摘要

因為銅良好的銲接性質，因此成為電子封裝產業中最被廣泛使用的金屬墊層之一。近幾十年來關於銅/錫系統的研究也引發各界興趣，相關資料已經相當深入且完整。但在我們重視的溫度範圍內(室溫~250℃)，依然有些現象無法提出完整的證據與合理解釋，甚至對於某些現象的認知上有著不同的觀點。尤其在Cu_6Sn_5中主要擴散元素的研究仍然沒有切確的答案。

根據之前相關的研究指出，在室溫條件下，銅原子在Cu_6Sn_5內具有較快的擴散速度，因此反應會發生於Cu_6Sn_5/Sn的界面。當溫度升高至 200℃以上時，錫原子將取代銅原子成為主要的擴散元素。其實這樣的結果相當合理。因為當溫度升高，空孔擴散速率增加，將取代格隙擴散與晶界擴散，成為主要的擴散機制。所以當溫度升高時，錫原子的擴散速率也會超越銅原子。但這些現象的描述還是缺乏有利的證據，而且當溫度範圍介於室溫~200℃時，Cu_6Sn_5中主要擴散元素的研究資料也不夠完整，因此我們希望能設計一個實驗，將此現象作一個更完整的解釋與驗證。

為了能清楚判斷在Cu_6Sn_5中何種元素具有較快的擴散速率，我們在銅/錫擴散偶中設計了可判讀主要擴散元素的標記物。並在 100℃，130℃，160℃與 200℃下進行時間不等的熱處理。實驗的結果顯示，當溫度從 100℃上升到 200℃，標記物的移動方向皆往錫端靠近，最後會位在Cu_6Sn_5/Sn的界面處或進入到Cu_6Sn_5內部。此結果明顯的指出，當溫度介於 100℃~200℃範圍時，錫原子在Cu_6Sn_5內是主要的擴散元素。

除了根據標記物的位置判斷Cu_6Sn_5中的主要擴散元素外，我們更進一步利用Cu_6Sn_5：Cu_3Sn的厚度比例，加上標記物和介金屬最後的相對位置，假設簡單的模型並搭配實驗結果，排列出銅原子與錫原子在Cu_6Sn_5與Cu_3Sn內擴散速度的大小關係。並且探討了標記物寬度對原子擴散的影響。

ABSTRACT

Cu is the most common conductor metal, which is utilized in contact with solders owing to its good solderability characteristics when proper coatings are used. The interfacial reactions between solid Cu and Sn are of special interest and have been investigates thoroughly during the past decades. However, the results are not entirely in agreement and some of them are even contradictory to each other in our concerning temperature range (from room temperature up to 250℃). Especially, the main diffusing species in the Cu_6Sn_5 differs from one investigation to another.

From the results of the previous investigation, it presented that Cu is the main diffusing species at room temperature, and the reaction will occur at the Cu_6Sn_5/ Sn interface. When temperature increases up to 200 ℃, diffusion of Sn starts to control the growth of the Cu_6Sn_5. This is rational, since as the temperature is increased, volume diffusion starts to dominate and grain boundary and interstitial diffusion of Cu does not play such a big role anymore. But no further evidence was provided to support this statement and the data of main diffusing species in η-phase between room temperature to 200 ℃ was not complete enough .We hope to design a experiment to confirm these phenomenon.

To determine whether Cu or Sn is the dominant diffusing species, in my study, a marker experiment has been performed at temperature from 100℃ to 200 ℃ by using of a flash W as diffusion markers. When Cu/Sn diffusion couples were aged at 100 ℃, 130 ℃, 160 ℃, and 200 ℃ for different time, markers all move toward Sn side and located at Cu_6Sn_5/Sn interface. The results showed that Sn is the main diffusing species in Cu_6Sn_5 from 100 to 200 ℃.

From the site where markers located and the Cu_3Sn/Cu_6Sn_5 ratio changed at different temperature, we hypothesize a simple model to match up our experiment results. Finally, we discuss the influence of marker width to atoms diffusion.