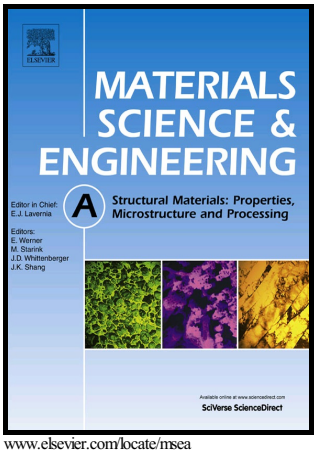
Numerical simulations of adiabatic shear localization in textured FCC metal based on crystal plasticity finite element method

Jianguo Li, Yulong Li, Tao Suo, Qiuming Wei



www.elsevier.com/locate/msea

PII: S0921-5093(18)31182-1
DOI: https://doi.org/10.1016/j.msea.2018.08.105
Reference: MSA36876

To appear in: *Materials Science & Engineering A*

Received date: 17 April 2018
Revised date: 17 July 2018
Accepted date: 29 August 2018

Cite this article as: Jianguo Li, Yulong Li, Tao Suo and Qiuming Wei, Numerical simulations of adiabatic shear localization in textured FCC metal based on crystal plasticity finite element method, *Materials Science & Engineering A,* https://doi.org/10.1016/j.msea.2018.08.105

Numerical simulations of adiabatic shear localization in textured FCC metal based on crystal plasticity finite element method

Jianguo Li[a,b,c], Yulong Li[a,b], Tao Suo[a,b,*], Qiuming Wei[c,*]

[a] School of Aeronautics, Northwestern Polytechnical University, Xi'an 710072, China.

[b] Key Laboratory of Impact Dynamic and Engineering Application (IDEA), Northwestern Polytechnical University, Xi'an 710072, Shaanxi, PR China.

[c] Department of Mechanical Engineering, University of North Carolina at Charlotte, Charlotte, NC 28223-0001, USA.

* Corresponding authors

Email addresses: suotao@nwpu.edu.cn (T. Suo),

qwei@uncc.edu (Q. Wei)

Abstract

Experimental investigations of adiabatic shear localization in the nanostructured face-centered-cubic (FCC) alloys have revealed that micro-texture has a key role in advancing the formation of adiabatic shear bands (ASBs) (Li et al., 2017a). In this work, we present the crystal plasticity finite element simulations (CPFEM) of dynamic uniaxial compression and simple shear in polycrystalline models with different initial textures. The aim is to study the effects of typical textures, which are often observed in FCC metals after severe plastic deformation or recrystallization, on the formation of ASBs under high strain rate loading. The materials response is described by an elastic-viscoplastic continuum slip constitutive relation, in which the dependence of slip systems' resistance on the temperature evolution is also considered. Simulation results show that, under high-rate compression, except for some textures which are not favorable for the formation of ASBs, different textures lead to various orientation of shear bands and different critical strains at which the shear localizations occur. High-rate simple shear loading is found to facilitate ASB formation. Even in the texture-free, namely Random texture, model obvious shear localization was observed. However, the dependence of slip system activation on texture