球矩陣式電子封裝中鎳與鉛錫合金及鉛鉍錫合金界面反應之研究

ABSTRACT

Two sets of experiments were carried out in this work. The first is the reaction between Ni and 63Sn37Pb (wt.%) solder, and the second is the reaction between Ni and 43Sn14Bi43Pb solder. The alloy 63Sn37Pb and 43Sn14Bi43Pb are widely used in electronic industry. Ni is used in many printed circuit board (PCB) and ball grid array (BGA) package surface finishes.

We carried out two parts of experiments. The first is the reaction between solid Ni and liquid solder, and the second part is the reaction between solid Ni and solid solder. In the reaction between solid Ni and liquid 63Sn37Pb, experiments were carried out at 190, 220, 250 and 280^{o}C for 3 to 192 hours. It was found that a reaction zone formed between Ni and 63Sn37Pb alloy. Reaction at 190^{o}C produced a thin reaction layer of Ni_3Sn_4. The average thickness of the reaction layer increased slowly with reaction time, reaching 9μm after 192 hours. Reactions at 220 to 280^{o}C produced thicker reaction layers with increasing reaction temperatures and time, and some Ni_3Sn_4 pieces were dispersed in the 63Sn37Pb alloy. The growth of Ni_3Sn_4 was diffusion controlled with an activation energy of 28 kJ/mol between 190~280^{o}C.

In the reaction between solid Ni and solid 63Sn37Pb, experiments were carried out at 100, 125, 150, and 175^{o}C for 25 4900 hours. It was found that Ni_3Sn_4 with layered structure formed between Ni and

63Sn37Pb alloy. Analysis using electron microprobe showed that Ni_3Sn_4 has the composition of 57.1±0.5 at.% Sn. The growth of Ni_3Sn_4 layer was diffusion controlled with an activation energy of 55 kJ/mol.

In the reaction between solid Ni and liquid 43Sn14Bi43Pb, experiments were carried out at 190, 220, 250 and 280 ^oC for 8 to 192 hours. It was found that a reaction zone formed between Ni and 43Sn14Bi43Pb alloy. Reaction at 190 ^oC produced a thin reaction layer of Ni_3Sn_4. The average thickness of the reaction layer increased slowly with reaction time, reaching 7μm after 192 hours. Reactions at 220 to 280^oC produced thicker reaction layers with increasing reaction temperatures and time, and some Ni_3Sn_4 pieces were dispersed in the 43Sn14Bi43Pb alloy. The growth of Ni_3Sn_4 was diffusion controlled with an activation energy of 18 kJ/mol between 190~280^oC.

In the reaction between solid Ni and solid 43Sn14Bi43Pb, experiments were carried out at 100 and 125^oC for 25 4900 hours. It was found that Ni_3Sn_4 with layered structure formed between Ni and 43Sn14Bi43Pb alloy. Analysis using electron microprobe showed that only Ni_3Sn_4 formed. The growth of Ni_3Sn_4 layer was diffusion controlled with an activation energy of 53 kJ/mol.