

Nanotechnology Signature Initiative*

Sustainable Nanomanufacturing: Creating the Industries of the Future

Overview

The long-term vision for nanomanufacturing is to create flexible, "bottom-up" or "top-down/bottom-up" continuous assembly methods to construct elaborate systems of complex nanodevices. Furthermore, these systems by design will reduce overall environmental and health impacts over their full life cycles. This NSI is developing the foundation for this vision by establishing sustainable industrial-scale manufacturing of functional systems with relatively limited complexity based on engineered nanomaterials (ENMs) designed to have specific properties. Advances in several areas are required to move beyond laboratory-specific demonstrations: production must be scaled up to a commercially viable throughput and yield; the generation, manipulation, and organization of nanostructures must be accomplished in a precise, controlled, and sustainable manner; and final nanotechnology-enabled products must perform to specification over their expected lifetimes without the release of potentially harmful ENMs. The availability of high-throughput, inline metrology to enable closed-loop process control and quality assurance is a critical prerequisite for the development of cost-effective nanomanufacturing.

Goals

To develop new technologies for the manufacture of advanced materials, devices, and systems based on nanoscale building blocks and components, and for their economical and sustainable integration into complex, large-scale systems.

Thrust Areas

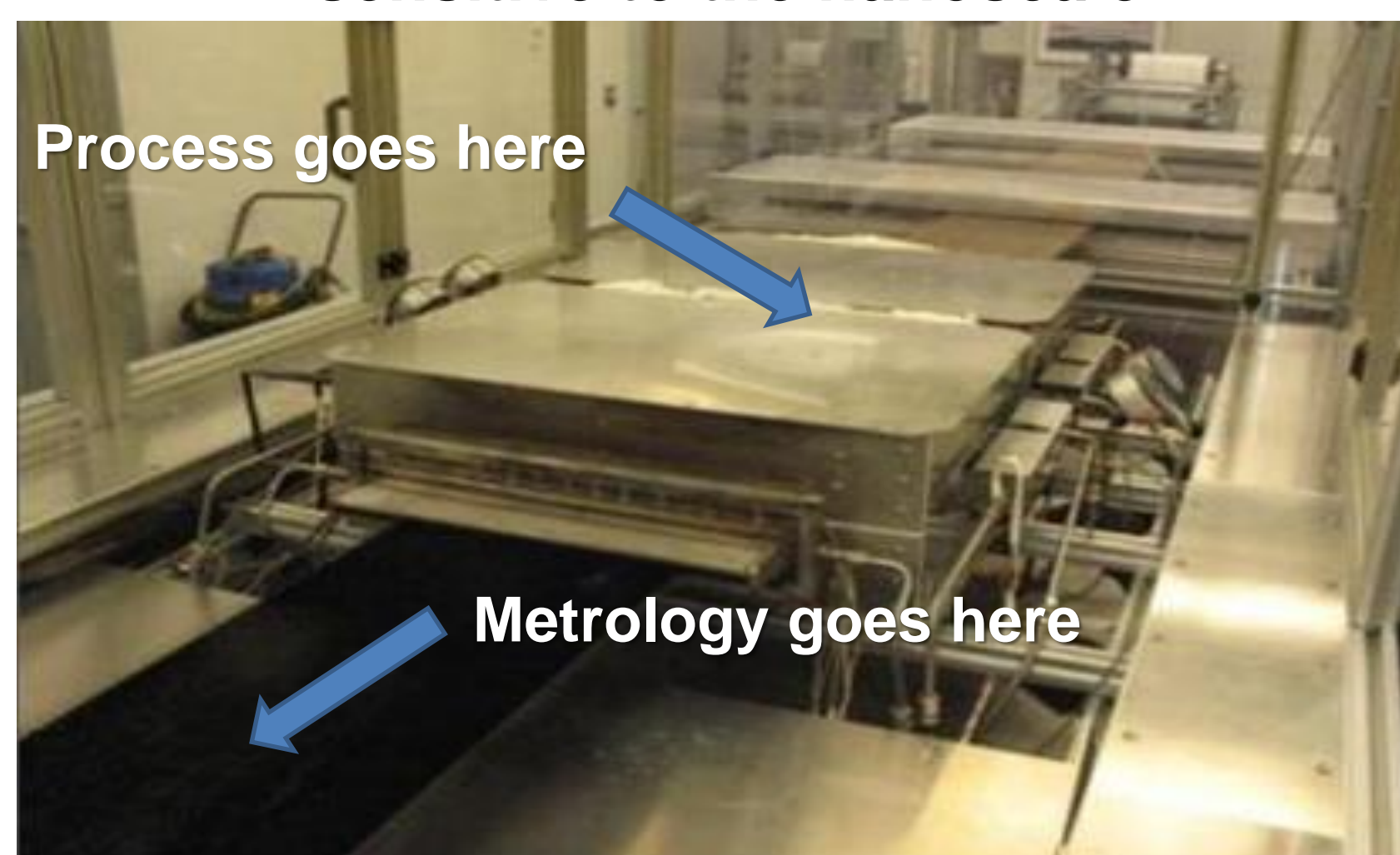
- Design of scalable and sustainable nanomaterials, components, devices, and processes
- Nanomanufacturing measurement technologies

Agencies Involved

Department of Commerce (National Institute of Standards and Technology), Department of Defense, Department of Energy, Department of Health and Human Services (National Institutes of Health, National Institute for Occupational Safety and Health), Department of Labor (Occupational Safety and Health Admin.), Environmental Protection Agency, Intelligence Community, National Aeronautics and Space Administration, National Science Foundation, and U.S. Department of Agriculture (Forest Service).

Examples of Activities that Support the Goals of the Nanomanufacturing NSI

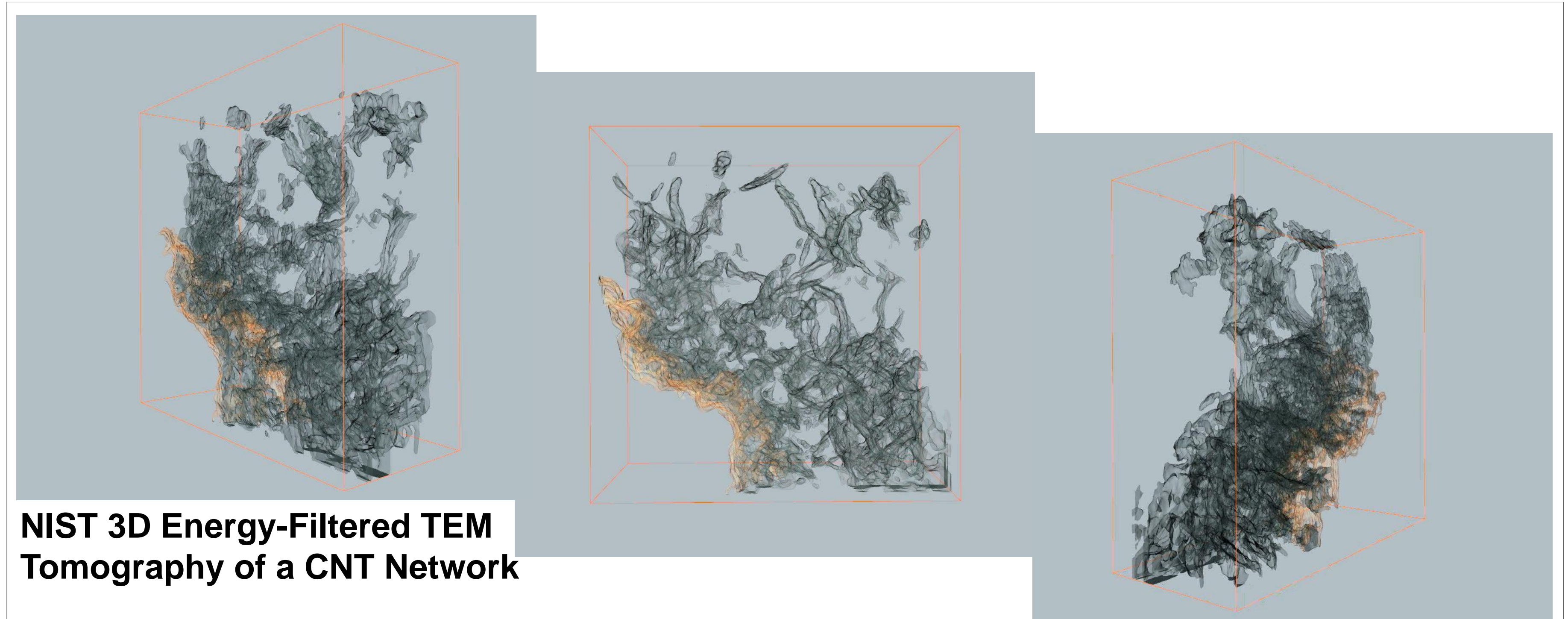
Production metrology must be fast, economical, and sensitive to the nanoscale



Carbon nanotube (CNT) nanocomposite pilot line at Applied Nanostructured Solutions – nanostructures generated on a meter wide web moving at meters/minute

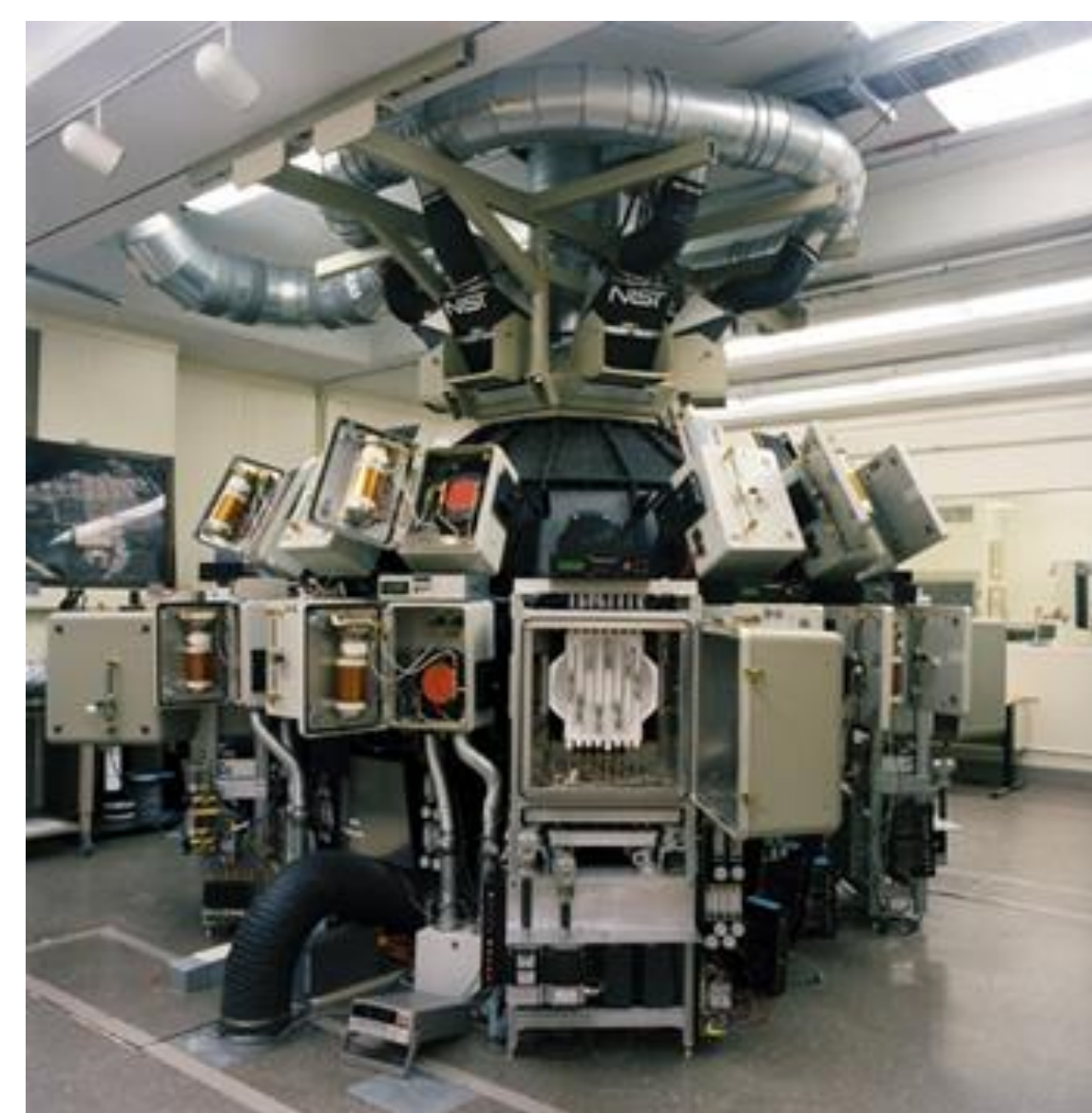
Examples of Activities that Support the Goals of the Nanomanufacturing NSI

Carbon Nanotubes (CNTs)



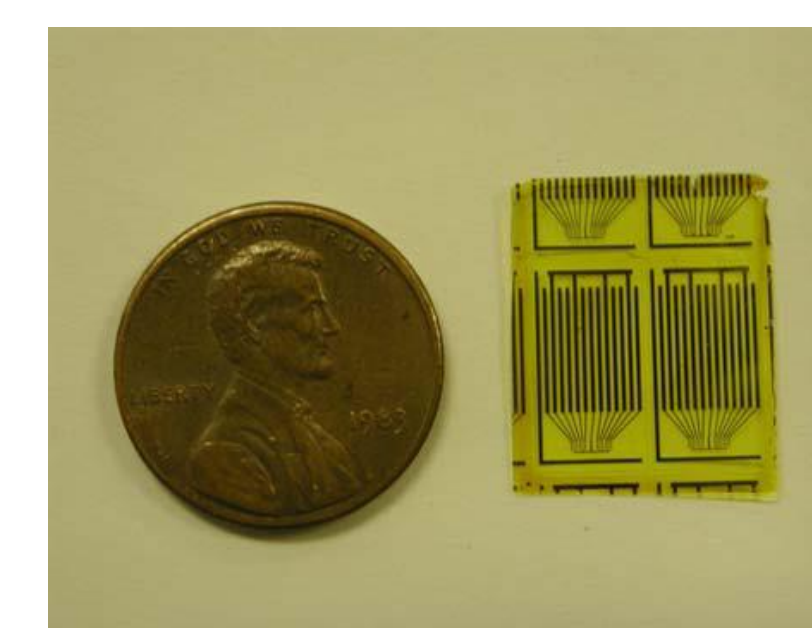
NIST 3D Energy-Filtered TEM Tomography of a CNT Network

Rapid testing of CNT embedded polymers



NIST Simulated Photodegradation by High Energy Radiant Exposure

NASA CNT Strain Sensor

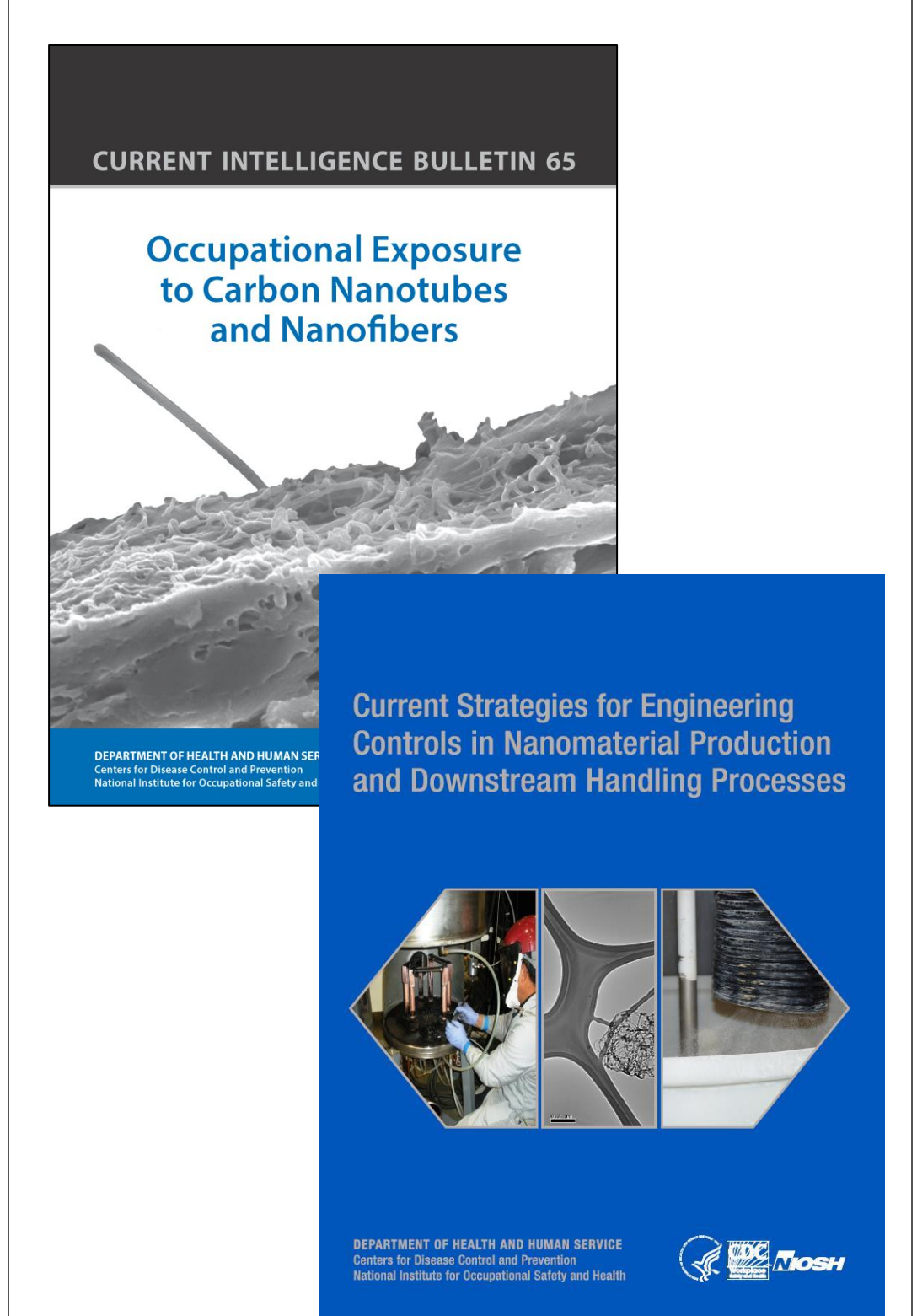


CNT Sheeting



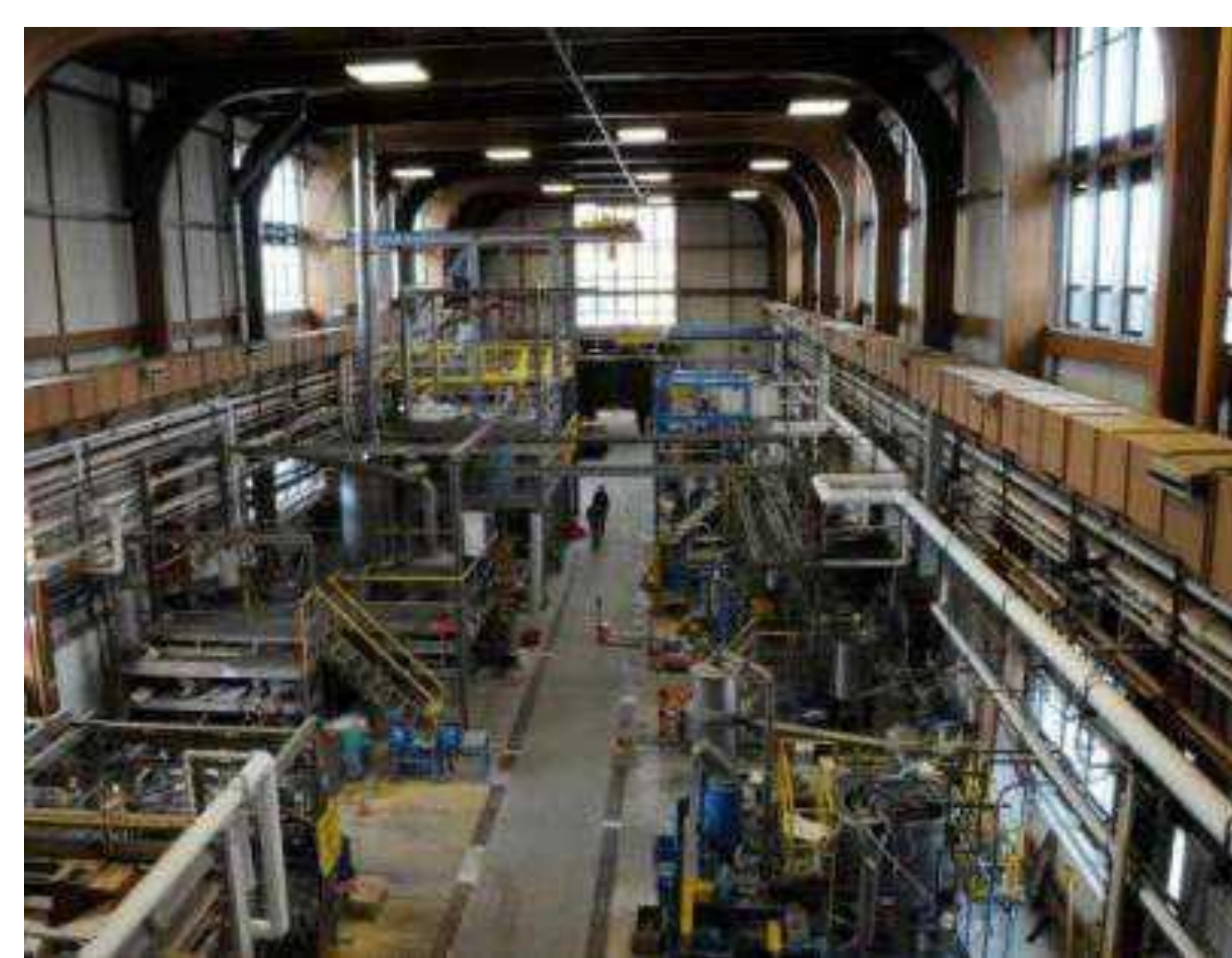
Workers glue sheets of carbon nanotubes together with an industrial adhesive. This sheet is 61 meters long (Courtesy of MIT).

NIOSH Guidance Documents



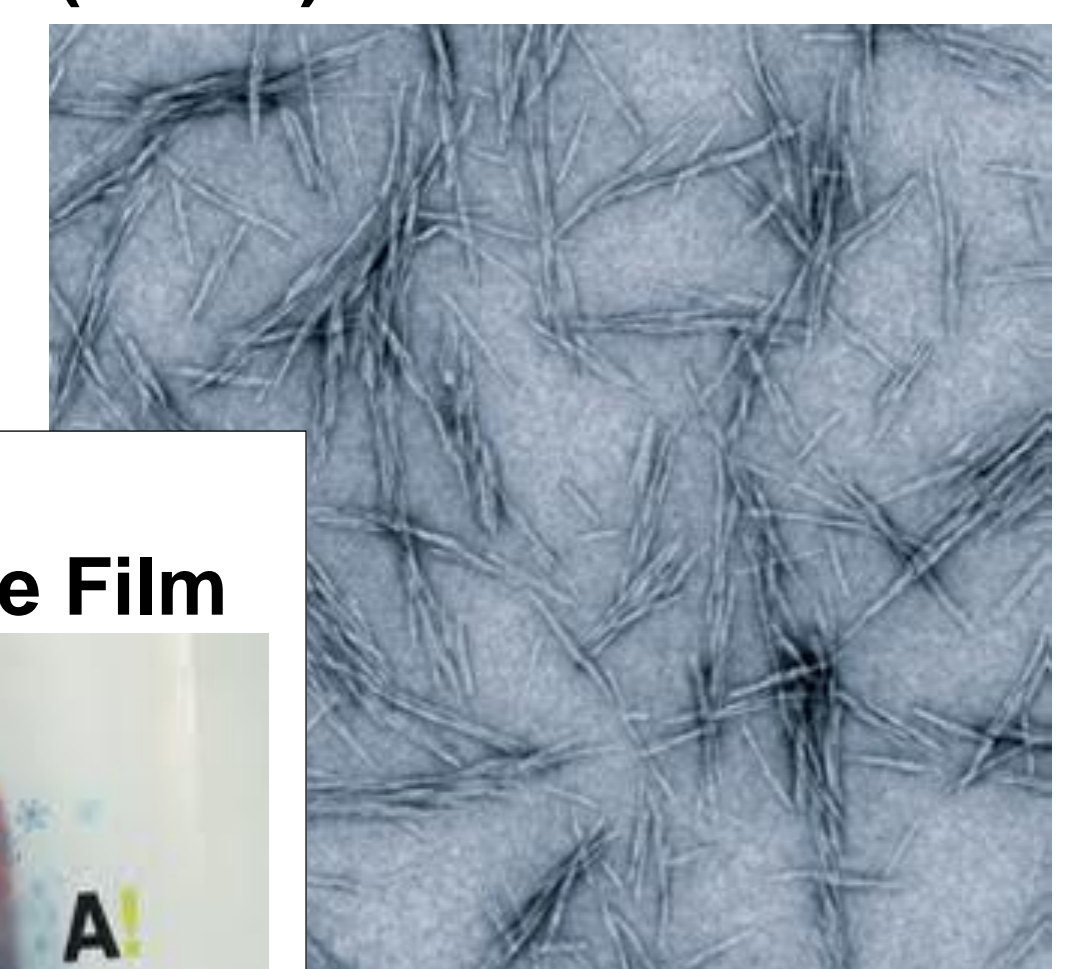
Cellulosic Nanomaterials

USDA Cellulose Nanomaterial Pilot Plant



USDA Forest Service, Forest Products Laboratory

Cellulose Nanocrystals (CNCs)



Produced at Forest Products Laboratory

Transparent Nanocellulose Film



* Nanotechnology Signature Initiatives (NSIs) are topical areas identified by the National Nanotechnology Initiative and its agencies as benefiting greatly from close and targeted interagency interactions. The NSIs spotlight key areas of national priority and provide a mechanism for enhanced collaboration to leverage research and development programs across multiple agencies.