Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Mechanical properties of holographically-defined porous polymers and carbonized polymers JAE-HWANG LEE, Materials Science and Engineering, MIT, LIFENG WANG, Mechanical Engineering, MIT, STEVEN KOOI, Institute for Soldier Nanotechnologies, MIT, MARY BOYCE, Mechanical Engineering, MIT, EDWIN THOMAS, Materials Science and Engineering, MIT — A new class of porous materials, so called a holographically-defined porous material (HDPM), has been available by the interference of multiple laser beams. Since the solid volume fraction (f_V) can be systematically adjusted without altering periodicity, we studied the mechanical behavior of polymer-HDPM as a function of f_V using nanoindentation. The observed elastic modulus of the polymer-HDPM has a significantly lower value than what expected from theoretical models at a high f_V. We confirmed that polymer-HDPM has two different plastic deformation modes from the transition in modulus and in energy absorption associated with the deformation. We also studied carbon-HDPM and compared these materials with the polymer-HDPM in energy absorption. Although carbon is a highly elastic material in bulk, carbon-HDPM absorbs energy by inelastic deformation including highly localized cracks. The energy absorption per residual indentation volume is proportional to a cube of indentation depth for all carbon-HDPM. Interestingly, when a carbon-HDPM has a partially disconnected network, its behavior was clearly different with the connected and rather similar to polymer-HDPM.

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Date submitted: 18 Nov 2009 Electronic form version 1.4