MECHANICAL TESTING OF TWINNED COPPER AND COPPER ALLOY MICROPILLARS

Sebastian Krauß, Friedrich-Alexander-University Erlangen-Nürnberg (FAU)
sebastian.s.krauss@fau.de
Jan Philipp Liebig, Friedrich-Alexander-University Erlangen-Nürnberg (FAU)
Mathias Göken, Friedrich-Alexander-University Erlangen-Nürnberg (FAU)
Benoit Merle, Friedrich-Alexander-University Erlangen-Nürnberg (FAU)

Key Words: nanotwin, nanoindentation, micropillar, copper, stacking-fault energy

Nanotwinned metals are a promising class of modern materials combining a very high strength and ductility with excellent electrical properties. Their remarkable strength is connected to the high effectiveness of twin boundaries as obstacles to dislocation motion. In order to further characterize these interactions, micropillars containing single coherent twin boundaries with different orientations were compressed with a flat punch and subsequently investigated in the scanning electron microscope. The crystal orientations for compression were selected to activate different slip modes. The aim is to probe the different barrier effects that can act on gliding dislocations. The investigations concentrated on copper and α-brass. The latter is a low stacking-fault energy alloy exhibiting a high density of recrystallization twins. Coherent twin boundaries were selected from an EBSD orientation mapping of the sample and oriented by means of a custom sample holder. FIB-milling at these interfaces yielded micropillar samples containing a single twin boundary. Single crystal reference samples were obtained from the bulk of the grain located on both sides of the twin boundary. The microcompression tests enabled the quantification of the influence of the twin boundary barrier on the strength of each sample. The tests evidenced a strong dependency of the strength of the sample on crystal orientation and stacking-fault energy. The activated glide systems were subsequently identified from slip trace analysis and STEM mapping of lamellas obtained by FIB lift-out from the bulk of the tested micropillars.

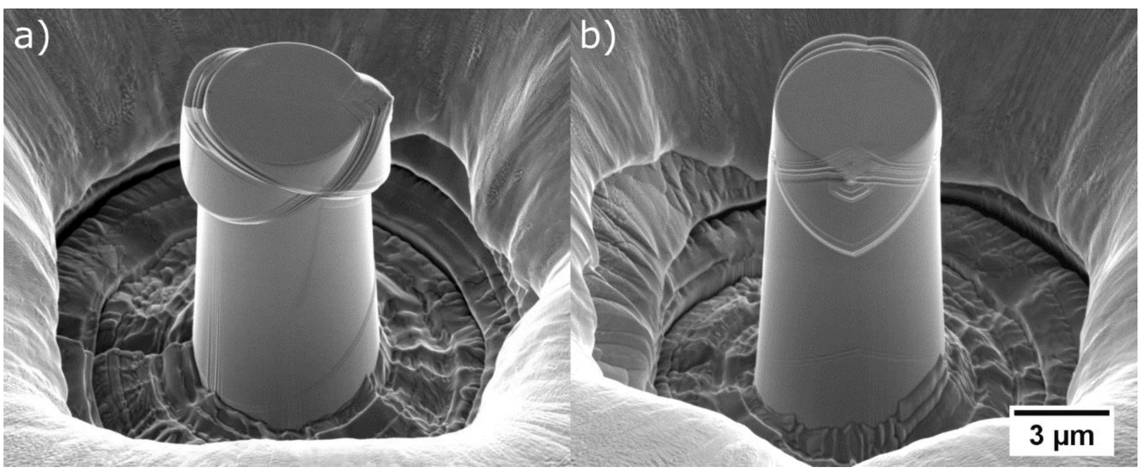

Figure 1 – Post testing SEM Image of a CuZn30 Micropillar a) Front view b) Side view