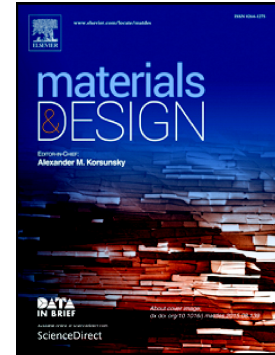


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Accelerated Temperature Cycling Induced Strain and Failure Behaviour for BGA Assemblies of Third Generation High Ag Content Pb-Free Solder Alloys

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Abstract

In severe operation environments where extreme thermal cycles and long dwells are common, such as the engine compartment of motor vehicles, solder alloys resistant to fatigue under thermomechanical stimuli are required. With this in mind, new third generation lead free alloys are being designed to enhance the toughness of interfacial intermetallic layer (IML), and solid solution strengthening is introduced to compensate for the strength loss due to Ag_3Sn particle coarsening. In this paper, the reliability of ceramic Ball Grid Array (BGA) assemblies using third generation lead-free alloys under various strain levels and Accelerated Temperature Cycling (ATC) profiles, 0/100 °C and -40/125 °C, are presented. Failure analysis was conducted and cracking along the IML at the solder/package interface was determined to be the root failure mechanism. The ATC test results indicate that the induced fatigue strain on each ring of the BGAs is a function of maximum dwell temperature, alloy choice and temperature change (ΔT) within the thermal cycle, and this is noted to have a significant influence on characteristic lifetimes. Results correlate well with the Coffin-Manson model, and activation energies (E_A) were determined to predict the reliability of the electronic on the premise of the same predominant failure mechanism.

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Keywords: Solder; Reliability; microstructure; Weibull; alloys; modelling

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