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Optical Shock Generation Integrated with Time-resolved Spectroscopy G. SAINI, T. PEZERIL, MIT, ISN, S.E. KOOI, ISN, E.L. THOMAS, K.A. NELSON, MIT, ISN — A detailed understanding of how materials respond to ballistic shock-loading is critical for the design and development of new protective materials. However, nonlinear viscoelastic deformation present in polymers during and immediately following a ballistic impact event is not currently well understood. The dynamic mechanical responses of materials during shock-loading are quite complex, with large amplitude compressions resulting in strain rates of $10^6 s^{-1}$ and pressures exceeding several GPa. The mechanical properties of multilayered thin films are measured using impulsive stimulated thermal scattering, a laser-based photoacoustic technique. Since the data can be acquired on a single shot basis, the measurement is compatible with laser shock loading. To this end, a novel pairing of optical shock generation and time-resolved spectroscopy is used, providing an insightful tool for studying the material response to large-amplitude short-time mechanical transients. Laser-induced shock loading has been synchronized with ISTS measurement of acoustic waves so that dynamical evolution of mechanical properties in laser-shocked materials can be examined. The results could complement those from a recent gas gun-ISTS combination that permits measurement of acoustic and mechanical properties during steady-state shock loading. This work is supported by the U.S. Army Research Office.

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