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Combining in situ tensile testing and orientation microscopy in the SEM: A MEMS based setup for studying time dependent deformation of thin films by TKD and STEM

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COMBINING IN SITU TENSILE TESTING AND ORIENTATION MICROSCOPY IN THE SEM: A MEMS BASED SETUP FOR STUDYING TIME DEPENDENT DEFORMATION OF THIN FILMS BY TKD AND STEM

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Structures in integrated devices are constantly subjected to residual or thermal stresses during operation. Understanding the relaxation behavior of thin films is therefore critical for improving their reliability.
Recently it was shown that Transmission Kikuchi Diffraction (TKD) in the Scanning Electron Microscope (SEM) enables the determination of local crystal orientations with high spatial resolution using standard Electron Backscatter Diffraction (EBSD) instrumentation [1, 2]. Giving access to quantitative information on mechanisms like grain growth, grain rotation and strain gradient evolution, time resolved TKD stands out as a promising technique for the characterization of microstructural changes upon relaxation of thin films.
We have implemented a MEMS based tensile device [3] into a custom setup specifically designed for in situ TKD imaging inside the SEM. A scanning TEM detector is used complementarily to access shorter time scales. In this context, a novel technique for the preparation and mounting of freestanding thin film tensile samples is presented, which relies on focused ion beam (FIB) milling and selective, electron-beam-assisted etching of silicon membranes. First stress relaxation results of tests on fcc metallic thin films are shown to demonstrate the capabilities of time resolved TKD.

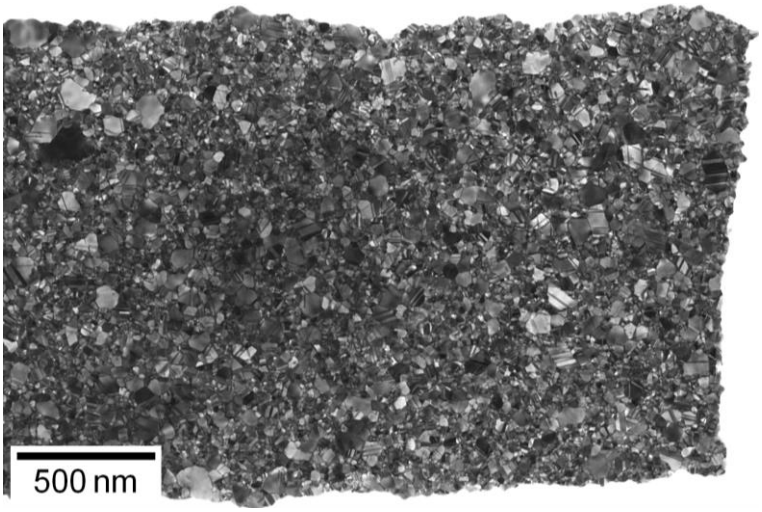

Figure 1 – STEM micrograph of a 30 nm thick gold specimen after fracture

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