SHOCK07-2007-000324
Abstract for an Invited Paper
for the SHOCK07 Meeting of
the American Physical Society

Compressive strength of aluminum under high-rate loading

JAMES ASAY, Sandia National Laboratories

The compressive yield strength of materials is important in a number of scientific and applied applications. Techniques for measuring strength at high pressure are limited, with the result that measurements have been made on only a few materials. Shock and quasi-isentropic loading are important techniques for studying material strength and other properties over a broad range of initial loading rates and at high stresses. The combined use of these techniques on a single material allows evaluation of the history dependence of strength properties, including effects of loading history, pressure, and temperature. Wave profile methods for estimating strength properties have been applied to a systematic study of the compressive strength of aluminum for a variety of initial material properties, loading rates, peak stress, and for cyclic loading. I will present recent wave profile measurements of yield strength in several aluminum alloys using these different techniques. The combined data reveal several observations about history effects of the yield strength in aluminum, including a general increase with longitudinal stress and an insensitivity to initial metallurgical properties for both shock and quasi-isentropic loading. In particular, the results suggest that deformation processes produced in both processes appear to have a larger effect than initial material properties on the change in strength at high pressure. In addition, it is found from cyclic loading experiments that pressure appears to be the dominant hardening mechanism in aluminum at high rates and high pressure. – Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract No. DE-AC04-94AL85000.