On the Evolution of the Properties and Microstructure of Backward Compatible Solder Joints During Cycling and Aging

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A number of groups have published accelerated test results comparing backward compatible (mixed) solder joints to pure SnPb and lead free ones, but the question remains as to the actual reliability under realistic long term service conditions. We are addressing this in a comprehensive fundamental study of the evolution of the microstructure and resulting joint properties and performance for mixed solder joints. The present work reports results of reflowing 30 mil SAC305 balls onto Cu coated BGA pads with different amounts of SnPb paste, aging and/or cycling the joints and inspecting the microstructure by cross polarizer microscopy and SEM. The addition of small amounts of Pb was found to affect the solidification during cool-down from reflow, and thus the initial microstructure, in a profound fashion. The shapes and distributions of secondary precipitates were, as expected, different from those observed in `pure' SAC305 joints and a large number of very small Pb inclusions were distributed within the Sn dendrites. As a result the mixed joints started out harder and did not soften as rapidly during thermal cycling and aging. In fact, an initial break up of elongated Ag₃Sn precipitates first led to a slight hardening and strengthening. In addition thermal cycling induced recrystallization of the Sn was delayed and acceleration factors were lower. However, the strongly reduced sensitivity to aging suggests that mixed joints may compare more favorably to their `pure' lead free counterparts in long term service than reflected by accelerated test results.