Available online at www.sciencedirect.com

ScienceDirect

www.elsevier.com/locate/matchar

# Orientation dependence of the dislocation microstructure in compressed body-centered cubic molybdenum

S. Wang[a], M.P. Wang[a], C. Chen[a,b,*], Z. Xiao[a], Y.L. Jia[a], Z. Li[a], Z.X. Wang[b]

[a]School of Materials Science and Engineering, Central South University, Changsha 410083, China
[b]School of Metallurgy and Environment, Central South University, Changsha 410083, China

ARTICLE DATA

*Article history:*
Received 14 December 2013
Received in revised form
4 February 2014
Accepted 5 February 2014

*Keywords:*
Mo
Deformation structure
Dislocation boundaries
Transmission electron microscopy (TEM)
Electron backscatter diffraction (EBSD)

ABSTRACT

The orientation dependence of the deformation microstructure has been investigated in commercial pure molybdenum. After deformation, the dislocation boundaries of compressed molybdenum can be classified, similar to that in face-centered cubic metals, into three types: dislocation cells (Type 2), and extended planar boundaries parallel to (Type 1) or not parallel to (Type 3) a {110} trace. However, it shows a reciprocal relationship between face-centered cubic metals and body-centered cubic metals on the orientation dependence of the deformation microstructure. The higher the strain, the finer the microstructure is and the smaller the inclination angle between extended planar boundaries and the compression axis is.


## 1. Introduction

Plastic deformation plays an important role in developing new materials for a variety of applications. It is an efficient way to change the shape of materials. Meanwhile, it can change the properties of materials by changing their texture and microstructure. Therefore, special attention has been paid on the plastic deformation behaviors in material science. Study on the deformation-induced dislocation structure has been made for several decades. Face-centered cubic (FCC) crystal structure and body-centered cubic (BCC) crystal structure are two common crystal structures of metals used in our daily life, such as Al, Cu, Fe and refractory metals. Many studies have been done both on their plastic deformation and phase transformation. It has been found that plastic deformation of FCC or BCC metals with medium-to-high stacking fault energy results in the formation

* *Corresponding author at:* School of Materials Science and Engineering, Central South University, Changsha 410083, China. Tel.: +86 731 88830264; fax: +86 731 88876692.
E-mail address: chench011-33@163.com (C. Chen).

http://dx.doi.org/10.1016/j.matchar.2014.02.001

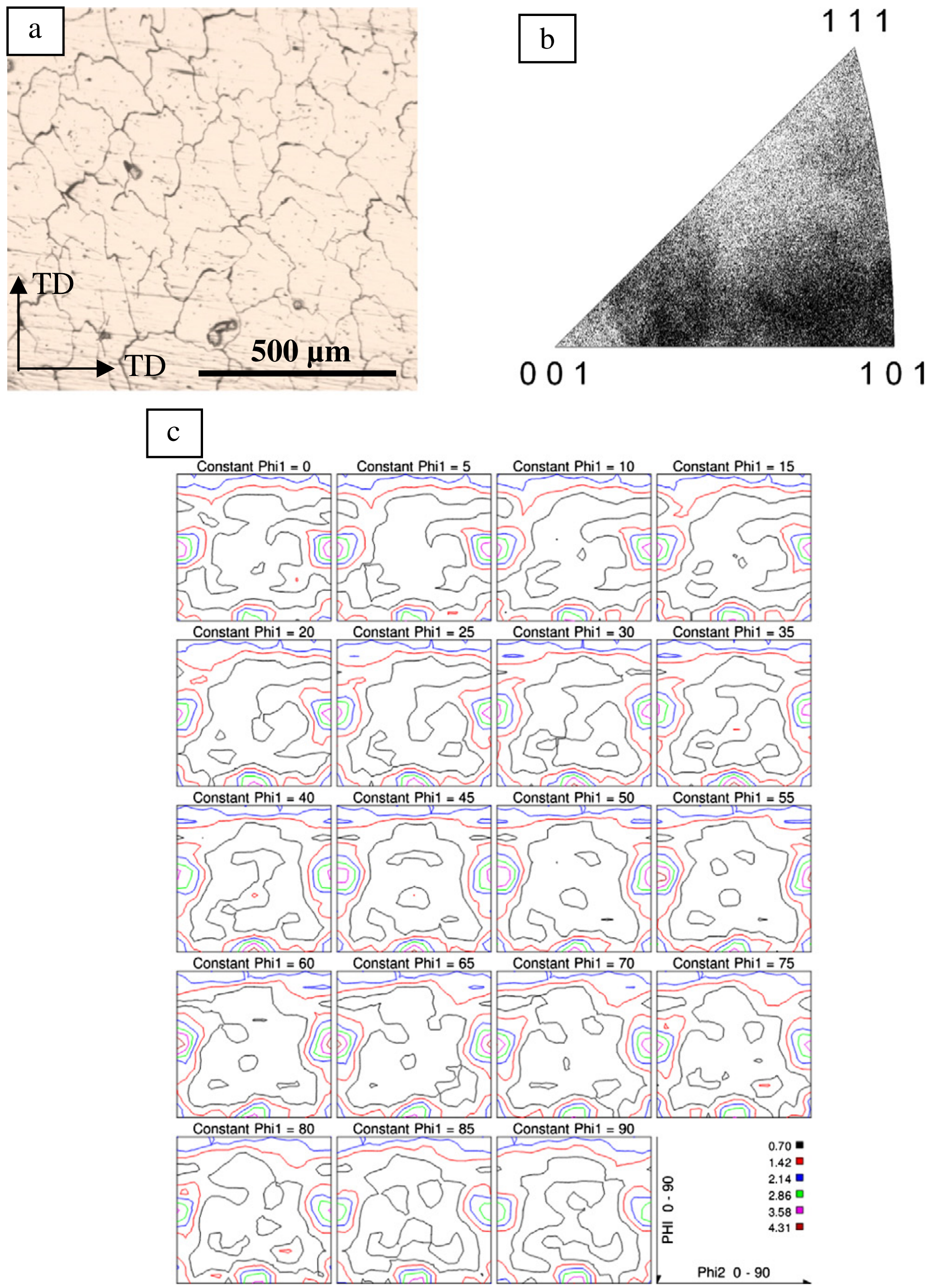


**Fig. 1 – Optical microstructure of undeformed Mo (a); inverse pole figure showing the normal directions of grains in the deformed Mo (b); the orientation distribution function of undeformed Mo bars measured by X-ray (c).**

of extended planar dislocation boundaries (EPBs) [1–5]. These EPBs have also been characterized as geometrically necessary boundaries (GNBs), since they result from the interaction of dislocations from either different combinations of slip systems or identical sets of systems operating with different strain amplitudes [6]. An important question concerning the EPBs is whether they lie on planes predominantly related to the orientation of the grain in which they form (i.e. are crystallographically determined) or the sample deformation geometry (i.e. are macroscopically determined). The question also has implications for the development of models of mechanical anisotropy as well as for the relationship between the deformation microstructure and the slip pattern [7–9]. Therefore, it is very important to determine the relationship between the deformation microstructure and orientation. Up to now, much work on this has been done in FCC metals, especially in Al and its alloys, and the research is mainly done by Niels Hansen's group [10–12]. Most of the detailed research results on the