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Orientation-depedent mechanical behaviour of electrodeposited copper with nanoscale twins

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ORIENTATION-DEPENDENT MECHANICAL BEHAVIOUR OF ELECTRODEPOSITED COPPER WITH NANOSCALE TWINS

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Key Words: twin boundary engineering, Nanotwinned Cu, microcompression

The electrodeposition of copper is an important technology for the fabrication of micro-components and interconnects. In contrast to nanocrystalline copper, nanotwinned Cu (nt-Cu) exhibits remarkable strength, ductility and electrical conductivity[1]. Our recent work[2] reported the possibility to deposit copper samples with highly-oriented nanoscale twins by pulse electrodeposition. The twin orientation was altered from horizontal to vertical by changing the applied potential and the twin spacing was controlled with pulse-off time.

In this poster, we report the orientation-dependent mechanical properties of electrodeposited copper with nanoscale twins confined within micron-sized columnar grains. The strength and strain rate sensitivity are investigated with respect to the twin orientation by micro-pillar compression. A strong anisotropy is observed between both orientations. A higher strength and strain rate sensitivity is measured for micro-pillars with horizontal twins when compared to vertical twins. Mechanisms responsible for this effect are explored through post-deformation SEM and FIB imaging. The plastic anisotropy was related to the change in critical resolved shear stress in twinned slip system. The experimental work shows the possibility to tailor the mechanical properties of nt-Cu by grain boundary engineering.

[1] M. Dao, L. Lu, Y.F. Shen, and S. Suresh, Acta Mater. **54**, 5421 (2006).
[2] M. Hasegawa, M. Mieszala, Y. Zhang, R. Erni, J. Michler, and L. Philippe, Electrochem. Acta (2015), Accepted for publication, doi:10.1016/j.electacta.2015.08.022.

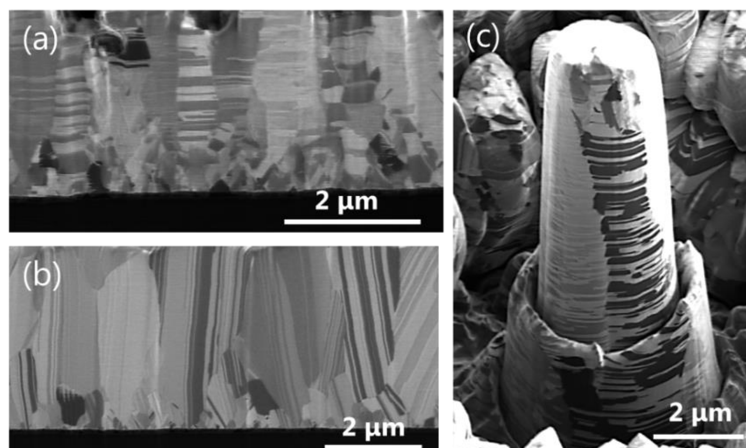

Figure 1 – Cross-section images (a) (111)-textured and (b) (112)-textured copper films. (c) FIB micrograph of a micropillar.