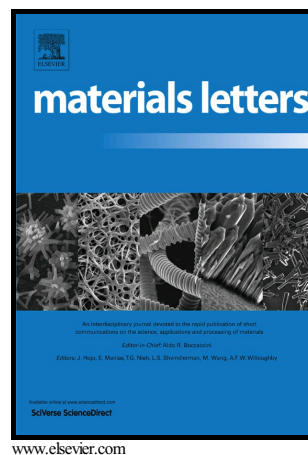


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Suppression of Cu₃Sn layer and formation of multi-orientation IMCs during thermal aging in Cu/Sn-3.5Ag/Cu-15Zn transient liquid-phase bonding in novel 3D-IC Technologies

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Abstract

The evolution of grain structures and microstructures in Cu/Sn-3.5Ag/Cu-xZn (x=0 or 15 wt%) TLP bonding before and after aging were investigated. Cu-Sn intermetallic compounds (IMCs) with a strong [001] orientation rapidly form from the Cu pads and cause impingement in TLP bond, allowing cracks to easily propagate. During aging, the Cu₆Sn₅ becomes one layer with a homogeneous structure, thick Cu₃Sn layers form, and Kirkendall voids occur at bonding interfaces, causing degradation of bonding strength. This study demonstrates that doping Zn into one of the Cu substrates efficiently retains the multi-orientation structure of Cu-Sn IMCs and suppresses the formation of Cu₃Sn during long-time aging. The Cu/Sn-3.5Ag/Cu-15Zn TLP bonding is potentially useful in strengthening the interconnections for novel 3D-IC technologies.

Keywords: Crystal structure; Electron microscopy; Intermetallic alloys and compounds; Metals and alloys; Electronic materials; Semiconductors

1. Introduction

For high quality wafer bonding in 3D-IC technologies, transient liquid phase (TLP) bonding provides a bonding scheme with a low bonding temperature, yet the bonded layer can tolerate high

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