

# Study of Solderless Interconnect Technology Process : Ageing of Pressfit Connectors

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Salle conférence bâtiment André RASSAT

## **Jury :**

Philippe GENDRE, DOCTEUR EN SCIENCES, PEM	Examineur
Muriel VERON, PROFESSEUR DES UNIVERSITES, Grenoble INP	Examineur
Yves BIENVENU, PROFESSEUR EMERITE, MINES ParisTech	Examineur
Olivier THOMAS, PROFESSEUR DES UNIVERSITES , Aix-Marseille Université	Rapporteur
Damien FABREGUE, PROFESSEUR DES UNIVERSITES, INSA Lyon	Rapporteur

**Abstract:** Tin alloys are widely used to make solder connections for electrical components or connectors. They are usually deposited as thin films. On these deposits surface, whiskers (monocrystalline filaments with micrometric diameters) can appear during ageing.

The understanding of the key parameters which lead to the whiskers on thin tin films electrodeposited on copper alloy base material (generally used in pressfit automotive connectors) is of paramount importance. Indeed, these whiskers can generate short circuits between connectors, which affects the reliability of these connector systems. Several intrinsic (thickness and type of tin, growth of intermetallic compounds, presence of a diffusion barrier underlayer, ...) and extrinsic (environmental conditions, compressive stress, ...) physicochemical parameters play an important role.

In this work, we first identified the different growth kinetics of intermetallic compounds within the tin layer by means of microstructural characterizations carried out on three types of tin (matte, bright and reflowed). We also correlated these observations with the whisker densities obtained for different thicknesses of electrodeposited tin. Furthermore, using the  $\sin^2\psi$  method in XRD, residual stress measurements in the tin showed that the layer generally remains under compressive stress.

Without using a nickel underlayer acting as a diffusion barrier, the analyses showed that increasing the deposition thickness from 0.5 to 4 $\mu$ m considerably decreases the whisker density for the three types of tin (matte, bright and reflowed) because thicker layers better relax the compressive stresses, which are the consequence of the formation of copper-tin intermetallic compounds (mainly Cu<sub>6</sub>Sn<sub>5</sub>). The presence of nickel as an underlayer completely eliminates the growth of whiskers.

Furthermore, the study of the finished product resulting from a 'pressfit' process (tinned connector inserted in a printed circuit board) enabled us to show that, despite the presence of a nickel underlayer, whiskers have developed on the tin which is extruded during the pressfit insertion. Finally, Laue microdiffraction analyses have shown that only pure tin is extruded and that the growth of whiskers on these chips is, among other things, the consequence of a high residual stress field. The large grain

size of the extruded tin seems to show that dynamic recrystallization mechanisms (DRX) have mechanisms have certainly operated.