PROBING GRAIN BOUNDARY RELAXATION IN ULTRA-FINE GRAINED TANTALUM BY MICROMECHANICAL SPECTROSCOPY IN AN SEM

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The study of grain boundaries (GBs) in polycrystalline materials is a field of major interest, since many physical properties, such as thermal and electrical conductivity, magnetic coercitivity, strength or fracture toughness, are influenced by the actual structure of GBs. One of the main challenges in investigating them is the fact that techniques capable to resolve their structure, for example transmission electron microscopy, require very small sample volumes. However, the necessary removal of the surrounding material might change the natural state of the GB by elimination of surrounding material constraints. To counteract this influence, one could apply indirect measurements such as internal friction to probe changes in the GB structure. However, given the ongoing trend towards miniaturization and integration, most of these macroscopic techniques are at their limit.

In our current work, we developed a miniaturized technique for performing mechanical spectroscopy based on micronized bending beams in conjunction with a nanoindenter equipped with a continuous stiffness measurement module in-situ in a scanning electron microscope (SEM). We apply this miniaturized spectroscopy technique to study grain boundary relaxations of ultra-fine grained tantalum micro bending beams in-situ in the SEM, where we assess the influence of a thermal relaxation treatment on the GB structure.