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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 550 $\mu$ m 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<sub>3</sub>Sn blades and Cu<sub>6</sub>Sn<sub>5</sub> rods.  $\beta$ Sn dendrites grew from the CoSn<sub>3</sub> reaction layer and the  $\beta$ Sn grains are shown to inherit their orientation from the CoSn<sub>3</sub> layer due to heterogeneous nucleation with the following orientation relationship:  $(100)_{\text{Sn}} \parallel (100)_{\text{CoSn}_3}$  with  $[001]_{\text{Sn}} \parallel [001]_{\text{CoSn}_3}$ . Changes in the dendrite and eutectic microstructure are shown to be caused by the reduced nucleation undercooling for  $\beta$ Sn and the altered solidification path due to cobalt substrate dissolution.

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