Reflectivity of Sn Solder for LED Lead Frame

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Abstract :
In this study, in order to obtain a high reflectivity for the LED lead frame, tin dip coating and tin plating were conducted respectively, and wettability of LED lead frame with tin solder also was tested by wetting balance tester. A Cu sheet was plated in Cu brighten electroplating bath and followed by immersion in a Sn electro-less plating bath [1]. On the other hand, in the dip coating process, a Cu sheet was dipped into molten tin. In the progress of wetting test, besides wetting balance curve, the maximum measured force(F_m), the maximum withdrawal force(F_w) and zero-cross time(t_0) were obtained in various temperatures. With the maximum withdrawal force, the surface tension was calculated at different temperatures. The Cu sheet plated with bright Cu and Sn show a silver bright property while that of Cu dipped with Sn possessed a high reflectance density of 1.34GAM at 270℃.

1. Introduction

As the key element of LED, a LED lead frame is required to be coated with a high reflective layer to improve its luminous efficiency. Ag coating is considered the highest reflective metal layer but needs the highest cost. Sn is reported with a high reflectivity above 80%, and low cost and high solderability.

High reflective Sn layer is demanded to be quite even in micro surface zone where normal reflection is much more than diffuse reflection. As the micro color meter for plating layer glossy, VSR-400 can achieve the value attached unit of GAM indicating the proportion of normal reflection in whole reflection.

Sn was the matrix of all the Sn-based solder alloys that were applied extensively in electronic interconnections, and mechanical properties of pure tin strongly affected the reliability of solder joints. Nowadays, due to the low cost and eco-friendly, Sn solder attracts plenty of research since a Pb-free solder is prevailing in electronic field. The wettability of Sn is defined by the contact angle and surface tension. However, contact angle is too small to test directly, and in this study, the maximum withdrawal force and peak time from the wetting curve and surface tension can be calculated by the equation deduced by Park et al [2, 3].

2. Experimental & Results

A Cu sheet was electroplated with a thin bright copper layer and then immersed into Sn electroless acid bath, and the immersion time is changed from 2 to 4 min. This resulted in formation of a high reflective silvery bright Sn layer. Comparatively, other Cu sheet was dipped into molten Sn around temperature from 260 ℃ to 300℃, and formed a Sn coating layer with thickness of 15~25um. By VSR-400, the highest reflectance density of Sn dip coated layer was obtained as 1.34GAM when the temperaute is 270℃.

In the wetting test, Cu coupon was dipped into molten Sn at temperature from 260 ℃ to 300℃. The zero-cross time decreased with temperature form the wetting balance curve. In the case of the maximum force (F_m), it increased in proportion to temperature.

3. Conclusion

The reflectance density of Sn dip coated layer reached 1.34GAM at 270℃ which almost met the specification of LED lead frame. The Sn plating layer is silvery bright which also indicate a high reflective property. The Sn solder revealed the fine wetting property as the temperature increased.

Reference

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