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Carbon condensation subsequent to ultrafast compression of cryogenic liquid CO[1] MICHAEL ARMSTRONG, REBECCA LINDSEY, NIR GOLDMAN, MICHAEL NIELSEN, ELISSAIOS STAVROU, JOSEPH ZAUG, SORIN BASTEA, Lawrence Livermore Natl Lab — Self-propagating shocks (detonations) in most organic negative oxygen balance explosives produce "soot" in the form of nanocarbon polymorphs. The formation of carbon condensates is of fundamental importance to detonation chemistry, and this process may occur on sub-ns time scales. To investigate carbon condensation in a chemically reacting environment, we present results of ultrafast shock experiments in cryogenic liquid CO in a modified, commercial cryostat. Ultrafast (100s ps to 1 ns) duration experiments have the capability to resolve very fast condensation processes, have high throughput, and can be more directly compared to simulations. Using sub-ns shock compression, we observe shocked states consistent with long time scale gas gun experiments, and evidence of the formation of carbon condensates over a ˜50 ps time scale at shock pressures above around 16 GPa. These results compare well to DFT force-matched molecular mechanics simulations, which predict carbon nanoparticle formation in the 10s nm range, consistent with nanocarbon agglomerates recovered from the experiment and in situ optical transmission measurements.

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