ESMC 2018 BOLOGNA

UNIVERSITÀ DI TRENTO

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

ESMC 2018

10th European Solid Mechanics Conference

EUROPEAN MECHANICS SOCIETY

BOLOGNA July 2-6, 2018 | Palazzo dei Congressi

PROGRAM BOOK

Viscoplastic flow accounting for multilevel hierarchy of shear banding

Ryszard B. Pęcherski
Department of Theory of Continuous Media and Nanostructures, Institute of Fundamental Technological Research of the Polish Academy of Sciences, Warsaw, Poland
E-mail: rpecher@ippt.pan.pl

Keywords: shear banding, viscoplasticity, strong discontinuity surface.

Experimental observations show that inelastic deformation of metals is often produced as an effect of competing mechanisms of crystallographic glide, twinning and micro-shear banding. The micro-shear bands are observed as concentrated shear zones in the form of trans crystalline layers of the thickness of the order 0.1 μm. They cooperate with active mechanisms of crystallographic glide and/or twinning controlling to various degrees process of viscoplastic flow. It has been observed that the change of the mechanism of inelastic deformation has strong influence on mechanical properties of material under consideration. Therefore, the identification and elucidation of physical mechanisms that are responsible for initiation, growth and evolution of micro-shear bands is of fundamental importance for understanding the macroscopic behaviour of metallic materials, [1].

A new physical model of multilevel hierarchy and evolution of shear bands is proposed with use of the analysis of recent state of the art of the investigations carried on different levels of observations: uni-axial and bi-axial mechanical tests enhanced with digital image correlation method and *in-situ* tests with use of electron microscopy as well as atom probe tomography in relation with *ab initio* and molecular dynamics computational simulations. Physical motivation and heuristic foundations of theoretical description are discussed with reference to known results in the literature, [2]. The difficulties with application of a direct multiscale integration scheme are discussed and an original idea of an extension of the representative volume element concept with use of the known theory of the propagation of the singular surfaces of microscopic velocity field is proposed. A new formulation of the description of rate of shear strain generated by multilevel hierarchy of shear bands is formulated in the workflow integration approach, in which information from molecular simulation at different levels flows into the decision process, [3].

[1] *R.B. Pęcherski, Macroscopic effects of micro-shear banding in plasticity of metals, Acta Mechanica, **131**, pp 203–224, (1988).*
[2] *A. Gusak, M. Danielewski, A. Korbel, M. Bochniak, N. Storozhuk, Elementary model of severe plastic deformation by KoBo process, Journal of Applied Physics, **115,** 034905, (2014).*
[3] *G. Goldbeck, Foreword, in: Industrial Applications of Molecular Simulations, M. Meunier (ed.), CRC Press, Taylor & Francis Group, Boca Raton, (2012).*