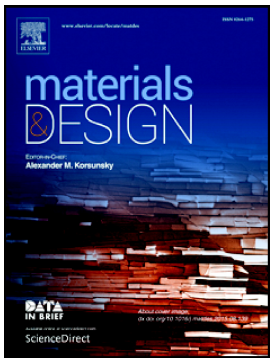
Accepted Manuscript



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Eric Dalton, Guang Ren, Jeff Punch, Maurice N. Collins

PII:	S0264-1275(18)30415-5
DOI:	doi:10.1016/j.matdes.2018.05.030
Reference:	JMADE 3930
To appear in:	*Materials & Design*
Received date:	5 April 2018
Revised date:	3 May 2018
Accepted date:	14 May 2018

Please cite this article as: Eric Dalton, Guang Ren, Jeff Punch, Maurice N. Collins , Accelerated temperature cycling induced strain and failure behaviour for BGA assemblies of third generation high Ag content Pb-free solder alloys. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Jmade(2017), doi:10.1016/j.matdes.2018.05.030

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

Eric Dalton, Guang Ren, Jeff Punch and Maurice N Collins*

Stokes Laboratories, Bernal Institute, University of Limerick, Ireland.

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.

*Dr Maurice N Collins Maurice.collins@ul.ie, Tel 353 61 202867

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