Effect of Lid Materials on the Solder Ball Reliability of Thermally Enhanced Flip-Chip Plastic Ball Grid Array Packages

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Abstract

This research studied the thermal fatigue life for eutectic solder balls of thermally enhanced flip-chip plastic ball grid array(FC-PBGA) packages with different lid materials under thermal cycling tests. Three FC-PBGA packages with different lid materials, i.e., Al, AlSiC, and Cu, were utilized to examine the lid material effect on solder ball reliability. The cyclic stress/strain behavior for the packages was estimated by using the nonlinear finite element method. The eutectic solder was assumed to be elastic-plastic-creep. The stable stress/strain results obtained from FEM analysis were utilized to predict the thermal fatigue life of solder balls by using the Coffin-Manson prediction model. Simulation results showed that the fatigue life of the FC-PBGA package with a Cu lid was much shorter than FC-PBGA package with a Cu lid was due to the complex constrained behavior caused by the thermal mismatch between the lid, substrate and the printed circuit board. The difference was insignificant in the fatigue lives between the package with an Al lid and the conventional package.

Keyword：Fatigue life; reliability; thermally enhanced FC-PBGA package; lid; creep