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Effects of Fourth Alloying Additive on Microstructure and Mechanical Properties of Sn-Ag-Cu Alloy

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Abstract : Among the various alloy systems being considered as lead-free solder candidates, Sn-Ag-Cu alloys have been recognized as the most promising because of their excellent reliability and compatibility with current components. Thus, Sn-Ag-Cu alloys have recently attracted considerable attention and have been proposed by the Japanese, the EU and the US consortiums to replace conventional Sn-Pb eutectic solder. However, many problems or unknown characteristics of the Sn-Ag-Cu alloy system such as the best composition, the large undercooling in solidification, and the formation of large intermetallics still exist. It is expected that the addition of some solidification nuclei for Sn-Ag-Cu alloys will refine the solidification microstructure and will suppress undercooling.In the present work, the effects of the fourth elements, i.e., Zn, Ni, Bi, In and Co, on microstructural and mechanical properties of Sn-3.5Ag-0.9Cu lead-free solder were investigated. Sn-3.5Ag-0.9Cu-0.5X (X= Zn, Ni, Bi, In, Co (wt.)) alloys were prepared in a graphite crucible under vacuum atmosphere. The samples were directionally solidified upward at a constant temperature gradient and growth rates by using a Bridgman type directional solidification furnace. The microstructure, microhardness and ultimate tensile strength of alloys were measured. The effects of fourth elements on the microstructure and mechanical properties of Sn–Ag-Cu eutectic alloys were investigated. The results obtained in the present work were compared with the previous experimental results.

Keywords : lead-free solders, microhardness, microstructure, tensile strength
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