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The influence of nano-particles on microstructural development at the interface of Sn3.5Ag-solder and Cu-substrate

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Abstract: Preliminary experimental results have shown that an unexpected large needle-like phase Ag3Sn grows from the solder/substrate interface and large polygon-like Sn-Cu intermetallic compounds are present in the region, which is close to the interface when using lead-free binary Sn3.5Ag solder alloy. This paper summarises the efforts made to prevent the formation of these deleterious phases. An addition of 0.25 wt% of either copper nano-particles or nickel nano-particles was found to effectively avoid the formation of large Ag3Sn phase and to modify the solder matrix through a random dispersion of the in-situ intermetallic compounds Cu6Sn5 or Sn4Ni3. The mechanism involved in influencing the interfacial structure is quite different for copper and nickel nano-particles. The addition of copper nano-particles stimulates the formation of the Sn-Cu compound Cu6Sn5 at the solder/substrate interface, while the nickel nano-particles promotes the formation of Sn-Cu-Ni-Ag compound to replace the regular scallop-like Cu6Sn5 having a round morphology.

Keywords: lead free solders; Sn3.5Ag solder; interfacial structure; nano-particles; microstructure; reinforcement; nickel; copper.

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