Microstructural and shear strength properties of RHA-reinforced Sn–0.7Cu composite solder joints on bare Cu and ENIAg surface finish

ABSTRACT

In this study, the joint effect of rice husk ash (RHA) reinforcement as an alternative silica source and electroless nickel immersion silver (ENIAg) surface finish on the intermetallic compound (IMC) formation and shear strength of the Sn–0.7Cu solder system was investigated. A series of plain and composite lead-free solder systems (Sn–0.7Cu−xRHA; x = 0, 0.01, 0.05 and 0.1 wt%) was successfully developed and subjected to reflow soldering on bare Cu and ENIAg surface finish. After conducting a comprehensive microstructural study using the scanning electron microscopy and energy dispersive spectroscopy techniques, the Cu_6Sn_5 and Cu_3Sn intermetallic compound (IMC) phases were observed at the interface of the Sn–0.7Cu−xRHA/Cu composite solder joints. On the other hand, the $(Cu,Ni)_6Sn_5$ and Ni_3Sn_4 IMC phases dominated the interface of the Sn–0.7Cu−xRHA/ENIAg counterparts. Given the promising potential of the ENIAg surface finish, the Sn–0.7Cu−xRHA/ENIAg exhibited IMC thickness values within a range of 3.81–4.74 µm as compared to the 6.13–9.3 µm range exhibited by the Sn–0.7Cu−xRHA/Cu counterpart. More so, the ENIAg surface finish was effective in improving the shear strength of the plain solder joint, with the Sn–0.7Cu/ENIAg exhibiting 13.44 MPa relative to the 11.5 MPa exhibited by the Sn–0.7Cu/Cu counterpart. Overall, the strengthening effect of the RHA reinforcement was well marked in the Sn–0.7Cu−xRHA/Cu composite solder joints with the composite having 0.1 wt% RHA exhibiting the highest shear strength (14.6 MPa) across the board.