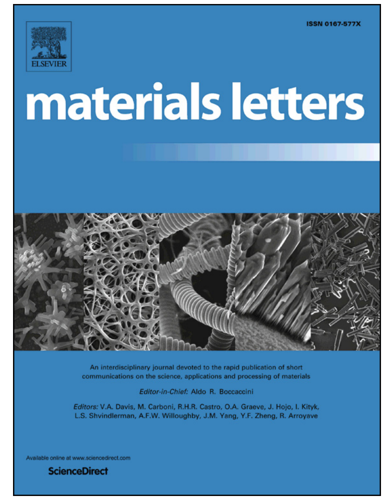
Accepted Manuscript



On the shear band velocity in metallic glasses: a high-speed imaging study

M. Seleznev, I.S. Yasnikov, A. Vinogradov

PII: S0167-577X(18)30719-5
DOI: https://doi.org/10.1016/j.matlet.2018.04.116
Reference: MLBLUE 24283

To appear in: *Materials Letters*

Received Date: 8 February 2018
Revised Date: 23 April 2018
Accepted Date: 30 April 2018

On the shear band velocity in metallic glasses: a high-speed imaging study

M. Seleznev[1], I. S. Yasnikov[2], A. Vinogradov[2,3]

[1] Freiberg University of Mining and Technology, Freiberg, 09599, Germany

[2] Institute of Advanced Technologies, Togliatti State University, 445020, Russia

[3] Norwegian University of Science and Technology – NTNU, Trondheim, 7491, Norway

Development of localised shear bands (SB) in bulk metallic glassy (BMG) alloys was investigated by a high-speed microscopic imaging technique. The velocities of SBs propagating by a progressive mechanism were found to be in the m/s range. It has been shown that after rapid initiation, the mean SB velocity decays as a function of time t, exhibiting a scaling-like t^{-n} behaviour with n close to 2 over several orders of magnitude.

Keywords: metallic glasses; shear bands; velocity; rapid video imaging

Metallic glasses (MGs) possess high strength while their ductility at low homologous temperature is low. Plastic deformation of MGs is confined to narrow, of 10 nm wide, shear bands (SBs) [1, 2]. Once initiated, a shear band dominates the plastic strain distribution and the plastic strain rate, which is by orders of magnitude higher than the imposed strain rate. Due to apparent lack of work hardening, rapid shear strain localisation in SBs greatly destabilizes plastic flow and provokes early development of micro-cracks leading finally to catastrophic fracture [3, 4]. Although the SBs in MGs have been intensively studied during past three decades, the phenomenology of shear banding and its underlying microscopic mechanism in MGs is still unclear [1, 5]. Experimental investigations of SB dynamics are still challenging in view of their nano-scale spatial dimensions (thickness) and rapid temporal evolution [2, 5].

Considerable evidence exists to suggest that under quasi-static loading, shear-banding events initiate heterogeneously at stress concentrations at the surface. The shear front propagates across the specimen, disordering the atomic structure along its path [6], changing the internal stress distribution [7, 8], lowering the local flow stress, and finally promoting continued progressive deformation along the resulting macroscopic SB [2, 9].

The significantly different results have been reported for the SB velocity, depending on the experimental technique used. On large time scales corresponding to stress drops caused by