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Nucleation, grain orientations, and microstructure of Sn-3Ag-0.5Cu soldered on cobalt substrates

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Abstract

The potential of cobalt substrates to control the microstructure of 550μm Sn-3Ag-0.5Cu ball grid array (BGA) joints is explored. It is shown that cobalt substrates give a small and reproducible nucleation undercooling for tin and prevent the formation of large primary Ag_3Sn blades and Cu_6Sn_5 rods. βSn dendrites grew from the $CoSn_3$ reaction layer and the βSn grains are shown to inherit their orientation from the $CoSn_3$ layer due to heterogeneous nucleation with the following orientation relationship: $(100)_{Sn}\|(100)_{CoSn3}$ with $[001]_{Sn}\|[001]_{CoSn3}$. Changes in the dendrite and eutectic microstructure are shown to be caused by the reduced nucleation undercooling for βSn and the altered solidification path due to cobalt substrate dissolution.