Adhesion Considerations in Designing Dielectric Materials for Advanced Packaging Applications

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Abstract

Advanced packaging relies more and more on multilayer RDL stacking. In the complex integration schemes employed in advanced package integration, organic dielectric materials are expected to be in contact with a plurality of heterogeneous materials like copper, epoxy molded compound (EMC), nitride, oxide, aluminum and a variety of other low-k films. Copper traces are either embedded into organic dielectric material as in a typical Damascene scheme or are deposited on top of dielectric film in a typical SAP scheme. There are additional steps such as under bump metallization, grinding to planarize topography or expose chip surface, solder balling, under-filling and die-attach where dielectric film is subjected to harsh thermal, chemical and mechanical stresses.

Complexity in design and architecture of advanced packages has put greater demand on dielectric material to perform under diverse and extreme application conditions. Next generation of dielectric materials are required to demonstrate high resolution capabilities along with excellent electrical and mechanical properties. Reliability and integrity of a device under manufacturing as well as extreme service conditions depends on strong adhesion between organic dielectric film and all interfaces it shares with a diverse class of materials that are integral part of a device.

In this paper we will demonstrate correlation between adhesive strength of a photoimageable dielectric film and reliability. Reliability will be determined under biased- and un-biased HAST conditions as well as HTS performance after 1000 hours of storage at 150˚C. Photoimageable film (PID) of the study can be cured at temperatures below 180˚, with less than 5% film shrinkage under curing conditions, resulting in <15MPa residual stress. The PID film is based on fully cyclized polyimide platform that has demonstrated resolution capability down to 3 micron contact hole. Mechanical and electrical properties of the material are typical of a polyimide platform.