Structural and thermodynamic studies of SAC108 lead-free solders enriched with Ga

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In recent years, lead-free solders based on Sn-Ag-Cu (SAC) have been considered as the most promising alternative to Sn-Pb solders [1,2]. The most preferred candidates used in industry are SAC387 (95.5 wt.% Sn, 3.8 wt.% Ag, and 0.7 wt.% Cu) and SAC 305 (96.5 wt.% Sn, 3.0 wt.% Ag, and 0.5 wt.% Cu) [1]. However, there is a tendency to reduce the overall cost of the solder by reducing the Ag content. Despite the fact that a lot of work has been done in recent years, properties of lead-free solders have not been fully optimized compared to lead-based solders [3]. However, it was found that additional alloying elements (e.g., Ga, In, Bi, Ni) can lower the melting temperature and optimize the thickness and morphology of the intermetallic compound (IMC) layer [4-6].

Considering the above facts, this work is focused on the study of SAC108 (98.2 wt.% Sn, 1.0 wt.% Ag, and 0.8 wt.% Cu) enriched with Ga. The main aim is to study the influence of Ga on structural, thermal, and mechanical properties of SAC using scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), X-ray diffraction (XRD), differential scanning calorimetry (DSC), and Vickers hardness testing (HV1). The phase composition and morphology is discussed. The hardness and melting point of studies solders are evaluated. The effect of the Ga addition is also discussed in terms of thermodynamic calculations performed by the Thermo-Calc software.

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