Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Laser induced projectile impact test (LIPIT): A micron-scale ballistic test for high-strain rate mechanical study of nano-structures JAE-HWANG LEE, Department of Mechanical Engineering and Materials Science, Rice University, DAVID VEYSSET, KEITH NELSON, Department of Chemistry, MIT, EDWIN THOMAS, Department of Mechanical Engineering and Materials Science, Rice University — We present a method to apply a highly localized deformation at a high-strain-rate for the study of mechanical characteristics of micro- and nano-structures. In the technique, Laser Induced Projectile Impact Test (LIPIT), micro-projectiles (solid silica spheres of 3.7μm diameter) are accelerated to a supersonic speed (up to 4 km/s) in air by a micro-explosion created by laser ablation of polystyrene and impact a sample target. The velocity information of the micro-projectiles is explicitly determined by two consecutive high-speed images during the flight of the projectiles. For demonstration, a glassy-rubbery nanocomposite consisting of a periodic self-assembled stack of 20 nm thick layers of polystyrene and polydimethylsiloxane blocks (PS-b-PDMS) is tested by LIPIT at the extremely high-strain rate of 10^8 s^{-1}. The polymer nanocomposite demonstrates new orientation dependent deformation and failure mechanisms including a surprising order to disorder transition fluidization, and the energy absorbing ability of a layered nanocomposite through plastic deformation leading to a melting of the layered structure.

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Date submitted: 26 Nov 2011 Electronic form version 1.4