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**Measuring Fast and Slow Energy Release from Aluminum Powders** JENNIFER GOTTFRIED, STEVEN DEAN, CHI-CHIN WU, FRANK DE LUCIA, JR., US Army Research Lab - APG — Because of its high specific energy density (31 kJ/g) and widespread availability, micron-sized aluminum (Al) powders have been used in energetics applications, primarily for blast enhancement on extended timescales. A key goal in energetic materials research is to accelerate the reaction of metals during an explosion so that the detonation performance of the explosive is enhanced. Nano-sized Al particles have the potential to react faster than micron-Al, but suffer from issues such as the formation of a native oxide layer which delays reaction and strong agglomeration of the particles resulting in incomplete combustion. The mechanisms and timescale of energy release from Al at very high heating rates (~$10^{13}$ K/s) comparable to those behind a detonation front are of significant interest for energetic applications. For the first time, we have systematically investigated the fast (microsecond-timescale) energy release of Al following laser-induced breakdown ignition. A ns-pulsed laser was used to ignite 9 different Al powders ranging in size from 20 nm to 30 $\mu$m. A wide variety of diagnostics including the detection of time-resolved AlO emission with a PMT and integrated combustion emission with a photodiode, high-resolution spectroscopy of the laser-induced plasma and subsequent combustion events, and high-speed imaging to measure the laser-induced shock velocities were employed to understand the effect of particle size and active aluminum content on the rate of energy release.

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