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ANALYSIS AND MODELING OF DEFORMATION MECHANISM IN SUB-MICRON SIZED METALLIC GLASSES

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In the present contribution the modeling and computation of size effects in sub-micron sized metallic glasses with focus on the stable shear localization process is discussed. For the underlying model description, we resort to a thermodynamically consistent approach. In our previous work [1], we formulated the model in the small strain framework which we extended recently to finite strains [2]. The field variables of interest represent the deformation field, free volume and plastic strain. The strongly coupled and highly non-linear system of field equations is solved with a dual mixed finite element method. The influence of decreasing sample size is investigated. It is shown that the proposed finite deformation model is well suitable to predict the stable shear localization process in submicron-sized metallic glasses and its size effect. The model confirms that with decreasing sample size the shear localization process becomes stable and is delayed to a higher deformation state. In contrast to the modeling results in small strains, the finite deformation model is able to predict the failure process as well as the delay of failure with decreasing sample size. Recent experimental results [3] indicate that the change in the deformation mode in metallic glasses is determined by the sample size where the surface state has an tremendous effect on the final ductility and work hardening behavior of the sample. This surface effect is analyzed with our non-local model [2] and the influence of different boundary conditions for the free volume are studied. Additionally the pronounced tension-compression asymmetry in metallic glass samples is discussed. Correlations to experimental observations are presented.

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