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Application of the thermodynamic-based strain gradient plasticity theory in high velocity impact problems GEORGE VOYIADJIS, YOOSEOB SONG, Louisiana State University — In this work, a thermodynamic-based framework of the higher-order strain gradient plasticity is presented to investigate the thermo-mechanical material response of the metallic volumes at extreme conditions such as high velocity impact related problems. The need of the plastic strain gradients and their corresponding rates is discussed along with the mechanism associated with geometrically necessary dislocations. One of the major issues in the strain gradient plasticity is the determination of the intrinsic material length scales that scale with the gradient of the plastic strain. Explicit and implicit microstructural length scales, which preserve the well-posed nature of the differential equations, are introduced through the use of the viscosity and gradient localization limiters. Numerical simulations of the dynamic deformation response of tantalum hat-shaped specimens, subjected to compressive loading at the ambient initial temperatures and three different strain rates, are carried out and the comparisons of the numerical results to experimental measurements are also made. Another numerical application of a blunt projectile impacting a target is examined and the direct comparison between numerical and experimental results is presented.

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