# Quantitative grain growth and rotation probed by in-situ TEM straining and orientation mapping in small grained Al thin films

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In small grain materials, grain boundary (GB) mechanisms are expected to play an important role in the plastic accommodation. Both experimental and theoretical studies have evidenced shear coupled GB migration leading to grain growth. Contrary to grain growth that can be easily evidenced, observations of grain rotation remains limited. Experimental evidence are hard to capture in small-grained materials and might lead to artefacts like sample rigid rotation. Recent efforts to unravel elementary GB mechanics mostly focused on individual straight low index coincident GB, and the analysis of the collective behavior of a realistic GB network is still in its infancy. We have developed an original methodology combining sequential in-situ straining experiments on MEMS-supported polycrystalline thin films followed by automated crystal orientation mapping in a TEM and a custom-made data processing. This configuration allows both dynamical observations of elementary mechanisms, analysis of GB evolution in individual grain and statistical analysis at large scale. We have shown that grain growth and rotation are limited to areas where the stress is concentrated. These mechanisms are carried out by the nucleation and propagation of GB dislocations that were observed in-situ. Grain rotation was found, as for grain growth, to be a direct consequence of GB dislocation motion with a Burgers vector out of the film plane.