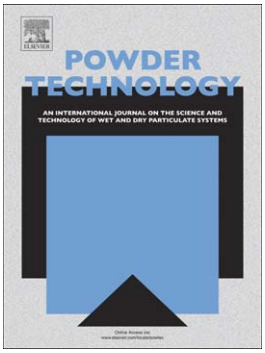

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Nanocomposite thermite powders with improved flowability prepared by mechanical milling

Quang Nguyen[1], Ci Huang[1], Mirko Schoenitz[1], Kyle T. Sullivan[2], and Edward L. Dreizin[1]*

[1] New Jersey Institute of Technology, Newark, NJ, USA

[2]Lawrence Livermore National Laboratory, Livermore, CA, USA

[*]Corresponding Author Email: dreizin@njit.edu

Abstract

Nanocomposite thermite powders can be used in reactive parts and components. Manufacturing these components requires tailoring powder particle size distributions, particle shapes, and powder flowability. Specifically, an improved flowability is desired to use such powders as feedstock in additive manufacturing. Arrested reactive milling (ARM) offers a versatile and practical approach for preparing nanocomposite thermites with fully dense particles, which will retain their structures and mixedness between reactive components while being stored, handled, and processed. However, ARM products usually have broad particle size distributions, rock-like particle shapes, and poor flowability. Here, ARM is modified to include a low-energy milling step to tune the shapes and flowability of the prepared powders. Experiments are performed with aluminum-rich $Al{\cdot}Fe_2O_3$ thermites. After the initial nanocomposite thermite is prepared in a planetary mill, it is additionally milled at a reduced rotation rate, replacing milling balls with smaller glass beads, and adding different liquid process control agents. Powders with modified particle shapes and size distributions are obtained, which have substantially improved flowability compared to the initial material. The reactivity of the initial and modified powders is evaluated using their ignition on a heated wire, by electro-static discharge, by thermal analysis (DSC) and in constant volume