Surface Modification of Insulation Resin for Build-up Process Using TiO_2 as a Photocatalyst and Its Application to the Metallization

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1.Introduction

In recent years, electronic devices have been required higher density of interconnection and packaging since many electronic equipments have become downsized and multifunctioned. Generally, organic materials are used as an insulating material of Printed Circuit Boards (PCBs) and packaging components. The formation of conductive layers for wiring on these insulators is a key technology. Particularly, smooth conductive layer with excellent adhesion is demanded for the formation of fine-pitch circuits on PCBs.

We have been studied for the formation of smooth conductive layers with strong adhesion between the deposited metal and insulating surface. Chemical modification without roughening on the insulating resin can be accomplished with UV light irradiation under the presence of TiO_2 as a photocatalyst. Carbonyl groups are formed during the chemical modification treatment. The adhesion strength of 1.17 kgf/cm can be achieved between the deposited copper and insulation resin by the surface modification with UV light irradiation under the presence of TiO_2.

2. Experimental

The substrate was immersed in a surface modification solution which dispersed TiO_2. Ultraviolet rays were irradiated from the upper part. The surface modification conditions were carefully selected and the surface modification and catalyzing treatment were performed, after the surface modification, and the electroless copper was deposited and followed by the copper electroplating. For the measurement of adhesion strength between the modified substrate and deposited metal, the deposited copper films were peeled from the resin by the vertical direction using instron tester. The exfoliated side and the surface morphology of the copper films were observed by scanning electron microscope (JSM-5300LV). For analysis of modified layer of polymer surface, the improvement of wettability on the surface modification surface measured by FTIR-ATR .

3. Results and discussion

It was confirmed that the optimum irradiation time was 70min and distance from UV light to the substrate was 10 mm with the surface modification solution containing 0.005g/dm^3 of TiO_2. The adhesion strength of 1.17 kgf/cm was obtained under these conditions. .As shown in **Figure 1a**, etching sites ranging from submicron to micron are formed on the resin by the conventional etching with permanganate solution.

On the other hand, the surface appearance was not significantly changed by the surface modification treatment and smooth surface just like the untreated substrate was maintained as shown in **Figure 1b**.

In this way, the surface modification by UV irradiation under the presence of TiO_2 is effective to achieve the good adhesion between resin and deposited metal without etching the surface. **Figure2** and **Figure3** show the comparison of preparation of the fine patterns by subtractive method between conventional etching and the surface modification process. Many tails or debris around the periphery of the etched patterns can be seen by the conventional etching process from the SEM observation with reflection mode. On the other hand, very sharp patterns without debris were obtained by this surface modification process. Accordingly, this process is suitable for the preparation of finer circuits and higher packaging densities with higher frequency characteristics.

4. Conclusion

(1) The adhesion strength of 1.17kgf/cm was obtained between the resin surface and deposited metal using the surface modification solution by UV light irradiation under the presence of TiO_2.

(2) Fine line circuits can be formed without etching by this process.

Acknowledgment

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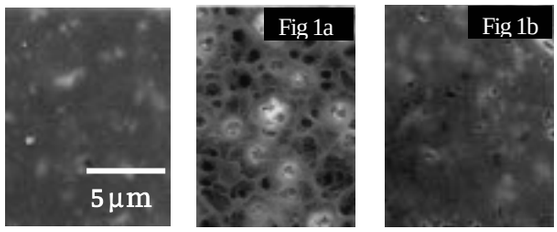

Sumple etching process surface modification

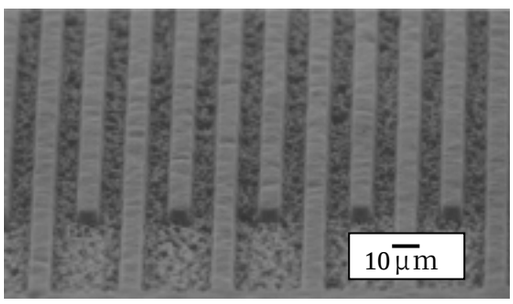

Fig 2 etching process substrate

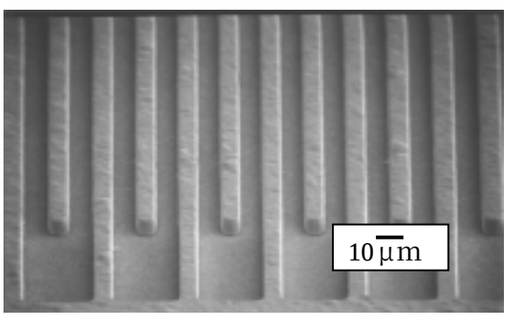

Fig 3 surface modification substrate