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LENGTH SCALE EFFECTS IN DYNAMIC FAILURE OF MATERIALS

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ABSTRACT

Recent advances in the synthesis of materials have provided new impetus for designing materials with novel microstructures that are often inhomogeneous. The mechanical response of these materials is dominated by the activation of novel deformation mechanisms that are influenced by the interactions at microscopic and macroscopic length scales. These length scales have a profound influence on the yield strength, strain rate sensitivity, strain hardening, thermal conductivity etc., and may therefore influence the failure mechanisms, especially when subjected to high rates of loading.

Often, the constitutive models for dynamic failure have been phenomenological in nature. There, an incomplete microstructural basis may result in limited predictive capabilities. However, with the availability of vastly improved computational power, investigations are now possible over a wide range of length scales ranging from atomistics to large-scale continuum models. For example, molecular dynamics simulations provide a natural way for investigating shock response of materials. Similarly, coupled atomistic-continuum techniques are being devised to relate atomic-level forces and displacements to macroscopic stresses, strains, and failure processes.

The primary goal of the proposed mini-symposium is to provide a forum for understanding the length scale effects in the materials subjected to very high rates of loading. A broad objective of the mini-symposium is to highlight strategies that will enable mitigating empiricism and uncertainties in the computational modeling of dynamic failure. Computational techniques such as molecular dynamics, discrete dislocation dynamics, crystal plasticity, strain gradient theories, and continuum approaches are of interest. The mini-symposium aims at addressing the capabilities of these approaches and outstanding issues in order to accurately model the dynamic failure of advanced materials. Of particular interest are the hierarchical computational approaches (multiscale models) that are informed by robust experimental evidences at different length-scales. Therefore the symposium will bring together scientists from the Computational Solid Mechanics, Computational Materials Science, and Experimental Mechanics communities. The theme focuses on, but is not restricted to, nanostructured materials such as metals, ceramics, alloys and composites.