Development of Au-Ge based candidate alloys as an alternative to high-lead content solders

Au-Ge based candidate alloys have been proposed as an alternative to high-lead content solders that are currently being used for high-temperature applications. The changes in microstructure and microhardness associated with the addition of low melting point metals namely In, Sb and Sn to the Au-Ge eutectic were investigated in this work. Furthermore, the effects of thermal aging on the microstructure and its corresponding microhardness of these promising candidate alloys have been extensively reported. To investigate the effects of aging temperature, candidate alloys were aged at a lower temperature, 150°C for up to 3 weeks and compared with aging at 200°C. After being subjected to high-temperature aging, the microstructure varied a lot in morphology in the case of both Au-Ge-Sb and Au-Ge-Sn candidate alloys while the microstructure remained relatively stable even after long-term thermal aging in the case of the Au-Ge-In candidate alloy. The microhardness measurement is well correlated with the solubility and reactivity of these alloying elements, characteristics of their intermetallic compounds (IMCs) and the distribution of phases. The primary strengthening mechanism in the case of Au-Ge-In and Au-Ge-Sn combinations was determined to be the classic solid solution strengthening. The Au-Ge-Sb combination was primarily strengthened by the refined (Ge) dispersed phase. The aging temperature had a significant influence on the microhardness in the case of the Au-Ge-Sn candidate alloy. The distribution of phases played a relatively more crucial role in determining the ductility of the bulk solder alloy. The findings of this work are: the addition of Sb to the Au-Ge eutectic would not only decrease its melting point but would also improve its ductility substantially and the lattice strains induced by the In atoms were the most effective strengthening mechanism.

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