Abstract Submitted
for the SHOCK19 Meeting of
The American Physical Society

Controlling thermite reactivity with engineered porosity and architecture KYLE SULLIVAN, Lawrence Livermore Natl Lab, ELLIOT W, Johns Hopkins University, MICHAEL GRAPES, Lawrence Livermore Natl Lab — Thermites are two-component mixtures containing a metal fuel and a metal oxide as an oxidizer. The reactivity of these materials can vary from slow burns to rapid deflagrations depending on a variety of parameters such as the particle size, composition, and configuration. This shift has been attributed to a change in the mode of energy transport from a conductive mode to a convective mode. Additive manufacturing (AM) gives us unique control of the architecture, which can mean composition or the addition of microstructural features. With this tool, we can design and test thermite samples to control both the reaction rate and heat transfer modes in order to build a better understanding of the reaction mechanisms. In this work, we mix and Al and CuO ink on-the-fly during an extrusion process to create thermite samples. The porosity and filament size were varied in a systematic way to produce lattices of different surface area and density. The resultant reactivity was measured two ways; the velocity of the sweeping luminous front as well as the total time of luminous emission. In general, we observe that at least some porosity is needed in order to achieve rapid energy release and that intermediate gas trapping is important for accelerating the reaction. A "materials design plot" which plots the range of energy release rate as a function of volumetric energy density was constructed.
This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344. LLNL-ABS-768219

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Date submitted: 26 Feb 2019 Electronic form version 1.4