Depth-sensing cyclic nanoindentation of tantalum

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PII: S0263-4368(16)30842-3
DOI: doi: 10.1016/j.ijrmhm.2017.03.015
Reference: RMHM 4436

To appear in: *International Journal of Refractory Metals and Hard Materials*

Received date: 21 December 2016
Revised date: 15 March 2017
Accepted date: 21 March 2017

Please cite this article as: M. Haghshenas, R.J. Klassen, S.F. Liu , Depth-sensing cyclic nanoindentation of tantalum. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Rmhm(2017), doi: 10.1016/j.ijrmhm.2017.03.015

Depth-sensing cyclic nanoindentation of Tantalum

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Abstract

In the present paper, depth-sensing multi-cycling instrumented indentation testing of tantalum is studied to assess depth-dependent plastic deformation of the metal at room temperature. Loading/unloading/reloading Ffigscheme in cyclic indentation testing is a reliable indentation-based approach in which data collection is not necessarily adversely affected by lateral in-homogeneities of the sample leading to more accurate measurements. The experimental results show indentation size effect (ISE) and depth-dependent strain rate sensitivity in Ta. To interpret these phenomena, the density of geometrically necessary dislocations (GNDs) and statistically stored dislocations (SSDs) constructed by the Nix-Gao model were used. The observed dependence of hardness and activation volume upon indentation depth indicated that the average flow stress, and hence the average plastic strain, is higher around the small indentations than around the deep indentations.

Keywords: Hardness; tantalum; depth-sensing; cyclic indentation; BCC; strain rate sensitivity.