframe 70 to ensure no leakage of electrolytic fluid reaches the masked portions. A pressbar 65 with sponge 80 is applied at a pre-determined force (such as 3.5-5.5 bars) to the A2-plated leadframes 70 between the sponge 80 and the mask 85.

Then, the electrolytic fluid 100 is pumped through the bottom sparger plate 105 to nozzles 95 to the top sparger plate 75 and finally to the mask 85, and consequently, the unmasked portions of the leadframe 70 openings. The rectifier is then activated to start the flow of current for the A2 stripping process to take place and ends when the

stripping time is completed. After the stripping cycle is completed, the A2-plated lead frame 70 will be indexed and the next cycle begins.

5 The pressbar 65 is activated using compressed air with pressure to achieve the 3.5-5.5 bars.

The sponge 80 located below the pressbar 65 has a hardness of between 10-20 duro for good sealing, and to ensure the uniform transfer of the applied pressure to the leadframe 70 and mask 85. At pressure below 3.5 bar, the sealing pressure is insufficient to prevent consequential leakage of the electrolytic fluid on the masked portions,
 10 leading to moisture seepage points. Above 5.5 bar, practice has found the sealing pressure is most effective but the mask (85) life span will be shorten drastically, although the adhesive tape tests shows best result, which is to be discussed.

The mask 85 surface is made of silicone rubber with a hardness of between 60-75 duro
 15 and supported by a G10 material (glass epoxy material).

The electrolytic fluid 100 is pumped into the stripping tool at a flow rate of between 4.0-6.5 li/sec to achieve the required degree of immersion, and so form the electrolytic cell within a flowing medium. Concentration is maintained at least 90 ml/li while
 20 temperature is between 25-35 degree C and pH is controlled between 6.0-6.5.

Current density applied vary from 100-300 milliamps(mA)/cm square while stripping time ranges from 3.0 seconds to 9.0 seconds depending on the type of stripping tools and frame configuration.

In one embodiment, reduction in silver plating thickness should be checked before and after A2 stripping to make sure that the silver layer is under-cut indicating that the A2 layer is totally removed. A silver thickness reduction in the range 10%-20% may provide a sufficient degree of assurance of the removal of the A2.

Final testing to check the absence of A2 layer is by doing the actual wire bonding on the A2-stripped areas.

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Adhesion properties of A2 coating is checked in-house by a tape test method on baked and unbaked leadframes using an adhesive tape, for instance, 3M Scotch tape #600. The leadframe is placed on a flat surface and the adhesive tape is pressed over the leadframe. Then the tape is removed from the leadframe. For an unbaked frame, inspection is done on the leadframe for the presence of glue adhesive. Glue remains on the frames indicate that the A2 coating is present.

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For baked leadframes, inspection is done on the adhesive tape for the presence of any Cu oxide that peels off. Absence of Cu oxide peeling indicates that the A2 coating is present which prevented the Cu oxides from forming.

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During the early development, A2 coating can only pass adhesion test for leadframes baked at 280°C for 5 minutes. With the improvement done in process & tooling over the

years, A2-treated leadframes have managed to pass 300°C @ 5 minutes, 330°C @ 5 minutes and presently at 350°C for 5 minutes.

Wire bondability of the A2 stripped areas is checked at in-process by using a wire bonding machine during production.

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Presence or absence of A2 coating was also investigated using SEM-EDX, Auger analysis (AES), X-ray Photoelectron Spectroscopy (XPS) and ToFSIMS.

Claims

1. A method for processing metal plated leadframes, the method comprising the steps of:
 - 5 placing Zn/Cr alloy layer on said plated leadframes;
 - masking discrete portions of said leadframes, so as to expose wire connectable portions;
 - simultaneously immersing the leadframes in an electrolytic fluid and applying a current across said leadframes;
 - 10 and consequently stripping the Zn/Cr layer from the wire connectable portions, so as to expose a plated metal surface of said leadframe.
2. The method according to claim 1 wherein the immersing step includes the step of flowing the electrolytic fluid onto the leadframes.
- 15 3. The method according to claim 1 or 2 wherein the masking step includes the steps of providing a mask to said leadframes and applying a pressure to said mask, said pressure in the range 3.5 to 5.5 bar.
- 20 4. The method according to claim 3 wherein the hardness of the mask is in the range 60 to 75 duro.

5. The method according to any one of claims 1 to 4 wherein the leadframes are arranged so as to be an anode within an electrolytic cell, with the current in the range of 100-300 milliamps/cm².
- 5 6. The method according to any one of claims 2 to 5 wherein the flow rate of the electrolytic fluid is in the range 4.0-6.5 li/sec.
7. The method according to any one of claims 1 to 6 wherein the temperature of the electrolytic fluid is in the range of 25 to 35°C.
- 10 8. The method according to any one of claims 1 to 7 wherein the current application and immersion steps are continuously performed for a period of 3.0 to 9.0 seconds.
- 15 9. The method according to any one of claims 1 to 8 wherein the Zn/Cr alloy is A2
10. The method according to any one of claims 1 to 9 wherein the metal plating is one of copper and silver.
- 20 11. A leadframe having wire connectable portions produced according to the method of claims 1 to 10.