MM 2: Topical Session Glass Dynamics II

Time: Monday 12:00–13:00 Location: H16

Topical Talk MM 2.1 Mon 12:00 H16

Nanomechanics of glasses and supercooled melts — •S. G. Mayr — Leibniz-Institut für Oberflächenmodifizierung e.V. — Translationszentrum für regenerative Medizin, Universität Leipzig — Fakultät für Physik und Geowissenschaften, Universität Leipzig

Metallic glasses are characterized by a rather complex viscoelastic response and the occurrence of the glass transition, while the underlying atomistic foundations are still poorly understood. Using a realistic CuTi model glass we employ global and local elasticity tensors for a thorough analysis of relaxation kinetics and mechanical stability at the nanoscale. We obtain strong indication [1] that i) α and β relaxation are closely related, presumably manifestations of a general relaxation scenario, ii) glasses reveal intrinsic mechanical instabilities at the nanoscale, which are closely connected to collective shear events within shear transformation zones and iii) the glass transition can be understood as a percolation transition of these mechanically unstable regions.

[1] S.G. Mayr, Phys. Rev. B 79, 060201(R) (2009)

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MM 2.2 Mon 12:30 H16

Temperature dependent shear band dynamics in a Zr-based bulk metallic glass — •David Klaumünzer, Robert Maass, Florian Dalla Torre, and Jörg Löffler — Laboratory of Metal Physics and Technology, ETH Zürich, Wolfgang-Pauli-Strasse 10, 8093 Zürich, Switzerland

There is strong interest in determining the time scales involved in the shear banding process during plastic deformation of bulk metallic glasses. Knowing these time scales helps to understand shear banding in more detail, and may also answer the question of whether significant localised heating can occur in and near shear bands. In this study we investigated flow serrations, corresponding to discrete shear events, of a $Zr_{52.2}Ti_5Cu_{17.9}Ni_{14.6}Al_{10}$ (Vit105) bulk metallic glass with respect to their stress drop and strain burst magnitude as well as their duration, as a function of temperature in the range of 60°C to -40°C. The results show that while the stress drop magnitude and the strain burst magnitude remain approximately constant with varying temperature, there is a strong temperature dependence of the shear event duration, ranging from approximately 1 ms at 60°C to 80 ms at -40°C. A calculation of the associated shear band velocities shows pronounced Arrhenius-type behaviour with an activation energy of 0.3 eV, in good agreement with recent potential energy landscape simulations. The strong temperature dependence of shear banding observed in this metallic glass is found to be analogous to the behaviour of other (non-metallic) amorphous materials.

MM 2.3 Mon 12:45 H16

Deformation mechanisms in small samples of $Pd_{77}Si_{23}$ metallic glass — •Dominik Tönnies[1], Frans Spaepen[2], and Cynthia A. Volkert[1] — [1]Institut für Materialphysik, Georg-August-Universität Göttingen, Göttingen, Germany — [2]School of Engineering and Applied Sciences, Harvard University, Cambridge, MA, USA

Bulk metallic glasses show some remarkable mechanical properties, but their poor plastic behavior at room temperature limits their use in applications. In recent studies, the size dependence of room temperature deformation mechanisms has been investigated by micro-compression tests on a $Pd_{77}Si_{23}$ metallic glass. The results show a clear transition from the expected mechanism of shear band formation to homogeneous deformation in pillars with diameters smaller than 440 nm. In an effort to understand the parameters that control this size transition, further micro-compression and nanoindentation studies have been performed on the $Pd_{77}Si_{23}$ films as a function of the extent of structural relaxation. The results show that in a relaxed sample the critical transition size for homogeneous deformation is reduced. The results will be discussed in terms of sample size-dependent shear band spacing and overlap.