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Unveiling formation mechanisms for hierarchical nanocarbons derived from the detonation of high explosives

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The direct evaluation of chemical reactions that ensue behind the shock front is challenging, and as a result details of the nucleation and growth of solid carbon products remain poorly described. To improve our understanding of carbon fragment evolution post detonation of high explosives a combination of post-mortem analysis of the recovered soot and *in-situ* characterization of the carbon particles have been conducted. Primary particle morphology and distribution of carbon hybridization states are evaluated though multi-scale diagnostic characterization on unfractionated, unpurified recovered soot. The solid carbon condensates vary significantly depending on the high explosive and / or the detonation conditions. Based upon careful post-mortem analysis of the carbon particles recovered formation mechanisms are postulated in the context of detonation conditions. Mechanism verification is carried out, in part, by operando time-resolved X-ray scattering that probes the evolution of the carbon condensates behind the shock front on the hundreds of nanosecond to microsecond time regime. Understanding the correlation between detonation conditions and carbon product formation is important for achieving greater accuracy in predicting high explosive performance and model refinement.