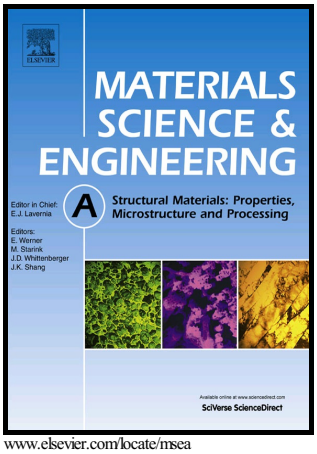
Mechanisms of Plastic Deformation in Ultrafine-Grained Aluminium - in-situ and ex-post studies

Witold Chrominski, Malgorzata Lewandowska



www.elsevier.com/locate/msea

PII: S0921-5093(17)31691-X
DOI: https://doi.org/10.1016/j.msea.2017.12.083
Reference: MSA35925

To appear in: *Materials Science & Engineering A*

Received date: 19 October 2017
Revised date: 18 December 2017
Accepted date: 21 December 2017

Cite this article as: Witold Chrominski and Malgorzata Lewandowska, Mechanisms of Plastic Deformation in Ultrafine-Grained Aluminium - in-situ and ex-post studies, *Materials Science & Engineering A,* https://doi.org/10.1016/j.msea.2017.12.083

Mechanisms of Plastic Deformation in Ultrafine-Grained Aluminium - in-situ and ex-post studies

Witold Chrominski (corresponding author), Malgorzata Lewandowska

Warsaw University of Technology, Faculty of Materials Science and Engineering, Woloska 141, 02-507 Warsaw, Poland

wichr@inmat.pw.edu.pl

tel. +48 (22) 2348441

Abstract

The microstructure of a 1050 aluminium alloy produced by hydrostatic extrusion varies in terms of grain boundary characteristics and the dislocation substructure depending on the grain orientation. This leads to a variance of plastic deformation mechanisms under external load. In this paper, the microstructure of as-extruded samples was compared to extruded and deformed in a bulk compression test to follow the reaction of various grains to external strain. In-situ TEM straining experiments were performed to study the variance of mobile dislocation activities depending on the local dislocation substructure in as-extruded material to deduce the operative deformation mechanism. These experiments accompanied with a estimation of strengthening mechanisms allowed to explain the role of different grains in the plastic deformation of ultrafine grained aluminium treated as a heterogenous complex system. It is demonstrated that well-developed ultrafine grains are responsible for providing strength since no intergranular dislocation intersections were reported but the motion of grain boundary dislocations or dislocation annihilation in boundaries. At the same time, relatively large grains with well developed dislocation