SHOCK11-2011-020005

Abstract for an Invited Paper
for the SHOCK11 Meeting of
the American Physical Society

Material Response to Shock / Dynamic Loading: Windows into Shock-Induced Processes in Materials

GEORGE GRAY, Los Alamos National Laboratory

While the field of shock-wave physics has provided significant insights into many of the processes related to wave propagation in materials, the exact operative micromechanisms of defect generation occurring during the shock and thereafter those controlling defect storage and damage evolution remain incompletely understood and poorly modeled. Attainment of a truly predictive capability to enable accurate simulations of dynamic impact, shock, and high-rate loading phenomena applications*requires* a linked experimental, modeling, and validation research program. Accordingly, the derivation of physically-based materials models is only achieved via close collaboration between experimentalists and modelers. In this talk an overview of the microstructural mechanisms affecting the strength of materials at high pressure and strain rates as well as the processes controlling damage evolution during shock loading will be reviewed. I shall discuss the challenges and opportunities for the development of physically-based models of shock-wave effects on materials. The need for models across multiple length scales and using both "real-time" and post-mortem materials characterization techniques will be discussed. The spectrum of physical phenomena and the potential nation-wide experimental facilities poised to study them is discussed. In addition, the limitations and caveats involved in using only velocimetry, single-pass radiography, and/or shock recovery alone to elucidate the 3-D aspects of defect generation, storage, and recovery will be examined in detail. Examples of how both "real-time" and post-mortem experimental approaches are needed to quantify dislocation / defect generation, shock-induced phase transitions, and damage evolution and spallation will be discussed.