» New Products

Roughening Copper Plating With High Resin Adhesion

1. INTRODUCTION

A semiconductor component, such as the LED, the transistor, the capacitor, is expected a market expansion due to its deployment for in-vehicle use. Based on this deployment, a high reliability is required from the point of view of a use in a high load environment or a temperature degradation due to increasing of power density, and the improvement of the packaging technology is progressing[1].

The lead frame of the semiconductor component is requested not only to secure the electric connection but also a high resin adhesion is required from the point of view of securing an excellent reliability in a high load environment. A mechanical bonding with an anchor effect is effective for the adhesion between the lead frame and the resin[2], and in order to improve this adhesion, the etching or the polishing on the material surface or the forming of a nickel-plating film with a large surface roughness (thereafter called nickel roughening)[3] are available, it is furthermore needed for more improvement in the reliability of the automotive component under the high load environment.

Furukawa electric developed the copper plating on the surface of the lead frame with the granular surface roughness (thereafter called roughening copper plating) in order to improve the resin adhesion. The detail of the roughening copper plating is introduced below.

2. MAJOR CHARACTERISTICS

The measurement result of the arithmetic mean height (Sa) and the developed interfacial area ratio (Sdr) for the roughening copper plating (the roughening height of 1, 3, 5 μm) and the conventional technology of the chemical etching, the nickel roughening and without roughening treatment are shown in table 1. Since the Sa and Sdr of the roughening copper plating material are larger than the conventional technology, the result shows that the roughening copper material has a large uneven shape and the surface area is increased. The high resin adhesion of the roughening copper plating is achieved based on the shape comparison with the conventional roughening treatment.

Figure 1 shows the surface shape and cross-sectional shape of various roughening treatment materials after plating layer with nickel (0.75 μm), palladium (0.02 μm)

Table 1 Surface roughness of the surface roughening treatment materials (the base material: EFTEC-64T-C, thickness: 0.125 mm).

Item	Evaluation Condition	Roughening copper plating			Nickel roughening	Etching	Without roughening
		Height: 1 μm	Height: 3 μm	Height: 5 μm			
Arithmetic mean height (Sa) /μm	Laser microscope Microscope observation, Magnification 50 times	0.53	1.02	1.38	0.30	0.37	0.27
Developed interfacial area ratio (Sdr) /–		3.4	5.6	7.7	2.4	2.3	1.1

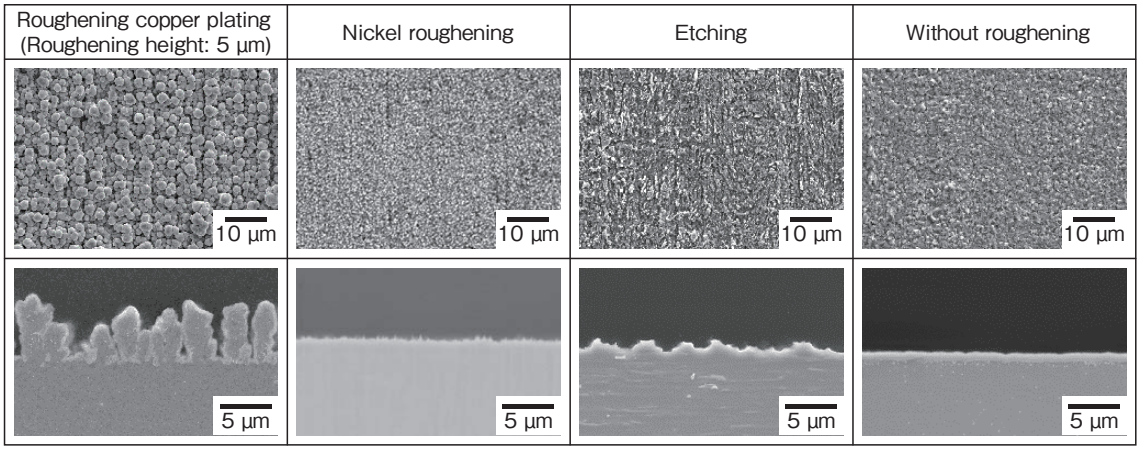

Figure 1 The SEM images of surface and cross section of the surface roughening treatment materials.

and gold (0.01 μm) assuming its use as the ground layer of the noble metal plating lead frame, represented by the palladium pre-plating lead frame (Pd-PPF). Since the roughening copper plating has a large uneven shape and the resin easily penetrates in the shape because of its large gap, a large anchor effect is expected.

Figure 2 shows the result of the shear strength measurement after the environmental test of the resin molded sample shown in table 2. The roughening copper plating treatment obtained a high resin adhesion for not only the copper surface but after the noble metal plating. Furthermore, since the resin penetrates in the uneven shape, the air tightness is excellent and prevents water from penetrating into the inner part under high temperature and humidity environment, and also it is possible to prevent the degradation of the inner element based on keeping the excellent resin adhesion.

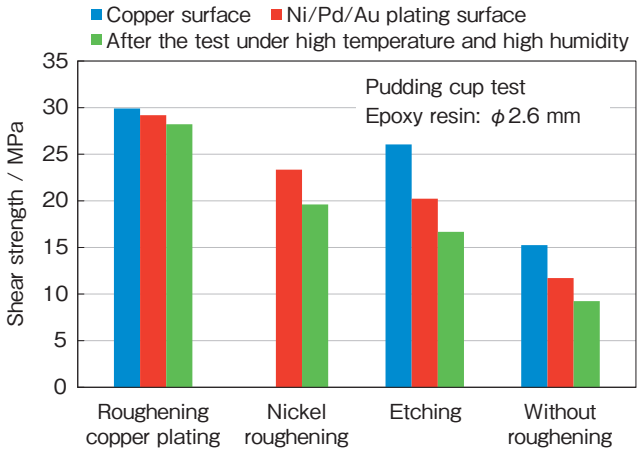

Figure 2 The shear strength before and after the environmental test.

Table 2 The condition of the environmental test and shear test.

Item	Condition
Resin mold condition	Used resin: EME-G630L (Sumitomo Bakelite Co., Ltd.) Resin mold: 130℃, 90 min. Mold size: ϕ 2.6 mm
High temperature and high humidity test	Temperature: 85℃, Relative humidity: 85%, 168 hours (JEDEC MSL LEVEL1)
Shear test	Extrusion rate: 100 μm/s

Figure 3 shows the pull strength on wire bonding of the roughening copper plating and of the one without roughening treatment. The pull strength of the roughening copper plating is the same as the material without roughening treatment and the roughening copper plating has a good wire bonding property.

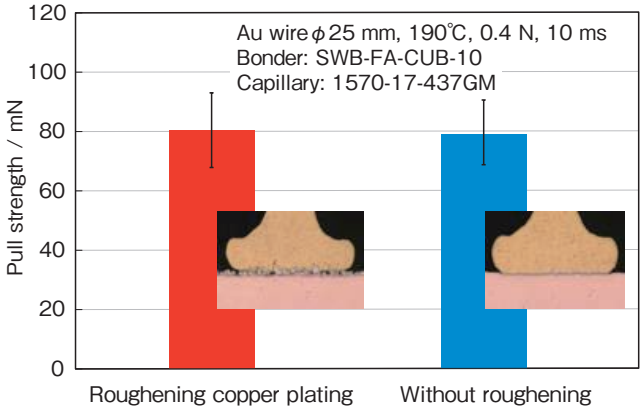

Figure 3 The pull strength on wire bonding.

3. CONCLUSION

The roughening copper plating developed by Furukawa Electric has a high resin adhesion and an environmental resistance. In the case of using the ground layer, it can improve the resin adhesion without damaging the mountability.

Table 3 shows the specification of a possible copper strip with roughening copper plating. Our roughening copper plating makes it possible to offer a proposal for improvement according to the customer request.

Table 3 Specification.

Item	Manufacturing range
Type of base material	Copper-based lead frame material
Plate thickness	0.08 ～ 0.6 mm
Width	20 ～ 75 mm

For more information, please contact:
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https://www.furukawa.co.jp/srm/form/index.php?id=encopper

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