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Abstract:

Impact Strength of Lead-free BGA Spheres

Concern about the failure of lead-free BGA packages when portable devices such as cell phones are accidentally dropped and a general concern about the resistance of these packages under shock loading has prompted an interest in the impact strength of the soldered BGA connection. This paper reports the results of the measurement of the impact strength of lead-free 1.6mm diameter BGA spheres on 0.42mm solder mask defined pads on copper/OSP and ENIG substrates using recently developed equipment that can load individual BGA spheres at high strain rates in shear and tension. Impact strength is measured as the energy required to detach the sphere from the substrate to which it has been soldered. Two lead-free solders, Sn-3.0Ag-0.5Cu (SAC305) and a silver-free Sn-0.7Cu-0.05Ni-0.006Ge (SCNG) were studied with Sn-37Pb included as a benchmark. To study the effect of intermetallic growth on impact strength BGA were tested after up to two reflow cycles and 200 hours ageing at 150°C. BGA were tested in shear at speeds of 10, 100, 1000, 2000 and 4000mm/sec and in tension at speeds of 1, 10, 100, 200, and 400mm/sec. Fracture surfaces were studied using scanning electron microscopy and the relative amounts of ductile and brittle fracture noted. Spheres were cross-sectioned to observe the effect of ageing on the growth of interfacial intermetallic. While at load rates lower that about 100mm/sec in shear and 10mm/sec in tension the energy required to detach the SAC305 was higher than that required to detach the Sn-Pb of SCNG sphere, at higher speeds the SAC305 failed in a brittle manner at low impact energy while the SCNG alloy required more energy even than the Sn-Pb and exhibited a high proportion of ductile fracture. This difference between the SAC305 and the SCNG alloy increased after ageing and this could be correlated with the greater increase in the thickness of the intermetallic layer in the SAC305.

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Author Biography

Keith Sweatman is a graduate in metallurgical engineering and began his involvement with soldering technology with the International Tin Research Institute, an organisation that did much of the work that established a scientific basis for what was previously the art of soldering. He took that experience with him to Multicore Solders where he worked in a variety of technical and management roles that culminated in the position of managing director of Multicore Solders operations in the Asia Pacific Region. Since 2001 he has been assisting Nihon Superior Co, Ltd. in the development of their global business in lead-free solders. Over that period he has

given some 30 presentations at conferences and seminars around the world and published articles in various industry journals. Currently he represents Nihon Superior in projects related to lead-free soldering technology in iNEMI and the HDP User Group and in the NASA/US Department of Defence lead-free solder project. He is a corresponding member of several IPC standards committees relating to soldering technology and is a member of the technical committee of the IPC Solder Products Value Council