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ABSTRACTS

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The abstracts are in order of the presenting author.

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Multilevel Hierarchy of Shear Banding in Viscoplastic Flow and Failure

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ABSTRACT

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 transcrystalline layers of the thickness of the order 0.1 μm. It has been observed that the change of the mechanism of inelastic deformation has strong influence on ductile failure processes in different length scales. 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. 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, [2]. 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. Pecherski, Macroscopic effects of micro-shear banding in plasticity of metals, Acta Mechanica, 131, pp 203–224, (1988). [2] R.B. Pecherski, Finite deformation plasticity with strain induced anisotropy and shear banding, Journal of Materials Processing Technology, 60, pp. 35-44, (1996). [3] G. Goldbeck, Foreword, in: Industrial Applications of Molecular Simulations, M. Meunier (ed.), CRC Press, Taylor & Francis Group, Boca Raton, (2012).