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Editorial Comment

Nanocomposite thermites are typically mixtures of metal fuel and metal oxide nanoparticles. They have attracted much attention in the recent years as potential energetic materials. Other names which have been used for these materials are superthermites and metastable interstitial/intermolecular composites, or simply MICs, for short. The key idea behind using nanoparticles is that the fuel and oxidizer can be mixed intimately at the nanometer scale, resulting in decreased mass diffusion length scales and significantly improved kinetics. This result is commonly traced back to 1995, when Aumann et al. [1] reported that an Al/MoO_3 composite utilizing nanoparticles reacted more than three orders of magnitude faster than micron-scaled counterparts. The combustion of nanocomposite thermites involves in general low to moderate gas production, and fast propagation velocities. Furthermore, their energy density is between those of propellants and explosives [2]. Thus, they are attractive candidates for a variety of energetic applications, which demand a controlled and reliable energy release rate. Thermite-like reactions have been identified in the 1970s in high-temperature synthesis studies (e.g. [3]), and Wang et al. [4] have reviewed them. The last decade or so, a growing number of studies on nanothermites have appeared. They have been reviewed by Yetter et al. [5].

While this class of materials have many attractive features, the mechanistic understanding about how these materials react is poor stemming from the very different transport properties and time scales associated with nanoparticles and their reactivity. For example, nanoparticles can be rapidly heated and cooled, and their small sizes make some of their fluid mechanics properties more akin to gases. Furthermore, commercial nanoparticles often are not synthesized as monodispersed particles, but rather as hard aggregates with a range of particle sizes and morphologies. Thus, experiments that can probe intrinsic reactions under extreme heating rates may provide the most valuable insight to the reaction mechanism. The feature article by *Kyle Sullivan, Nicholas Piekiel, Chunwei Wu, Snehaunshu Chowdhury, Stephen Kelly, Todd Hufnagel, Kamel Fezzaa* and, *Michael Zachariah*, exemplifies how using rapid heating experimental techniques can provide critical information about the underlying reaction mechanisms in such materials.

Among others, the results suggest that condensed-phase reactions may be more prominent than previously thought, and that the definition of particle size may need a critical re-evaluation. This work provides a qualitative understanding of the pertinent reaction mechanisms, and serves as a framework to spawn future efforts focused on further improving our fundamental understanding of the combustion of nanocomposite thermites.

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