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Cu Electroless Deposition by using Cu Nanoparticles as Catalysts for a Printed Circuit Board Metallization

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Printed Circuit Board (PCB) is used for mechanical support and the basic platform for the interconnection of electronic components, transmitting signal on a non-conductive substrate by following the etched copper patterns. Since the rapid increase in performance, functionality requirements of high speed devices, the high interconnection densities in PCBs are necessary.

The metallization of through holes and vias of a PCB is a critical step in manufacture. Up to known, the traditional PCB industry uses tin/palladium (Sn/Pd) colloid as the catalyst to initiate the Cu electroless deposition on the non-conducting materials of a PCB. However, Pd is very expensive. The residual palladium adsorbed on the epoxy dielectric has to be removed after copper patterning to prevent a possible short between two copper lines. This will limit the shrinkage of copper wire by using semi-additive process (SAP).

We made use of a flexible substrate to synthesize copper nanoparticles (CuNPs). The mean particle size of the CuNPs is below 10 nm and its size distribution is from 4 to 6 nm. Therefore, they perform high activity in Cu electroless deposition. Besides, the CuNPs show excellent stability because of a stabilizer, even exposure to air for a long time, as illustrated in Fig. 1.

PCBs are fabricated with a glass fiber and epoxy resin. After mechanical drilling, the two materials will appear at the sidewall of the through holes (THs). Because they are non-conducting materials, after desmear process they have to be metalized by Cu electroless deposition and then by Cu electroplating. For the Cu electroless deposition process, herein, we employed the CuNP as a catalyst for printed-through-hole (PTH), aiming to develop a palladium-free PTH process. The Pd-free Cu electroless process is illustrated in Fig. 2. These processes ensure the complete electroless copper coverage on the substrate, including epoxy resin and glass fiber. Copper seed layer was thus formed by the CuNP-catalyzed electroless copper deposition, which is coherent and conductive enough to allow PTH by Cu electroplating, as showed in Fig. 3. Figure 3 shows that the adhesion and coating of the Cu electroless layer catalyzed by the CuNPs are as good as that catalyzed by Pd catalysts. Both glass fiber and epoxy resin are completely covered by the electroless Cu layer along its roughness.

References

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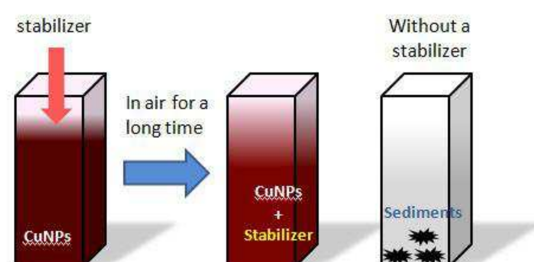

Figure 1. The effect of a stabilizer for enhancing CuNP stability in air.

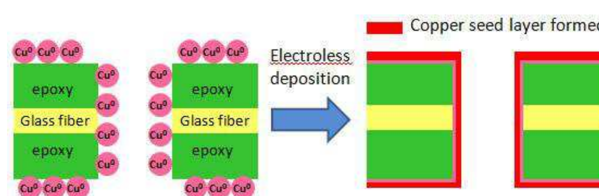

Figure 2. Copper electroless deposition process.

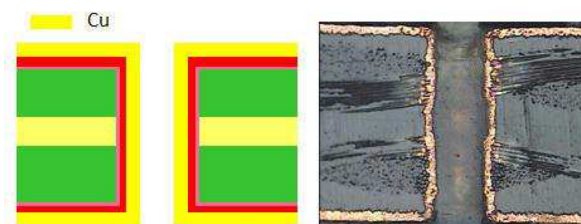

Figure 3. Electroplating image of PTH.