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Abstract for an Invited Paper for the SHOCK13 Meeting of the American Physical Society

## Plastic flow, inferred strength, and incipient failure in BCC metals at high pressures, strains, and strain rates $^1_{\rm HYE-SOOK\ PARK,\ LLNL}$

We present our extensive experimental results from the Omega laser to test models of high pressure, high strain rate strength at ~ 1 Mbar peak pressures, strains >10%, and strain rates of ~  $10^7 \text{ s}^{-1}$  in Ta, V, and Fe, using plastic flows driven by the Rayleigh-Taylor instability. The observed time evolution of the plastic deformation is compared with 2D simulations incorporating a strength model. This methodology allows average values of strength at peak pressure and peak strain rate conditions to be inferred. The observed values of strength are typically factors of 5-10 higher than ambient strength, with contributions coming from pressure hardening (via the shear modulus), and strain rate hardening. For Fe, there is the added contribution from the alpha-epsilon phase transition. Ta has been studied as a function of grain size, and at the high strain rates and short durations of the experiments, no grain size dependence was observed; the observed deformation and inferred strength were independent of grain size. Both Ta and V have been driven to large enough strains that incipient failure (softening) has been observed. Both the Ta and V experiments were compared favorably with multiscale strength models, with the conclusion that the Ta deformation was in the thermal activation regime, whereas the V deformation was in the phonon drag regime. Finally, preliminary results of new iron RT strength experiments done at ~ 1 Mbar pressures, and ~  $10^7 \text{ s}^{-1}$  strain rates, well beyond the alpha-epsilon phase transition, will be given.

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