Abstract Submitted
for the SHOCK17 Meeting of
The American Physical Society

Evolution of nanocarbon structure in shock-induced chemical reactions RACHEL C. HUBER, ERIK B. WATKINS, ARIANNA E. GLEASON, DANA M. DATTELBAUM, DAVID W. PODLESAK, RICHARD L. GUSTAVSEN, RICHARD L. SANDBERG, CYNTHIA A. BOLME, MILLICENT A. FIRESTONE, BRYAN S. RINGSTRAND, Los Alamos National Laboratory, ERIC GALTIER, HAE JA LEE, SLAC National Accelerator Laboratory — Carbon chemistry in the pressure (P) and temperature (T) regimes induced by shock compression includes phase transformation, nucleation and growth and, depending on the thermodynamic conditions, a variety of carbon allotropes and morphologies may form and evolve. Time resolved x-ray scattering experiments on the Matter in Extreme Conditions (MEC) beamline at the Linac Coherent Light Source (LCLS) were used to probe the structure of shock compressed carbon in real time. Shocks were delivered to carbon samples using 20 J laser pulses with 10-20 ns duration and 50 fs x-ray pulses were timed to interrogate the material response relative to shock arrival. A diagnostic suite including Velocity Interferometer System for Any Reflector (VISAR) to measure the P of the shock state and simultaneous x-ray diffraction (XRD) and small angle x-ray scattering (SAXS) to obtain structural information bridging from atomistic to meso length scales was employed. Carbon formation was investigated over a range of P conditions (10-120 GPa) in highly oriented pyrolytic graphite (HOPG) and amorphous carbon samples. Phase transformations to hexagonal and cubic diamond as a function of P and starting material and enhancement of atomistic ordering in shocked amorphous carbon were observed. LA-UR-17-21340

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Date submitted: 21 Feb 2017 Electronic form version 1.4