Effects of cooling rates on Material Behaviors of Solder Alloys

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Abstract

The leading candidates for replacing lead-contained solders are near-ternary eutectic Sn-Ag-Cu(SAC) alloys. The electronic industry has begun to study both the process behavior and the reliability assessment of these alloys in detail to figure out their applicability to electronic devices and products. In recent publications, the solidification behavior and the fatigue life of the accelerated thermal cycle test have been reported in terms of microstructure variations such as the formation of large Ag_3Sn plates and their effects. In this study, coupon type bulk specimens have been made for uniaxial tensile test by casting. To consider the effects of microstructure, casting cooling rates were controlled at furnace, reflow chamber and water. Eutectic Sn-Pb and near eutectic lead-free solder materials Sn-Ag-Cu and Sn-Cu alloys were used in mechanical testing. Also, nanoindentation tests were performed to measure Young' s modulus of materials having different microstructures. Tensile tests were performed at 3 different strain rates and then acquire 0.2% offset proof stress, ultimate tensile strength and elongation to failure.

Keywords: lead-free solder, Sn-Ag-Cu, Sn-Cu, microstructure, cooling rates, Young' s modulus and tensile properties