HIGH PRESSURE, HIGH STRAIN RATE STRENGTH EXPERIMENTS ON NIF[1]

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Understanding the high pressure, high strain rate plastic deformation dynamics of materials is an area of research of high interest to a number of fields, including planetary formation dynamics, meteor impact dynamics, asteroid deflection strategies, advanced armor studies, and advanced inertial confinement fusion designs. Developing predictive theoretical and computational descriptions of such systems, however, has been a difficult undertaking. We have performed many strength experiments on Omega [1] and NIF to test Ta strength models at high pressures (~5 Mbar), high strain rates (~10^7 s^{-1}) and high strains (> 30%) under ramped compression condition using Rayleigh-Taylor and Richtmyer-Meshkov instability properties. We also studied elastic to plastic transition time scale under shocked compression at Omega and LCLS using diffraction technique [2, 3]. All these studies showed surprising results that the strength mechanisms from macro to micro scales are different from the traditional strength model predictions and that are loading path dependent. We will describe a selection of results from this extensive set of experiments on the high pressure, high rate plastic deformation dynamics of Ta.

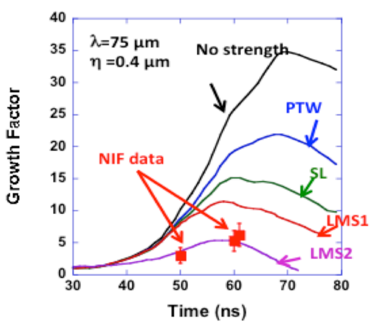

Fig. 1. Strength Rayleigh-Taylor experimental results from NIF. The measured Growth Factor was lower than the conventional strength model predictions.

[1] H. –S. Park et al., Phys. Rev. Lett. 114, 065502 (2015).
[2] A. J. Comley et al., Phys. Rev. Lett, 110, 115501 (2013).
[3] C. Wehrenberg et al., in preparation (2015).

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