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Exploiting the Unique Capabilities of Richtmyer-Meshkov Instability Strength Measurements at Extreme Strain Rates

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Only recently, Richtmyer-Meshkov Instability (RMI) experiments fielded with the perturbations on a free surface have been used to study strength at strain rates of about 10^7/second and near zero pressure. When perturbation velocities are measured, the excellent sensitivity to strength makes RMI experiments fairly simple to use for validation of constitutive models. This talk details ongoing efforts to exploit the unique capabilities of RMI beyond simple model validation. First, the use of impact loading rather than high explosives makes the experiments simpler and more accurate to analyze and also allows one to explore a wider range of conditions. Second, the hypothesis that RMI experiments sample only a compact range of strain, strain rate, temperature and pressure is explored to see if an estimated *average* strength value is meaningful and can be used to calibrate rather than just validate a strength model. Third, the ability of RMI to isolate high strain rate effects from high pressure can be used alone or combined with other dynamic experiments at high pressures to check some widely used but not yet validated modeling assumptions. New RMI results on tantalum indicate zero pressure strength at 10^7//second somewhat exceeding model expectations. The zero pressure RMI results at high rate were then used to predict strength at high pressure using the common assumption of scaling with the density (i.e., pressure) dependence of the shear modulus. Strength estimates at high rates and pressures up to 350 GPa from planar ramp loading and release experiments on the Z machine at Sandia National Laboratories indicate that, for pressures over 100 GPa, the strength significantly exceeds those predictions.

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