MECHANICAL TESTING OF COPPER AND COPPER ALLOY MICROPILLARS CONTAINING A SINGLE TWIN BOUNDARY

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Nanotwinned metals are a promising class of modern materials combining a very high strength with a high ductility and excellent electrical properties. This remarkable strength is believed to be connected to the good efficiency of twin boundaries as obstacles to dislocation motion. The present study aims at identifying and characterizing the possible interaction modes between dislocations and coherent twin boundaries. This is achieved by compressing micropillars containing a single twin boundary of a controlled orientation. The influence of the stacking fault energy on the intrinsic strength of the twin boundary is also investigated by varying the investigated material.

In detail, the micropillars are fabricated from recrystallized polycrystalline samples of copper and α-brass, which is a low stacking-fault energy alloy exhibiting a high density of recrystallization twins. Coherent twin boundaries are selected from an EBSD orientation mapping of the sample and oriented by means of a custom 3D-printed sample holder. FIB-milling at these interfaces yields micropillar specimens containing a single twin boundary. Single crystalline reference samples are obtained from the bulk of the grains located on both sides of the twin boundary. The microcompression tests allow quantifying the influence of the twin boundary barrier on the strength of the sample as a function of the stacking fault energy of the material. The activated glide systems are subsequently identified from slip trace analysis and STEM mapping of lamellas obtained by lift-off from the bulk of the tested micropillars. This allows identifying the different deformation modes, which will be discussed in the presentation.