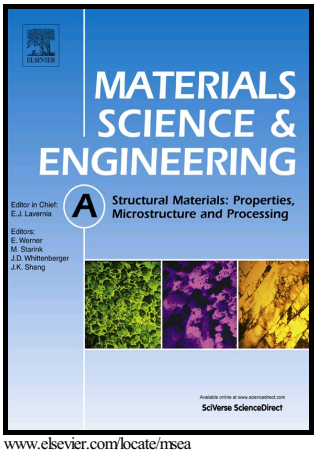
Interplay of stresses, plasticity at crack tips and small sample dimensions revealed by in-situ microcantilever tests in tungsten

Johannes Ast, Mikhail Polyakov, Gaurav Mohanty, Johann Michler, Xavier Maeder



www.elsevier.com/locate/msea

PII: S0921-5093(17)31424-7
DOI: https://doi.org/10.1016/j.msea.2017.10.096
Reference: MSA35699

To appear in: *Materials Science & Engineering A*

Received date: 15 August 2017
Revised date: 26 October 2017
Accepted date: 27 October 2017

Cite this article as: Johannes Ast, Mikhail Polyakov, Gaurav Mohanty, Johann Michler and Xavier Maeder, Interplay of stresses, plasticity at crack tips and small sample dimensions revealed by in-situ microcantilever tests in tungsten, *Materials Science & Engineering A,* https://doi.org/10.1016/j.msea.2017.10.096

Interplay of stresses, plasticity at crack tips and small sample dimensions revealed by in-situ micro-cantilever tests in tungsten

Johannes Ast*, Mikhail Polyakov, Gaurav Mohanty, Johann Michler and Xavier Maeder

*Corresponding author: Johannes Ast, johannes.ast@empa.ch, +41-587656385

EMPA, Swiss Federal Laboratories for Materials Science and Technology, Laboratory for Mechanics of Materials and Microstructures, Feuerwerkerstr. 39, 3602 Thun, Switzerland.

Keywords: Tungsten, EBSD, fracture mechanics, microcantilever tests, in-situ testing

Abstract

The evolution and distribution of stresses and geometrically necessary dislocation densities during microcantilever testing were studied in-situ in a scanning electron microscope using high-angular resolution electron back scatter diffraction. Focused ion beam milling was used to prepare the beams with dimensions of ca. 5-7 µm in height and width and 20 µm in length in a tungsten single crystal along a <100> axis. Unnotched cantilevers were tested to gain insight into dislocation mechanisms leading to significant strengthening during loading. Locally increased yield and flow stresses were linked to pronounced stress gradients on specific slip planes and dislocation pile-ups at regions of zero stress. The limited plastic deformation behaviour of tungsten at room