金濃度對球矩陣構裝錫點剪力強度影響之研究

[摘要]

The focus of the research work in this thesis was to think of the effect of gold concentration on shear strength of solder joints in the PBGA packaging. The PBGA substrates are used in core logic chipsets and graphic chipsets at present. The contact pads for solder balls on the PBGA substrates used in this study have the 0.4μm-Au / 8μm-Ni surface finish by electroplating. The diameter of the pads is 430 μm . The composition of the solder joints is 63Sn-37Pb (wt.%) used in the present electronic industry. For the reflow, the peak reflow temperature was 225℃, and the reflow time was 90 s. The research was to evaluate the reliability of the solder joints by measuring the shear strength of the solder joints on the PBGA substrates. The experiment was divided into two parts. The first part was the measurement of shear strength for solder joints aged at 160℃. The sizes of these solder joints before reflow are 750 μm ，600 μm ，and 450 μm in diameter, respectively. Therefore, the gold concentration for three kinds of solder joints is 0.07 wt.%，0.13 wt.%，and 0.31 wt.% respectively. The second part was the measurement of shear strength for solder joints during the process of RA500h160℃RA250h160℃RA250h160℃R. The sizes of these solder joints before reflow are 600 μm and 450 μm in diameter. Besides, we analyzed the fracture surface and cross-section view by SEM and EPMA.

After aging at 160℃ for 0 to 4318 hours, the shear strength for the three kinds of solder joints decreased. Among the three kinds of solder joints, the major difference was the aging time at which a sharp decrease in shear strength occurred. The sharply decreasing shear strength for 750-μm solder joints did not occur after a long term aging at 160℃. The average shear strength decreased slightly right after aging at 160℃. After 2500 hrs of aging at 160℃, the average shear strength decreased to 86% of the initial average shear strength (897g). The aging time of sharply decreasing shear strength for 600-μm solder joints was from 48 to 96 hours. After 96 hrs of

aging at 160℃, the average shear strength decreased to 85％ of the initial average shear strength (895g). However, the aging time of sharply decreasing shear strength for 450-μm solder joints was from 0 to 24 hours. After 24 hrs of aging at 160℃, the average shear strength decreased to 90％ of the initial average shear strength (860g). To sum up, the gold concentration between 0.07 wt.％ and 0.13 wt.％ would make the decreasing trend of the average shear strength change sharply. In addition, the gold concentration between 0.13 wt.％ and 0.31 wt.％ would make the initial average shear strength as a turning point. From the analytical results of the fracture surface, Ni, Ni3Sn4, (AuxNi1-x)Sn4, and solder existed in the fracture surface on the pad side. The fracture model of Ni3Sn4 was intergranular. But, the fracture model of (AuxNi1-x)Sn4 was transgranular. From the overall view of the fracture surface for 450-μm solder joints, the major fracture surface occurred inside the solder. This was because the cross-section area exerted by the initial shear force for 450-μm solder joints was close to the cross-section area of the pads. Nevertheless, the fracture surfaces for 600-μm and 750-μm solder joints occurred at Ni, Ni3Sn4, (AuxNi1-x)Sn4, and solder. There was a good possibility that the brittle fracture surface occurred. The proportion of Ni on the fracture surface increased, the shear strength of solder joints had the decreasing trend. Among the solder joints, the fracture surface on which the poorest shear strength occurred was made of Ni. The cross-section view right after reflow showed a thin layer Ni3Sn4 (2　3 μm) at the interface. From the analytical results of the cross-section view aged at 160℃ for 1500 hours, (AuxNi1-x)Sn4 would relocate from inside the solder joints to the interface, and the value of x for (AuxNi1-x)Sn4 at the interface was about 0.34 to 0.37. Moreover, the gold concentration inside the solder joints was the driving force for (AuxNi1-x)Sn4 to come back to the interface. The microstructure of solder coarsened, and this was one cause of the weak average shear strength for solder joints.

During the process of RA500h160℃RA250h160℃RA250h160℃R, we assured that further reflow could strengthen the average shear strength of solder joints

lost by aging at 160℃. But, the degree of strengthening would not at once make the average shear strength regain the initial average shear strength. However, after several reflow and aging cycles, the average shear strength could indeed come back to the initial value, and even be higher than the initial value.