

IOWA STATE UNIVERSITY
DEPARTMENT OF MECHANICAL ENGINEERING

**Ignition of nanocomposite thermites prepared by Arrested
Reactive Milling**

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**New Jersey Institute of Technology
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Abstract:

Multiple micron-sized nano-composite thermite powders were recently prepared by mechanical milling starting with powders of aluminum and metal oxides, such as CuO, MoO₃, Fe₂O₃, Bi₂O₃, and others. The prepared powder particles are fully dense and comprise of an aluminum matrix and inclusions of the oxidizer. Characteristic dimensions of the inclusions vary in the range of 10-100 nm. These materials are substantially more sensitive to various ignition stimuli, including heating, mechanical shock, or electro-static discharge compared to thermites with the same bulk compositions but containing components mixed on a coarser scale. The increased sensitivity is caused by a very high area of the reactive interface between fuel and oxidizer. Reactions occurring at relatively low temperatures that can be neglected for the materials with smaller interface area become very important for these nanocomposite materials. These reactions result in both substantial heat release and modification of the reacting components prior to their ignition. Therefore, both ignition kinetics and combustion dynamics of these nanocomposite materials depend on the pre-ignition reactions, which are, in turn, are affected by heating rates and other experimental conditions. In this talk, several experimental studies of ignition of nanocomposite thermites will be discussed and results will be compared to one another. Mechanistic investigations of different pre-ignition reactions using thermo-analytical experiments will also be presented. A multi-step ignition mechanism will be reviewed and its suitability for different materials and different ignition scenarios will be discussed.

Biography:

Dr. Dreizin received his MS in physics and his PhD in applied physics from Odessa State University, Ukraine in 1980 and 1992, respectively. He immigrated to the USA in 1992 and joined staff of Aero-Chem Research Labs, Inc., in Princeton NJ in 1993. In 1999, he became a research faculty member of New Jersey Institute of Technology, where he presently is a Professor of Chemical Engineering. Prof. Dreizin's present research is in the areas of metals combustion and synthesis and characterization of reactive materials. He authored more than 130 peer-reviewed journal articles, 4 book chapters, 4 patents, and multiple proceedings and abstracts. Prof. Dreizin is an Associate Fellow of AIAA and a member of AIChE and Combustion Institute. He is an Associate Editor of International Journal of Energetic Materials and Chemical Propulsion and a member of Editorial Board of International Journal of Self-Propagating High-Temperature Synthesis. He has been an invited lecturer in many universities and companies in the USA and abroad, including Singapore, China, Germany, and Russia.

This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.