Warpage Assessment In IC Packaging

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Abstract

The aim of this study is to predict deformed shapes of electronic packages after molding process through finite elements analysis (FEA).
Warpage phenomenon is studied on different types of manufacts: a simple dual beam sample composed of copper and molding compound, a single package device and a full strip made as assembly of multiple package devices. A common FEA approach is defined to describe warpage for different structures.
Shadow Moire' interferometry is used to extrapolate warpage shapes, signs, and values of the different deformed manufacts at different target temperatures with the scope to validate the model. FEA is conducted in parallel to compare the results with experimental data.
Based on findings, warpage and shape variation as a function of temperature of the single package device as well as bilaminar sample is well predicted by the model. This is confirmed by a comparison with experimental findings. However, when it comes to large thin structures, like strip systems, the shape prediction is poor probably due to non-linear effects.
In all cases, it is difficult to obtain a good estimation of warpage absolute value by employing a model developed with the assumption of linear elastic material properties. This evidence could also be related to the huge sensitiveness of molding process on residual stresses which may impact on warpage. Improvement of the model in terms of non-linearities and material constitutive model needs to be assessed to have accurate predictions of warpage values after molding process.

Reference

K. Chen, et al. "Cure Shrinkage Characterization and Warpage Simulation Optimization of Epoxy Molding Compound for 5G Application", International Conference on Electronic Packaging Technology (ICEPT),2021

C. Kim, et al. "Warpage Analysis of Electroplated Cu Films on Fiber-Reinforced
Polymer Packaging Substrates " Polymers, 2015

K. Suzuki, et al. "Investigation of the warpage modeling technique for thick multi-chip module encapsulated by compression molding", ICEP,2017