

**Microbumps and Electromigration:** As the electronics industry pushes the boundaries of miniaturization to the angstrom level, reliability is a growing concern. One area of focus is the solder microbump, used to interconnect chips within multichip modules, and to connect chip packages to printed circuit boards (PCBs). As microbumps shrink and the current density flowing through them increases, a phenomenon called electromigration (EM) is more likely to damage them. EM is where the flow of electric current actually causes the conductor material to move, creating voids or short circuits within it. A better understanding is needed of how EM occurs in materials commonly used to make ultrasmall microbumps, and how it can be prevented.

At ECTC, TSMC researchers will describe studies they conducted to do that. They investigated the EM performance of microbumps made from Cu/Sn and Cu/Ni/Sn/Cu in a full, complete intermetallic compound (IMC) structure. IMC is the interface layer where the solder and the base metal meet. It is formed during the soldering process. The researchers will report that full IMC microbumps are robust enough to withstand EM. Further, when EM does occur its main failure mode is failure of the aluminum (Al) traces, caused by the electromigration of Al atoms. This finding underscores the importance of forming full IMC joints to enhance the reliability of microbumps in demanding applications such as high-performance computing. **(Paper 28.4, *“The Influence of Full IMC Structure on Micro-Bump Electromigration Performance,”* Chung-Yu Chiu et al, TSMC)**

* **The image above** is a schematic diagram showing how the microstructures of (a) Cu/Sn and (b) Cu/Ni/Cu/Sn non-full IMC microbumps changed during electromigration testing, culminating in the failure of aluminum traces.

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