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X-ray diffraction experiments on the Materials in Extreme Conditions (MEC) LCLS x-ray FEL beamline RAYMOND SMITH, DAYNE FRATANDUONO, Lawrence Livermore National Laboratory, JUNE WICKS, TOM DUFFY, Princeton University, HAE JA LEE, EDUARDO GRANADOS, PHILIP HEIMANN, Stanford Linear Accelerator, ARIANNA GLEASON, CYNTHIA BOLME, Los Alamos National Laboratory, DAMIAN SWIFT, FEDERICA COPPARI, JON EGGERT, RIP COLLINS, Lawrence Livermore National Laboratory — The experiments described here were conducted on the MEC beamline hutch at the SLAC Linac Coherent Light Source. A 10 ns 527 nm laser pulse was used to shock compress 60-100 μm thick NaCl and Graphite samples. LCLS x-rays (40 fs, 8 keV), scattered off the shocked sample, were recorded on several pixel array detectors positioned downstream. The diffracted x-ray pattern allows us to determine changes in crystal structure at Mbar pressures and over nanosecond timescales. In this talk we detail the experimental setup, the current capabilities of the MEC laser and the considerations for optimizing the target design. We will describe the wave interactions within the shock-compressed target and the use of a 1D hydrocode to describe the pressure, temperature and density conditions within the target assembly as a function of time and Lagrangian position. We present observations of the B1-B2 phase transition in NaCl and subsequent back transformation during release to ambient pressure, and compare these findings to gas gun and static data. We also present results from a preliminary study of the shock-induced graphite to diamond transformation.

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