SHOCK19-2019-000735
Abstract for an Invited Paper
for the SHOCK19 Meeting of
the American Physical Society

Effect of liquid process control agent on structure and morphology of reactive materials prepared by high-energy milling

EDWARD L. DREIZIN, New Jersey Institute of Technology

High-energy milling has been used to prepare a broad range of reactive material powders, including thermites, metal-metalloid, and intermetallic compositions capable of highly exothermic reactions. Such reactions can involve both condensed components of the prepared powders and external oxidizers. Previous work focused on achieving nano-scale mixing of material components in the prepared, nearly fully dense composite powders. Additionally, control of powder microstructure and morphology, including particle sizes and shapes might be of critical importance in applications. In this talk, effect of polar and non-polar liquid process control agents (PCA) on properties of the prepared reactive material powders will be discussed. It has been shown to be possible to fine tune the powder particle size distributions using staged milling, involving different PCA in different stages. The particle size can be reduced effectively without detrimental effect on the reactivity of the prepared powders. Further, staged milling enables one to modify the chemistry of interfaces formed in the reactive composites, altering their initiation kinetics. It was also shown that spherical powders with narrow size distributions can be prepared using a broad range of starting material powders when PCA comprises two immiscible fluids. Such spherical powders were prepared using elemental Al and B as well as several Al-based thermites and B-metal composites. The mechanisms of formation of spherical powders remain unclear; it is hypothesized that they form from Pickering emulsions formed in the milling vial. Such emulsion interact at high stress and shear with the high-density powder suspension; this interaction is proposed to yield filled spherical particles, which can be recovered, characterized and used for preparing energetic formulations.

In collaboration with: Mehnaz Mursalat (NJIT) and Mirko Schoenitz (NJIT)