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Using Free Surface Velocity and X-Ray Imaging to Monitor the Closure of a Cylindrical Hole in Copper and Tantalum for Strength Measurements Under Pressure[1] ANDREW ROBINSON, JONATHAN LIND, MATTHEW NELMS, NATHAN BARTON, MUKUL KUMAR, Lawrence Livermore National Laboratory — The flow stress in a metal is dependent on a variety of factors such as strain, strain rate, microstructure, and temperature. Experiments (i.e. quasi-static tensile testing or Kolsky bar testing) with well characterized stress states have been used to determine the relation between flow stress and these many factors. However, for higher strain rates ($>10^5$/s) there is a dearth of high-fidelity data. Here, we present results of a recent in-situ gas-gun experimental technique that can probe strength effects at strain rates of $>10^5$/s. By measuring the diameter of a long cylindrical hole using x-ray imaging in conjunction with back surface velocimetry while the sample is subjected to controlled dynamic loading, the factors affecting flow stress can be inferred. Models of the experiment indicate that a relatively large volume of material around the hole experiences strain rates above 10^5/s. Materials with higher dynamic flow stresses tend to exhibit less diameter reduction than materials with lower flow stresses all else being equal. Experimental results indicate that the hole diameter reduction is also dependent on the peak pressure of the loading pulse and the duration of the pressure pulse.

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