摘要

在現今實際 BGA 或 Flip Chip 銲點中，銲料的兩端分別為 UBM 或表面處理層。故一個實際銲點結構可視為一 metal/solder/metal 的三明治結構。而 Ni/solder/Cu 的結構又是微電子銲點中很常見的一種組合。故本研究主要的目的是要探討在此類的結構中，Cu/solder 及 Ni/solder 間的界面反應是否會互相影響。亦即在 Ni/solder/Cu 銲點之兩界面間是否會有交互作用？然而在本實驗室過去的研究中曾經證實[TSA2]，在 Flip Chip 銲點中兩界面之交互作用在迴銲完後就已發生。但由於在迴銲的過程中，兩端會有部分的金屬溶入銲料當中，使整個系統變的過於複雜。故在本研究中，我們使用電鍍的方式，製造出 Flip Chip 尺寸的 Ni/Sn/Cu 擴散偶。利用其不需經過複雜的迴銲過程的優點，來探討在單純 200 ℃的固態反應下，Cu、Ni 在銲料間交互作用的情況。並將之與作為對照組的單一 Ni/Sn、Cu/Sn 界面反應結果比較，觀察其三者間的差異。

在單純 200 ℃的固態反應 15 分鐘的時間。由金相觀察的結果發現，Ni、Cu 兩端界面皆生成 Cu-Sn 介金屬，其組成由 EPMA 分析得知為 Cu_6Sn_5 的介金屬。故我們可以得知，在此 Ni/Sn/Cu 擴散偶中，經過短時間的固態反應後，Cu 端 Cu 原子已擴散至 Ni 端影響其界面介金屬的生成。亦即此時 Cu、Ni 間的交互作用已經產生。經過長時間的反應，Ni、Cu 兩端生成的介金屬種類並沒有變化，在 Ni 端為$(Cu_{1-x}Ni_x)_6Sn_5$，Cu 端則為不含 Ni 的 Cu_6Sn_5 及 Cu_3Sn。但在介金屬的形態上，卻與一般固/固反應界面生成物的形態較為不同，會呈現較大的高低起伏。在反應動力學方面，在 Ni/Sn/Cu 系統中，經過長時間的固態反應後，當對端有 Cu 層存在時，使 Ni 界面生成以 Cu 為主的$(Cu_{1-x}Ni_x)_6Sn_5$，故會抑致 Ni 端 Ni 的消耗。相反的當對端有

Ni 層存在時，使兩端界面皆生成以 Cu 為主的介金屬 Cu_6Sn_5 及 Cu_3Sn，故會加速 Cu 端 Cu 的消耗。

Abstract

In a real solder joint, the solder is always sandwiches between two metals. And the Ni/solder/Cu combination is one of the most common one in microelectronics devices. The objective of this study is to investigate whether the cross-interaction will occur between the interface of solder/Cu and Ni/solder. In fact, it is reported that the two interfaces of Ni/solder/Cu joint would interact after reflow. Therefore, it is known that the dissolved metal results in the system become complex. As the result, the Ni/Sn/Cu diffusion couples were prepared by electroplating in this study to investigate the cross-interaction of Cu and Ni in solder joint only in solid/solid reaction. Experiments were carried out at 200 ℃ for 15 minutes. It was found that Cu_6Sn_5 compound existed at both Ni/Sn and Cu/Sn interface. Basing on the result, we can say that the cross-interaction of Ni and Cu in a solder joint occurred very quickly at 200 ℃thermal aging.

After long term thermal aging, the reaction product didn't change at both Ni/Sn and Cu/Sn interface. There is$(Cu_{1-x}Ni_x)_6Sn_5$ at Ni/Sn interface and Cu_6Sn_5、Cu_3Sn at Sn/Cu interface.Beside it, we found that the microstructure of these reaction product is different from Sn/Cu and Sn/Ni diffusion couple. In other words, the morphology of IMC is largger variation than Sn/Cu and Sn/Ni diffusion couple. In thermodynamic kinetics, it has been show that the formation of of $(Cu_{1-x}Ni_x)_6Sn_5$ over the Ni layer can reduce the Ni consumption rate. At the same time, the Cu consumption rate of the opposite side was accelerated.