전해 도금법을 이용한 공정 납-주석 플립 칩 솔더 범프와 UBM(Under Bump Metallurgy)계면에 관한 연구

Interfacial Studies on the Electroplated Eutectic Pb/Sn Flip-Chip Solder Bump and UBM(Under Bump Metallurgy)

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Introduction

Flip-chip solder bump interconnections provide a very attractive solution for high density packaging with excellent advantages such as small size, high I/Os, handling capacity, quick and easy assembly, high reliability and good electrical performance. For the preparation of solder bumps on a chip, multi-layer thin films called UBM (Under Bump Metallurgy) are necessary as an adhesion, solder diffusion barrier, and solder wettable layers. However, there are some problems to use the solder containing high Sn because of its high diffusivity and reactivity with Cu. If solder-wetting Cu layer is completely consumed by rapid Cu-Sn IMC growth, solder could directly contact to the barrier layer which has usually poor solder wettability resulting in a bump delamination. In this paper, therefore, the interfacial reactions between several UBMs and eutectic Pb/Sn solder were investigated. And their effects on solder joint mechanical reliability were also investigated to optimize the UBM materials design for an eutectic Pb/Sn solder.

Experimemt

Various UBM systems such as 1㎛Al/0.2㎛Ti/5㎛Cu, 1㎛Al/0.2㎛Ti/1㎛Cu, 1㎛Al/0.2㎛Ni/1㎛Cu and 1㎛Al/0.2㎛Pd/1㎛Cu, laid under eutectic Pb/Sn solder of low melting point, were investigated with regard to their interfacial reactions and adhesion properties. The effects of numbers of solder reflow and aging time on the growth of intermetallic compounds (IMC) and on the solder ball shear strength were investigated.

Conclusions

Good ball shear strength was obtained with 1㎛Al/0.2㎛Ti/5㎛Cu and 1㎛Al/0.2㎛Ni/1㎛Cu even after 4 solder reflows or 7 day aging at 150℃. In contrast, 1㎛Al/0.2㎛Ti/1㎛Cu and 1㎛Al/0.2㎛Pd/1㎛Cu shows poor ball shear strength. The decrease of the shear strength was mainly due to the direct contact between solder and nonwettable metal such as Ti and Al resulting in a delamination. Thin 1㎛ Cu and 0.2㎛ Pd diffusion barrier layer were completely consumed by Cu-Sn and Pd-Sn reaction.