UNIVERSITY OF RHODE ISLAND
Department of Chemistry

SEMINAR

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"Composite Metal-based Reactive Materials, Characterization, and Combustion"

HOST

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Composite metal-based reactive materials: synthesis, characterization, and combustion

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Abstract

Metal powders are used as highly energetic fuels in propellants, explosives and pyrotechnics. The most common metal fuels include aluminum, magnesium, boron, titanium, and zirconium. Their combustion is more exothermic than that of common hydrocarbon fuels; however, the rates of combustion are typically lower. Recent research focused on modifying metal powders to reduce their ignition delays and accelerate their combustion. The modifiers may include oxidizers, other metals prompting phase changes triggering ignition, and gas-generating compounds producing fresh surface capable of rapid reaction. A materials synthesis approach relying on high-energy ball milling, a versatile and scalable technique, was developed at our lab to prepare a broad range of composite reactive materials. The materials include thermites, metal-metalloid, and metal-halogen composites. The prepared materials are characterized using electron microscopy, thermal analysis, and other techniques. Custom particle ignition and combustion experiments are designed to determine their burn rates and flame temperatures. Global ignition and combustion models for particles of reactive materials are necessary to predict their behavior in practical situations, such as in propulsion devices or in an expanding fireball produced by explosion. In this talk, the experimental techniques and selected results will be discussed. Results and interpretations for materials with biocidal combustion products capable of inactivating aerosolized spores of biological weapon agents, such as anthrax, will be presented in more detail.