

**Title:** Physical and mechanical properties of lead-free solder joints

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**Abstract:** Due to recent restriction of the classical Sn-Pb solder alloy, lead-free solders became an extensively investigated class of materials. This thesis focused on selected Sn-Cu based alloys. The influence of Cu content and minor additions of Ni and P on IMC layers morphology and reliability of simulated solder joints were investigated. The growth kinetics of IMC layers and mechanical properties of solder joints were studied after reaction of molten solders with Cu substrate at various times and temperatures, and after subsequent ageing at elevated temperatures. Detailed analysis of the evolution of IMC layers morphology was performed using EBSD. Higher Cu concentration in solders decreased the dissolution rate of Cu substrate. It was shown that the addition of 0.1 at.% of Ni significantly changed the morphology of IMC layers and improved mechanical properties of solder joints. Addition of P had only a minor effect on the IMC growth and the solder joint reliability.

**Keywords:** Lead-free solders, intermetallic compound layers, growth kinetics, reliability of solder joints