전해 Ni BGA 기판상의 무연 Sn-Ag-(Cu)와 Sn-Cu 솔더의 계면반응, IMC형상과 접합부 신뢰성에 관한 연구

(Interfacial reaction, IMC morphology and joint reliability of Pb-free Sn-Ag-(Cu) and Sn-Cu solders on electrolytic Ni BGA substrate)

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Abstract

The interfacial reaction, change of intermetallic compound (IMC) morphology and shear strength of three Pb-free solders (Sn-3.5Ag, Sn-3.5Ag-0.7Cu and Sn-0.7Cu)/Ni joints during reflow at 255℃ for up to 20min were investigated. The reaction between the molten Sn-Ag-Cu solder and Ni layer resulted in the formation of two IMCs such as $(Cu,Ni)_6Sn_5$ and $(Ni,Cu)_3Sn_4$ at the interface. The $(Ni,Cu)_3Sn_4$ IMCs were needle-like type, while the $(Cu,Ni)_6Sn_5$ IMCs were cylinders with a hexagonal cross section and pointed tips. In the case of the Sn-0.7Cu solder, after the reaction time of 1min, needle-type $(Cu,Ni)_6Sn_5$ IMC with a hexagonal cross-section was formed and attached well on the Ni substrate. After reflow for 5min, the $(Ni,Cu)_3Sn_4$ IMC started to form under the $(Cu,Ni)_6Sn_5$ IMC. In addition, spaces existed in-between the $(Cu,Ni)_6Sn_5$ particles acted as the channels of liquid solder during reflow reaction. After prolonged reflow time, the upper $(Cu,Ni)_6Sn_5$ IMC detached itself from the interface. Also, the morphology of the $(Cu,Ni)_6Sn_5$ IMC changed from needle-type to dodecagonal-type with reflow time. In the ball shear test, the shear strength did not change much as a function of reflow time. In all the samples, the fracture occurred in the bulk solder. The result of shear test indicated that the shear strengths of the three Pb-free solders/Ni BGA joints could not be significantly related to the thickness and spalling phenomenon of the IMCs formed at the interface.