Lead-free WLCSP Solder Bumps on ENIG & ENEP(G) UBM – a Comparison of Intermetallic Properties Using High Speed Pull Test

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Abstract

Electroless Nickel/Gold as a low cost under bump metallization for flip-chip and wafer-level CSP application is well established in the industry. Initial concerns of the technical community about reliability issues have been addressed by successful implementation in several application fields such as power management and protection devices, RFID and memory products, but also medical and automotive devices. Additionally, new technical challenges are producing strong interest in the electroless metallization process driven more by performance than only cost aspects.

Electroless Palladium, deposited as an additive metal layer of a few hundred nanometers on top of the Nickel layer, is investigated as a potential improvement of intermetallics formation with lead-free solders especially under high temperature conditions. The different intermetallic phases observed on Ni/Au versus Ni/Pd/Au can also change the brittleness and therefore, the stress compliance of the Sn-Ni IMC.

This paper is presenting newest test results based on a comparison of 3 different UBM configurations: Ni/Au, Ni/Pd/Au and Ni/Pd. Cross section and FIB analysis of the UBM has been performed to characterize the integrity of the UBM metal. A high speed pull test set up has been utilized as a tool to monitor IMC properties of the UBM-solder interface with regard to mechanical and thermal stress compensation.