Abstract #2071, 224th ECS Meeting, © 2013 The Electrochemical Society

A Novel Cu Plating Formula for Filling Through Holes

Jihh-Jyun Yan, Yu-Tien Lin, and Wei-Ping Dow*

Department of Chemical Engineering, National Chung Hsing University, Taichung 40227, Taiwan

dowwp@dragon.nchu.edu.tw

With the development of science and technology, the electronic products tend to be lighter, shorter and smaller. To shorten the chip-to-chip interconnection and reduce the size of chips, high density interconnection (HDI) has been employed. For HDI fabrication, not only blind vias (microvias) but also through holes (THs) need to be completely filled with copper. So far, the filling technology for microvia metallization by copper electroplating has been ripe. However, this technology cannot be applied for TH filling because of different geometric feature.

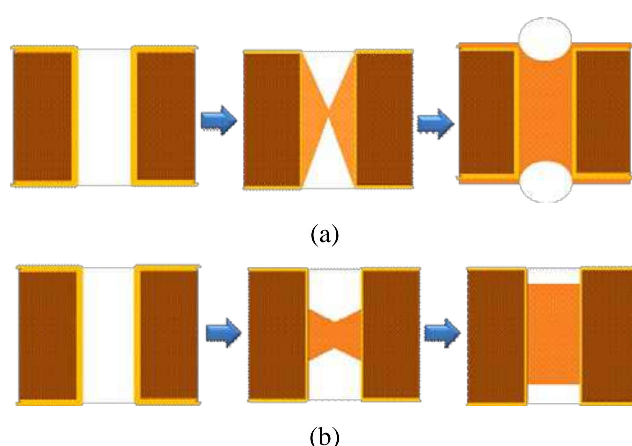
In the early period, we only demand the throwing power of a TH to be 100%. The next step is to fill the TH with polymer. Because of the insulation of polymer, we need to fabricate a copper pad on the TH. The filled polymer will induce an adhesion issue between the polymer and metal material. That is why we develop the technology of copper electroplating for TH filling, which avoids the adhesion issue of the polymer as mentioned[1].

While the copper electrodeposition proceeds faster on the surface than in vias, a void will be formed inside the plated copper pillar. To solve this problem, we add some additives, for example, halide, suppressor, and accelerator [2-4]. We have successfully filled the THs by copper electroplating using a single additive in 2008[1]. In the plating process, copper preferentially deposits at the hole center rather than at the hole mouth. The cross-sectional shape of the filled copper looks like a butterfly. Therefore, it is referred to as the Butterfly technology (BFT).

Herein, we modify the BFT to be a new filling mode. Copper is still preferentially deposited at the middle of the TH but its deposited shape seems like a square (plug), as illustrated in Fig. 1. This plating technology is referred to as the H-type TH filling. We can reduce the probability of a void in the copper pillar. If the TH is blocked up by the plated copper plug, it becomes two symmetric blind vias. We can continue to fill the two blind vias by using a bottom-up filling formula until complete filling is achieve.

References

1. W. P. Dow, H. H. Chen, M, Y, Yen, W. H. Chen, and K. H. Hsu, *J. Electrochem. Soc.,***155**, D750, 2008.
2. P. C. Andricacos, C. Uzoh, J. O. Dukovic, J. Horkans, and H. Deligianni, *IBM J. Res. Dev.*, **42**, 567 (1998).
3. P. M. Vereecken, R. A. Binstead, H. Deligianni, and P. C. Andricacos, *IBM J. Res. Dev.*, **49**, 3 (2005).
4. M. Yokoi, S. Konishi, and T. Hayashi, Denki Kagaku, **52**, 218 (1984).



(a)

(b)

Figure 1. Copper filling mode. (a) Butterfly technology, (b) H-type TH filling.