A Study Of Substrate Models And Its Effect On Package Warpage Prediction

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Abstract

In this work, a study of different substrate models on package warpage is performed. Three different substrate models are built: First, the package substrate is simplified and modeled as one effective layer. Second, a three-layer model is proposed with a top build-up layer, the middle that contains a low Coefficient of Thermal Expansion (CTE) core, and a bottom build-up layer. Third, a multi-layer laminate substrate that accounts for the complexity of copper trace, and the combination of polymer or non-metallic materials is considered. Package warpage among these models are compared and evaluated by both an analytical approach and Finite Element Analysis (FEA) in conjunction with the empirical data. The analytical and FEA results reveal that the three-layer model and multi-layer model could predict package warpage behavior in close approximation to the experimental results, whereas the one effective model provides an outlier quantity. A small amount of uncorrected warpage prediction may result in a large discrepancy of service life assessment of interconnected solder joints. The multi-layer model with detailed copper trace configuration is prohibitively expensive, while one effective layer could not represent correctly the major mechanical properties of the substrate; above all, the three-layer model is an optimal consideration and is recommended to have a proper FEA model for a more exact life prediction of solder interconnections.