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Performance Evaluation of Bimodal Thermite Composites: Nano- vs Miron Scale Particles

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In recent years many studies of metastable interstitial composites (MIC) have shown vast combustion improvements over traditional thermite materials. The main difference between these two materials is the size of the fuel particles in the mixture. Decreasing the fuel size from the micron to nanometer range significantly increases the combustion wave speed and ignition sensitivity. Little is known, however, about the critical level of nano-sized fuel particles needed to enhance the performance of the traditional thermite. Ignition sensitivity experiments were performed using Al/MoO_3 pellets at a theoretical maximum density of 50% (2 g/cm^3). The Al fuel particles were prepared as bi-modal size distributions with micron (i.e., 4 and 20 μm diameter) and nano-scale Al particles. The micron-scale Al was replaced in 10% increments by 80 nm Al particles until the fuel was 100% 80 nm Al. These bi-modal distributions allow the unique characteristics of nano-scale materials to be better understood. The pellets were ignited using a 50-W CO_2 laser. High speed imaging diagnostics were used to measure ignition delay times, and micro-thermocouples were used to measure ignition temperatures. Combustion wave speeds were also examined.