

Mechanical properties of Sn-0.7Cu/Si₃N₄ lead-free composite solder

Abstract

The use of reinforcing high performance ceramic particulates in monolithic lead-free solder is one way to improve the service temperature and mechanical behavior of a solderjoint. In this study, various compositions of Sn-0.7Cu/Si₃N₄ lead-free composite solder were fabricated via the application of powder metallurgy (PM) techniques. The influences of the Si₃N₄ particulates in the monolithic matrix solder on the melting point temperature (T_m), microhardness value, lap-shear strength, and surface fracture mechanisms were investigated based on the weight percentage addition used (0.5wt%, 1.0wt%, and 1.5wt%). Minimal alteration of the melting point temperature of the compositesolder sample was obtained. Improvements in the microhardness value and lap-shear strength were found for higher reinforcements of Si₃N₄ particulates, which revealed the formation of a more ductile fracture mode in the composite solder samples. The increasing addition of Si₃N₄ allowed the formation of homogeneous and finer dimples. Overall, the addition of Si₃N₄ particulates to the Sn-0.7Cu lead-free solder should be higher than 1.0wt%, as these compositions showed superior mechanical properties.