EXPLORING THE MECHANICAL CHARACTER OF MOLYBDENUM GRAIN BOUNDARIES VIA NANOINDENTATION AND THREE-POINT-BENDING

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The interactions of interfaces with dislocations have been extensively studied in the past. Still, there is a lack of high throughput methods, which can potentially be used for systematic studies to cover a wide range of grain boundary types. Nanoindentation offers the opportunity to combine a high spatial resolution with high effectiveness, thus enabling to obtain comprehensive mechanical data in the vicinity of grain boundaries. The present study on coarse-grained molybdenum will show results of mechanical property mapping near grain boundaries. Here, for the first time also the indenter tip rotation angle with respect to the loading axis as well as the grain orientation are considered. Results will show that neglecting these parameters can bias interpretations of the interface/dislocation interactions, as the localized deformation paths around the indentation are thereby significantly changed.

Systematic experiments on commercially pure, recrystallized molybdenum have been performed to investigate the dependence of the hardness increase near grain boundaries with respect to the boundary misorientation angle. As a complementary method, three-point-bending is applied on mm-sized specimens until individual grain boundaries delaminate, which in turn will be identified and cross-checked with findings of the nanoindentation tests. Doping molybdenum with elements like carbon and/or boron is known to suppress intercrystalline failure. For this reason, the presented grain boundary characterization methods will be applied to extract mechanical changes caused by these doping elements.