Statistical analysis of copper electrofroming for the fine-pitch 3D packaing applications

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Abstract

As mobile processor clock speeds continue to increase at a rate dictated by Moore's Law, the packaging interconnection must also scale in proportion to the processor speed. The development of fine-pitch interconnection capabilities in a flexible polyimide (PI) substrate for the next generation 3D packaging applications is described in this work. The copper thickness and surface roughness of PI substrates has been known to be influenced the transmission line attenuation for fine-pitch interconnection, an effect that worsens as frequency increases. The thickness and surface roughness plays an important role in product quality and manufacturing process planning, which is also a technical requirement. The purpose of this study is to understand the experimental conditions such as the effect of feature geometry, plating time, and plating temperature on the copper (Cu) electroforming in a flexible PI substrate. Statistical analysis leads to a model that predicts Cu fine-pitch interconnections well over the ranges of variables examined, provides guidelines for identification of optimum conditions, and identifies areas for further process improvement.

Keywords: flexible polyimide (PI), statistical analysis, copper (Cu) electroforming