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Single shot ultrafast observation of 40 GPa shock waves in a diamond anvil cell MICHAEL ARMSTRONG, JONATHAN CROWHURST, JOSEPH ZAUG, EVAN REED, W. MICHAEL HOWARD, LAWRENCE FRIED, Lawrence Livermore National Lab — We present the results of experiments using ultrafast laser excitation and detection of shock waves starting from high precompression (10s GPa) in a standard diamond anvil cell (DAC) attaining single shock pressures > 40 GPa. Using single shot ultrafast interferometry, we directly detect surface motion with ∼nm spatial resolution and ∼ps time resolution. Ultrafast time resolution enables the observation of states where shock-induced chemistry and phase changes may occur on sub-nanosecond time scales. Furthermore, standard DACs can reach ∼100 GPa precompression and >1000 degrees, enabling the examination of thermodynamic states off the principle Hugoniot, starting from a wide range of thermodynamic initial conditions. In particular, precompression of soft materials significantly enhances impedance matching to metal ablators and reduces the temperature of the shocked state. Here, we present the results of shocking nitromethane and argon from precompressed states. This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

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