# DEFORMATION AND FAILURE OF AN ELASTOMER AT VERY HIGH STRAIN RATES

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Pressure-shear plate impact experiments have been conducted to study the mechanical response of an elastomer - a polyurea - at very high strain rates, $10^5$ - $10^6$ $s^{-1}$. Samples with thicknesses in the range $100\mu m$ - $400\mu m$ are cast between two hard steel plates. Because of the comparatively low impedance of the elastomer, longitudinal waves reverberating through the thickness of the sample, and recorded with a laser interferometer, can be used to determine the slope of the uniaxial-strain isentrope of the material within the compressive stress regime of 500 $MPa$ to 2200 $MPa$. Once the sample is fully compressed, the incident shear wave arrives at the sample and imposes a simple shearing deformation. From the transverse velocity, also measured interferometrically at the rear surface of the sandwich target, the shear stress and the transverse velocity at the rear surface of the sample are determined. These measurements provide the shearing resistance of the material under pressure.

Plane, release wave experiments are used to study the dynamic tensile response of the elastomer and its failure behavior. For these experiments a thin elastomeric flyer plate impacts a thicker target plate made from the same material. The compressive stress pulses generated then reflect from the respective rear surfaces of the flyer and target to impose tensile loading in the target at the spall plane where the two reflected pulses meet. The free surface velocity history of the target plate, measured by a VISAR (Velocity Interferometer System for Any Reflector), is used to probe the tensile strength and failure behavior of the elastomer. In addition, the difference between the recorded arrival times of the compressive and tensile waves provide the wave speeds at stresses less than 500 $MPa$ and enable the completion of the description of the isentrope that was characterized at higher stresses by the pressure-shear plate impact experiments. Plane wave simulations of the release wave experiments, using ABAQUS, have made it possible to extend the isentrope into the tensile regime by requiring the simulations to match the measured rear-surface velocity-time profiles during unloading, but before tensile fracture occurs and the motion is no longer strictly one dimensional.

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