Microstructural evaluation of Bi-Ag and Bi-Sb lead-free high-temperature solder candidates on copper substrate with multiple reflow number

ABSTRACT

An impetus has been provided towards the development of lead-free solders by worldwide environmental legislation that banned the use of lead in solders due to the lead toxicity. This study focus on Bi-Ag and Bi-Sb solder alloys, in compositions from 1.5 to 5 wt % Ag and Sb. The effects of Ag and Sb amount, and reflow number on the microstructure and morphology of solder bulk were analysed by optical microscope and scanning electron microscope-energy dispersive X-ray. Based on the results, the grain boundary grooving was observed in all samples except Bi-5Sb in all three reflows. Metallurgical and chemical reaction between interface and solders were found in Bi-5Sb solder alloys in different reflow numbers which lead to appearance of Cu3Sb intermetallic compound layer at the interface. Reflow numbers had a significant effect on the size of Cu-rich phase. Also it was observed that, with increasing reflow number Bi-Cu phase found in Bi-2.5Sb solder dissolves into the solder bulk.

Keyword: Bi-Ag solder alloy; Bi-Sb solder alloy; Grain boundary grooving; Intermetallic compound (IMC); Lead-free solder; Multiple reflow number