Microelectronics International, vol. 23(2), 2006, pages 37-44

Application of artificial intelligence for the determination of package parameters for a desired solder joint fatigue life

Abstract

Purpose: Aims to present a finite element analysis based methodology for estimating the characteristic fatigue life of a solder joint interconnect under accelerated temperature cycling to predict the reliability performance of a flip chip package. Design/methodology/approach: The method uses the ANSYSTM finite element analysis tool along with Anand's viscoplastic constitutive law. Darveaux's crack growth rate model was applied to calculate solder joint characteristic life using simulated viscoplastic strain energy density results at the package substrate and printed circuit board solder joints. Two package configurations are evaluated with the above methodology, with the first being a simplified flip chip model and the second being a detailed flip chip model. Each of these configurations is subjected to two accelerated temperature cycling tests. Findings: Generally, the results indicate that the solder joint at the corner end of the package tends to fail first. The characteristic lives of solder joint at the package ball/board interface are 24-46 percent higher than the characteristic lives of solder joint at the package ball/substrate interface. This means that the interface between the solder ball and substrate will fail first before the interface between the solder ball and the board. Originality/value: Demonstrates that genetic algorithms can be used as tools to predict possible package dimensional values for given constraints on solder joint life.

Keywords — Joining materials, reliability management, solders