Abstract

Reactive and energetic materials are typically metastable, and are expected to transform into thermodynamically favorable reaction products with substantial energy release. When triggered thermally, by shock, or impact, such transformations may be useful in explosives, propellants, and pyrotechnics. Preparation of reactive materials mechanochemically or by mechanical milling is challenging: they are easily initiated by impact or friction. At the same time, milling offers a simple, scalable, and controllable technology capable of mixing reactive components on the nanoscale while producing fully dense composites. In most cases, for reactive materials milling should be interrupted or arrested to preserve the metastable phases. Arrested reactive milling was exploited to prepare many inorganic reactive materials, including nanocomposite thermites, metal-metalloid, and intermetallic systems. Prepared materials are typically micron-sized composite powders with unique properties, combining high density with extremely high reactivity. Types of the prepared materials will be briefly reviewed and the unique reaction mechanisms for some of the mechanochemically prepared composites will be discussed. In particular, processes governing ignition of fully-dense nanocomposite thermites will be considered. Recent results suggesting that in some cases, nanocomposite reactive materials retain the memory of their nano-structure even after ignition and during combustion will also be presented.

About the speaker

Dr. Dreizin received his MS in molecular physics and his PhD in applied physics from Odessa State University, Ukraine in 1985 and 1992, respectively. He immigrated to the US in 1992 and joined research staff of AeroChem Research Labs at Princeton, NJ in 1993. In 1999, he became a faculty member of New Jersey Institute of Technology at Newark, NJ, where he is presently Distinguished Professor of Chemical Engineering and Associate Chair for Graduate Studies at the O.H. York Department of Chemical, Biological, and Pharmaceutical Engineering. Prof. Dreizin authored and co-authored more than 220 peer reviewed journal articles and multiple conference papers and proceedings. He advised 15 PhD graduates and multiple MS and undergraduate researchers. Prof. Dreizin serves as an Associate Editor for International Journal of Energetic Materials and Chemical Propulsion; he is also a member of International Editorial Council for Combustion Explosion and Shock Waves and of the Editorial Board of International Journal of Self-Propagating High Temperature Synthesis.