Effect of Size of Lid-Substrate Adhesive on Reliability of Solder Balls in Thermally Enhanced Flip Chip PBGA Packages

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Abstract

Six design cases of lid-substrate adhesive with various combinations of widths and heights were analyzed to investigate how the size of the adhesive affects the reliability of the solder balls of thermally enhanced flip chip plastic ball grid array (FC-PBGA) packages in thermal cycling tests. Analysis results were compared with data on the reliability of conventional FC-PBGA packages. Thermal-mechanical behavior was simulated by the finite element (FE) method and the eutectic solder was assumed to exhibit elastic-viscoplastic behavior. The temperature-dependent nonlinear stress/strain relationship of the adhesive was experimentally determined and used in the FE analysis. Darveaux's model was employed to obtain the predicted fatigue life of the solder balls in Simulation results reveal that the fatigue life of the solder balls in thermally enhanced FC-PBGA packages is much shorter than that in conventional FC-PBGA packages, and the life of solder balls increases with both the width and the height of the adhesive. However, the effect of the width of the adhesive on the reliability of the solder ball is stronger than that of the height. Moreover, increasing either the width or the height reduces the plastic strain in the adhesive at critical locations, indication that the reliability of the adhesive can be improved by its size. The predicted result of the life of solder balls for some selected studied packages are also compared with experimental data from thermal cycling tests in the paper.

Keyword：Finite element (FE) method, flip-chip plastic ball grid array (FC-PBGA), lid-substrate adhesive, reliability, thermal cycling test, thermal enhancement, thermal fatigue life, viscoplastic.