Evolution of dislocation patterning under µN-nanoindentation and interactions with low-angle boundary in a bulk single crystal of medium entropy alloy

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The dislocation-Grain Boundary (GB) interactions significantly influence the yield strength of materials as proven by the Hall-Petch relationship [1-2]. However, this relationship does not provide the fundamental deformation mechanims in the vicinity of an individual and isolated GB. Few studies have experimentally cope with this issue by isolating a specific GB, introducing local deformation near it, and observing changes of the deformation microstructure [3] and/or mechanical properties [4]. Although such studies suggest that distinct GBs differently accommodate plastic deformation, they have not been able to determine to what extent and how dislocations interact with different and individual GBs on different length scales.

In this work, dislocation-Low-Angle GB (LAGB) interactions were studied in a single crystal of the equiatomic CrCoNi medium-entropy alloy. Local plastic deformation at varying distances from the LAGB was carried out using a µN-nanoindenter with a Berkovich indenter tip. Microstructural characterization around the LAGB was performed prior to and after plastic deformation using Accurate Electron Channeling Contrast Imaging [5,6] and Electron BackScatter Diffraction (EBSD). Nanoindentation Induced Dislocations (NID) and their patterning were tracked. The interaction of the NID with local microstructure and the LAGB was also studied on the mesoscale. The results shed light on the room-temperature plasticity of CrCoNi medium-entropy alloy.

References

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