Pollution Prevention through Nanotechnology Conference
Scope of Conference

The purpose of this paper is to explain the scope of EPA's Pollution Prevention through Nanotechnology Conference, including the need for responsible attainment of the pollution prevention benefits that can result from nanotechnologies.

Background

The National Nanotechnology Initiative (NNI) is a federal research and development program established to coordinate efforts in nanoscale science, engineering, and technology. As a participant in the NNI, the U.S. Environmental Protection Agency (EPA) is supporting research in this technology, while evaluating its regulatory responsibility to protect the environment and human health. In February 2007, EPA published the "Nanotechnology White Paper," which described EPA's science needs associated with nanotechnology. One of the recommendations of the document addresses the potential for pollution prevention through nanotechnology innovation. The Pollution Prevention through Nanotechnology Conference will: (1) improve understanding of the potential for pollution prevention benefits through nanotechnology; (2) aid understanding of the life-cycle considerations associated with the responsible development of nanotechnology; and (3) inform the development of EPA's program for nanoscale materials under the Toxic Substances Control Act (TSCA), including the development of a Stewardship Program for nanoscale materials.

Pollution prevention

Pollution prevention is reducing or eliminating waste at the source by modifying production processes, promoting the use of non-toxic or less-toxic substances, implementing conservation techniques, and re-using materials rather than putting them into the waste stream.

Beneficial characteristics

The unique and potentially useful properties of nanomaterials include dramatically increased surface areas and reactivities, improved strength-weight ratios, increased electrical conductivity, and changes in color and opacity. Materials designed to take advantage of these properties are finding application in a variety of areas, such as electronics, medicine, and environmental protection.

This conference is focused on three major areas of pollution prevention:

- Products – Products that are less toxic, less polluting, and wear-resistant;
- Processes – Processes that are more efficient and waste-reducing;
- Energy and Resource Efficiency – Processes or products that use less energy and fewer raw materials because of greater efficiency.

Products

Examples of products with potential for preventing pollution include coatings that are free of volatile organic compounds and diisocyanates, safer surfactants, and self-cleaning surfaces. Nanotechnology and nanomaterials can help create alternatives to light-emitting or absorbing applications that previously relied upon heavy metal-based semiconductors. Nanocomposites may be used in a variety of products, resulting in reduced need for addition of flame retardant chemicals. In addition, products including a variety of tools, automobile and airplane components, and coatings can be made harder and more wear-, erosion-, and fatigue-resistant than conventional counterparts.

Processes

Processes that could prevent pollution include more efficient industrial chemical production through the use of nanoscale catalysts, and the bottom-up self-assembly of materials, resulting in processing efficiency, reduction of waste in manufacturing, and stronger materials with fewer defects. In addition, the ability to enhance and tune chemical activity can result in catalysts that improve the efficiency of chemical reactions in automobile catalytic converters, power generation plants, and manufacturing facilities.

Energy and Resource Efficiency

Efficiency of resource use could be improved through nanotechnologies such as light-emitting diodes. Nanocomposites are valued in automotive applications for their improved physical properties and their ability to produce parts with reduced weight (leading to improved fuel efficiency). Carbon nanotubes added to inherently non-conductive polymers allow nanocomposite parts to be painted using electrostatic methods, significantly reducing paint emissions. Conventional and rechargeable batteries are used in a growing number of portable electronic devices, and nanomaterials are beginning to make an impact by enabling batteries to last longer and withstand an increased number of charging cycles. In addition, nanomaterials can be used to make aerogels: porous and extremely lightweight materials that can save energy when used as insulation.

Responsible development

While nanomaterials have beneficial applications, they also raise concerns over potential implications for human health and the environment. Bioaccumulation potential, toxicity, worker and community exposure, and ultimate fate are among the concerns that merit consideration. The pursuit of pollution prevention applications of nanotechnology should be undertaken with consideration of the potential impacts across the entire life cycle of the nanomaterials, including production, use, and end-of-life disposition. A broad consideration of the benefits and potential impacts can help to ensure that economic and environmental benefits are maximized, while minimizing the likelihood of unintended adverse consequences.