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Electroplating Application of Dimensionally Stable Anode for Copper Interconnects in 3D IC Manufacturing

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Copper electroplating is commonly used for copper interconnects in integrated circuit (IC) manufacturing. Especially the microvia filling of high density interconnection (HDI) of IC substrates and the through silicon via (TSV) filling of 3D chip packaging technology have to achieve the build-up process nowadays.

Acid copper electroplating has traditionally employed soluble copper anodes but these anodes have been found considerable drawbacks. The conventional copper anode needed to be filmed and bagged before plating and it produced sludge during plating because of the phosphorus doped in the copper anode, which affect both anode and bath performance. This results in a decrease in bath's life. It is difficult to maintain the performance of the soluble anode. Phosphorus-containing copper is somewhat more expensive than electrolytic copper.

Because of these problems, an insoluble anode (Dimensionally Stable Anode, DSA) has been used as an alternative to the preferred soluble types. However, the biggest problem of DSA is its high anodic potential that causes a high consumption of brightener. Therefore, it is important to choose proper anode materials and compatible brighteners.

Herein, we use iridium dioxide and two modified DSAs to compare with phosphorus-containing copper anode for studying. The copper electroplating with various DSAs and a new brightener for microvia and TSV filling are carried out. The filling performance and the lifetime of the brightener in various plating systems are evaluated. At the same time, a galvanostatic analysis is used to examine the electrochemical effect of different additives.

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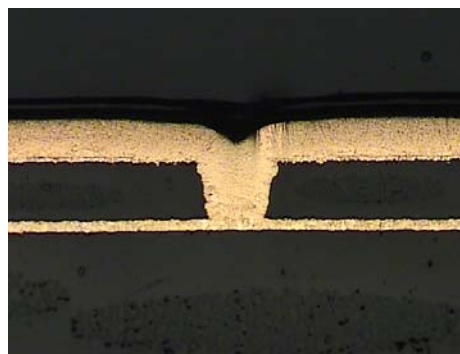


Figure 1. OM image of blind microvia of PCB after electroplating using DSA. The diameter of the microvia is 104 μm and the depth of the microvia is 80 μm .

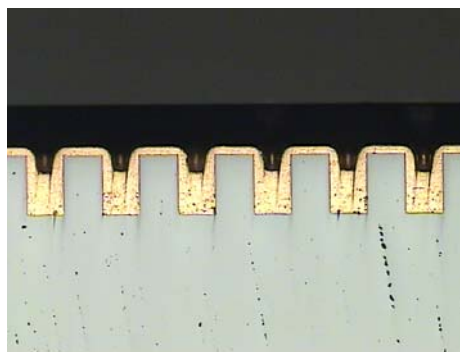


Figure 2. OM image of TSV after electroplating using DSA. The diameter of the microvia is 50 μm and the depth of the microvia is 80 μm .