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**DIFFRACTION ANALYSIS OF STRESS GRADIENTS IN
TIN THIN FILMS: AN EXPLANATION FOR THE OCCURRENCE
OF WHISKER FORMATION?**

M. Sobiech,^{1,2} U. Welzel,^{1,*} E.J. Mittemeijer,¹ W. Hügel,² & A. Seekamp²

¹ Max Planck Institute for Metals Research, Heisenbergstr. 3,
D-70569 Stuttgart, Germany

² Robert Bosch GmbH, Dieselstraße 6, D-72770 Reutlingen, Germany

* contact author; u.welzel@mf.mpg.de

Sn thin films (layer thicknesses of some microns) on Cu substrates have been prepared by electrodeposition. Upon subsequent storage at ambient temperatures, Cu diffuses into the Sn thin film and the formation of an intermetallic compound η' -Cu₆Sn₅ takes place at the Cu/Sn-interface, and in particular also along the Sn grain boundaries intersecting the Sn/Cu interface. The η' -Cu₆Sn₅ formation is accompanied by a volume expansion and as a consequence, compressive residual stresses can be generated in the Sn thin films. During storage at ambient temperatures whiskers form on the Sn surface. Filamentary Sn-whisker growth can cause short circuits in microelectronic devices and therefore Sn-whiskers became a serious issue in high-reliability applications.

The microstructural development, phase formation and residual stress evolution during ageing at ambient temperatures have been investigated employing scanning electron and focused ion beam microscopy, electron backscatter diffraction, X-ray photoelectron spectroscopy and, in particular, X-ray diffraction. Residual stress gradients at different ageing times have been determined by means of laboratory X-ray diffraction measurements at controlled penetration/information depths. The driving force for spontaneous Sn-whisker formation will be related to the measured stress-depth gradients.