PURDUE ENGINEERING

ENVIRONMENTAL AND ECOLOGICAL ENGINEERING

EEE Research Seminar
DATE: Tuesday, February 27, 2018
TIME: 10:30 A.M.
LOCATION: Fu Room POTR 234

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Nanomanufacturing Scale-up: Exploring the Benefits and Concerns

Abstract
Given the potential benefits and concerns over the use of nano-enabled products (NEPs), *and* because many businesses are currently working to commercialize NEPs, it is critical to assess the technological, environmental, and economic tradeoffs. This work explores the use of life cycle assessment (LCA), risk assessment, life cycle costing, material flow analyses, decision analysis optimization tools, and net benefit analyses for carbon nanotube (CNT) and nano-silver applications throughout the product life cycle, and in particular, how to responsibly manufacture and potentially recycle nano-enabled products in light of the uncertain and often ambiguous environmental and health effects associated with CNT and nano-silver exposures. In general, the application of green engineering principles steered our efforts in investigating NEPs using a myriad of tools. Several applications were investigated using these techniques with respect to their lifecycle impacts with varying amounts of CNT (bio- and chemical sensors, electronic switches, batteries, EMI-shielding, and polymer-based composites) or with varying amounts of nano-silver (clothing, medical bandages and protective gear, packaging, as well as children's toys, cups and blankets). With insights from the assessment tools and a holistic and systems approach to the issues of uncertainty and risk, product redesign can be pursued to reduce the environmental and health impacts of nano-enabled products and to understand the environmental and health risks of nanomaterials relative to one other. Opportunities to mitigate exposures during manufacture and disposal processing were explored, with best practices recommended. It was also shown that recycling of CNT-composites at end-of-life is possible and preferred over incineration or disposal. Product stewardship initiatives were explored in light of existing U.S. practices. As an interdisciplinary project, the research included expertise across the various fields of nano-engineering, policy, nano environmental health and safety, exposure sciences and nanotoxicology, and led to greater understanding of the challenges of sustainable development and governance of emerging nanotechnologies. Ultimately, the project contributes new data, approaches, and methods to the future responsible *and* sustainable development of nanotechnology.

Bio
Dr. Jacqueline A. Isaacs is a professor in the Department of Mechanical and Industrial Engineering with a secondary appointment in the School of Public Policy and Urban Affairs at Northeastern University, where she is an associate director of the NSF Nanoscale Science and Engineering Center for High-rate Nanomanufacturing (CHN). She is currently serving as Associate Dean for Faculty Affairs. Her research interests include assessment of the regulatory, economic, environmental and ethical issues facing the development of nanomanufacturing and other emerging technologies. Dr. Isaacs' research group works on various aspects of life cycle assessment and to assess and compare processes or products alternatives with respect to materials and design choices. Her 1998 NSF Career Award, one of the first that focused on environmentally benign

manufacturing, had a powder metallurgy theme. Dr. Isaacs also guides research on development and assessment of educational computer games that aim to offer students an exploration of environmentally benign processes and supply chains in manufacturing. She received a B.S. from Carnegie Mellon University and S.M and Sc.D. degrees in Materials Science and Engineering from the Massachusetts Institute of Technology. Dr. Isaacs has been recognized by Northeastern University, receiving the President's Aspiration Award in 2005 and a University-wide Excellence in Teaching Award in 2000. She is also a 2013 ELATE Fellow.