Nanomaterial Design for Environmental Health and Safety

Robert H. Hurt
Brown University, Providence, Rhode Island, USA
Robert_Hurt@brown.edu

ABSTRACT

Nanotechnology offers both challenges and opportunities for environmental health and safety (EHS). Nanomaterials can protect human health as high-efficiency catalysts or sorbents for destruction or capture of conventional toxicants. Nanomaterials may also pose risks to human health through inhalation, dermal exposure, ingestion or implantation. Lack of consistent scientific data on nanomaterial health impacts has led to the current climate of uncertainty for technology companies, regulatory agencies, and consumer groups. A longer term view is that the nanotechnology movement is fortunate to have been given a unique "window of opportunity" to develop methods for managing EHS concerns before its products become truly widespread in the marketplace. In contrast to traditional pollutants, nanomaterials are high-technology products over which we have precise control of structure and properties, including the structures responsible adverse biological impacts. Nanotechnology is also expanding rapidly – an amazing variety of new nanomaterials, complex nanostructures, and interacting nanosystems are under active development. For these reasons, the logical long-term goal for nano-EHS research is to identify the fundamental material *features* responsible for adverse biological impacts and to develop *generalized rules* for safe nanomaterial design and formulation. This talk gives examples of nanotechnology-EHS research at Brown University including: (i) mechanistic studies that identify the *specific features* of carbon nanotube samples responsible for cell interactions, (ii) new nanotube purification methods specifically designed for detoxification, (iii) antioxidant surfactants to improve nanomaterial dispersion and protect cells from oxidative stress, (iv) surface functionalization chemistries that reduce adverse biological impacts, and (v) nanomaterials designed for capturing mercury released from fluorescent lamps. An intensive cooperative international research effort is needed to ensure that the environmental health benefits of nanotechnology will outweigh the risks, and that nanotechnology will make an important positive contribution to the global challenges of the 21st century.