Forensic Science at the Nanoscale

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Forensic science has been conventionally defined as “belonging to or used in courts of judicature,” and usually employed towards criminal, civil or environmental law. However, in the past twenty years, the term “forensics” is being applied to a much broader set of scientific activities or investigations including non-proliferation, treaty verification, and acts of domestic and international terrorism, that requires unique technical expertise and experience across the spectrum of chemical, biological, radiological, nuclear and explosive (CBRNE) threats. While the spirit of forensic investigation remains the same—reaching scientific conclusions (which are often challenged) through the examination of associated materials and the interpretation of the resulting data—the nature of CBRNE related materials can introduce expanded and often unique requirements for their analysis. The need for a broad, reliable and validated knowledge base to facilitate CBRNE forensics has driven new and innovative research in chemistry, materials science, advanced analytical techniques, computations simulation and modeling that ultimately reveal important information at the nanoscale or molecular level.

This talk will focus on emerging and innovative research across the CBRNE threat spectrum, leading to understanding of physiological effects of chemical and biological agents (toxicity and dosing effects, signatures and biomarkers for exposure) to physicochemical properties of materials pertinent to forensic investigations (synthesis and agent characterization, attribution signatures, synthesis pathways determination, environmental behavior and reactivity, route attribution, isotopic information, sensing and detection). An integrated computational and experimental science-based approach towards CBRNE forensic science, can also lead to a mechanistic understanding of material and agent reactivity in operationally relevant environments and biological systems. By developing new techniques, materials and analyticalmethodology that can be applied towards CBNRE forensic investigations, an enhanced understanding of the scope and nature of the emerging proliferant activities and possibleasymmetric threats can be obtained.