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Low Aspect Ratio Through-hole Filling by Copper Electroplating

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Abstract

Many factors effect Electro-copper plating of PCB (Printed Circuit Board) substrates, this plating determines through-hole for 3D electro-connection structures and brightness of surface. As technology developes, necessity of thin board, low aspect ratio through-hole filling will be studied. In this study, the parameters of three major items that additives, current density, and the stirring of plating chemicals inside the plating bath have been reviewed. It can be concluded that the input current methods and stirring have the greatest impact on filling of through-holes with low aspect ratio. However, when simply step up current and no-stirring conditions were used to increase the filling nature of plating, occurred void and irregular plating on the surface. In order to prevent voids and irregular plating, consider that concentration rate of PEG (polyethylene glycol) was increased from 10 ppm to 100 ppm.

Key Words : Low Aspect Ratio Through-hole Filling, Printed Circuit Board , Additive, Step Current Density

1. Introduction

Recently, IoT (Internet of Things) is expected to take over not only electronic devices such as smart phones, but everything that surrounds us and is connected to the internet. This will bring rapid changes to the basis of our lives and businesses, and will increase the demands of wearable devices over mobile devices such as smartphone, tablet PC, etc. Such demands for wearable device will require higher performance, smaller dimensions and thickness, and less weight, as well as the need for higher degree of integration of PCB that interconnects each component in electronic devices [1, 2]. However, increasing degree of integration puts the thermal problem on the rise where components generate heat that needs to be effectively dissipated into thermal paths in PCB.

One way to increase thermal conductivity of the board and maintain its components and traces' high level of performance is to fill in through-holes of PCB by electrolytic plating [3, 4].

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However, as PCB is getting thinner, low aspect ratio holes require through-hole filling technology with uniform plating thickness while avoiding any incomplete hole filling. Sputtering is one way to create thin metal layer, but the past research items our research group published including via-filling and high aspect ratio through-hole filling were referenced in this study. We report on the increase level of filling inside through-holes and the level of surface uniformity while suppressing the plating on surface layer during filling of low aspect ratio through-holes in PCB.

2. Experimental method

Specimens for this experiment were 40 μm thick polyimide (UBE Industries, LTD., UPILEX®) resin cut to 50 mm by 75 mm, where 100 holes with diameter of 75 μm were drilled with UV laser at 375 μm pitch. These holes have aspect ratio of 1: 0.5. The top and cross-sectional view of the prepared specimens are shown in Figure 1.