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Time-resolved Small Angle X-ray Scattering During the Formation of Detonation Nano-Carbon Condensates MICHAEL BAGGE-HANSEN, JOSH HAMMONS, MIKE NIELSEN, LISA LAUDERBACH, RALPH HODGIN, SORIN BASTEA, TONY VAN BUUREN, PHIL PAGORIA, CHADD MAY, Lawrence Livermore Natl Lab, BRIAN JENSEN, RICK GUSTAVSEN, ERIK WATKINS, MILLIE FIRESTONE, DANA DATTELBAUM, Los Alamos Natl Lab, LARRY FRIED, MATT COWAN, TREVOR WILLEY, Lawrence Livermore Natl Lab — Carbon nanomaterials are spontaneously generated under high pressure and temperature conditions present during the detonation of many high explosive (HE) materials. Thermochemical modeling suggests that the phase, size, and morphology of carbon condensates are strongly dependent on the type of HE used and associated evolution of temperature and pressure during the very early stages of detonation. Experimental validation of carbon condensation under these extreme conditions has been technically challenging. Here, we present synchrotron-based, time-resolved small-angle x-ray scattering (TR-SAXS) measurements collected during HE detonations, acquired from discrete sub-100 ps x-ray pulses, every 153.4 ns. We select from various HE materials and geometries to explore a range of achievable pressures and temperatures that span detonation conditions and, correspondingly, generate an array of nano-carbon products, including nano-diamonds and nano-onions. The TR-SAXS patterns evolve rapidly over the first few hundred nanoseconds. Comparing the results with modeling offers significant progress towards a general carbon equation of state. Prepared by LLNL under Contract DE-AC52-07NA27344.

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