

Chapter 5

Conclusions

We found that in thin-film UBM Ti 0.1 μm /Cr-Cu0.3 μm /Cu 0.7 μm / Sn63Pb37 /Au0.025 μm /Ni(P)5 μm /Cu20 μm , thermal aging reduced the solder bump resistance of electromigration(EM), when the sample is under 0.28A stress (average max. current density $1.8 \times 10^3 \text{A/cm}^2$). Void formed in between UBM and solder when we aged it before electromigration test. However, the opposite result was received from the experiment with thick-film UBM Ti0.1 μm /Cr-Cu0.3 μm /Cu0.7 μm /Sn63Pb37/Au 0.025 μm /Ni(P)5 μm /Cu20 μm . When the sample is subjected to suitable thermal aging time, 0.75A(average max. current density 10^4A/cm^2), its life time would from 430hr which didn't thermal aging to 868hr which thermal aging 25hr at 170 $^\circ\text{C}$. We easily found Ni₃Sn₄ in chip side is 0.82 μm thick which didn't thermal aging to 3.1 μm which thermal aging 170 $^\circ\text{C}$ 25hr. We speculated that thermal aging increases the thickness of IMC thicker is important reason for bump to resist EM behavior. This IMC layer may keep the solder away from the high current-density region and the hot-spot region. Therefore, the EM lifetime increased after 25hrs of aging. As aging time increased, although the thickness of the IMC continued to increase, the composition of the solder moved toward to eutectic composition. This change may decrease EM resistance. We use four-point probe to obtain middle state of thick-film bump in EM test. In thick-film sample we found in middle state its void was more series, but after aging void would not series and having IMC channel to form. We may, therefore, reasonably conclude that bump having suitable IMC between solder and UBM before EM test can prolong the solder-joint life time.