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Energy absorption behavior of polyurea coatings under laser-induced dynamic tensile and mixed-mode loading[1] KAILASH JAJAM, JAE-JUN LEE, NANCY SOTTOS, University of Illinois at Urbana-Champaign — Energy absorbing, lightweight, thin transparent layers/coatings are desirable in many civilian and military applications such as hurricane resistant windows, personnel face-shields, helmet liners, aircraft canopies, laser shields, blast-tolerant sandwich structures, sound and vibration damping materials to name a few. Polyurea, a class of segmented block copolymer, has attracted recent attention for its energy absorbing properties. However, most of the dynamic property characterization of polyurea is limited to tensile and split-Hopkinson-pressure-bar compression loading experiments with strain rates on the order of 10^2 and 10^4 s^{-1}, respectively. In the present work, we report the energy absorption behavior of polyurea thin films (1 to 2 μm) subjected to laser-induced dynamic tensile and mixed-mode loading. The laser-generated high amplitude stress wave propagates through the film in short time frames (15 to 20 ns) leading to very high strain rates (10^7 to 10^8 s^{-1}). The substrate stress, surface velocity and fluence histories are inferred from the displacement fringe data. On comparing input and output fluences, test results indicate significant energy absorption by the polyurea films under both tensile and mixed-mode loading conditions. Microscopic examination reveals distinct changes in failure mechanisms under mixed-mode loading from that observed under pure tensile loading.

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