



Office of Independent Oversight

The Role of Integrated Safety Management in Nanoscale Research at DOE Facilities

August 27, 2008



Nanotechnology

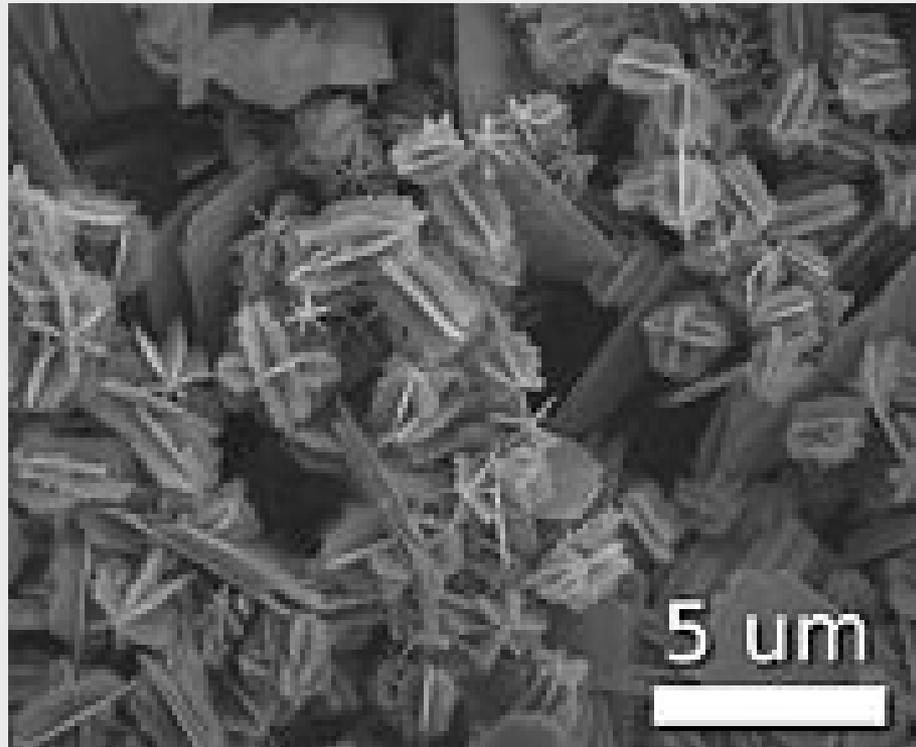


- ◆ A term referring to a wide range of technologies that measure, manipulate, fabricate or incorporate materials and/or features with at least one dimension between 1 and 100 nanometers (nm). Such applications exploit those properties, distinct from bulk or molecular systems of nanoscale components.

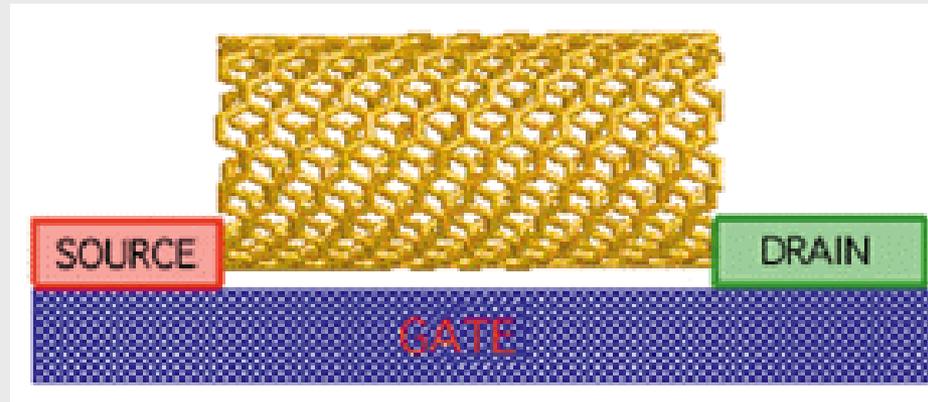


NanoMaterials

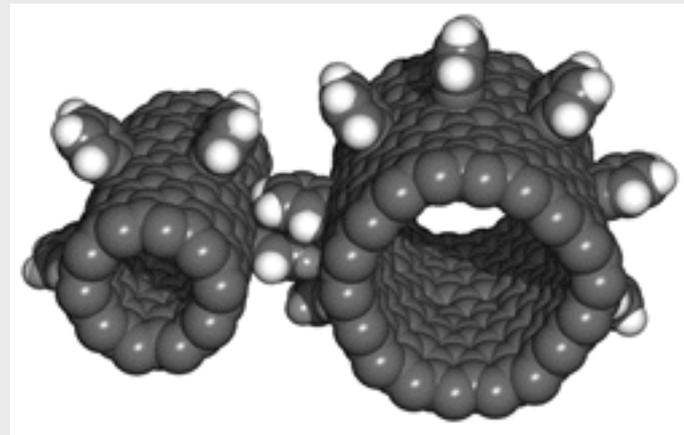
- ◆ Nanoparticles, i.e., Dispersible Particles Having 2 or 3 Dimensions Between 1 and 100 nm
- ◆ “Engineered” Nanomaterials, i.e., Consisting of or Containing Structures of Between 1 and 100 nm that Make Use of Properties Unique to Nanoscale Forms of Materials



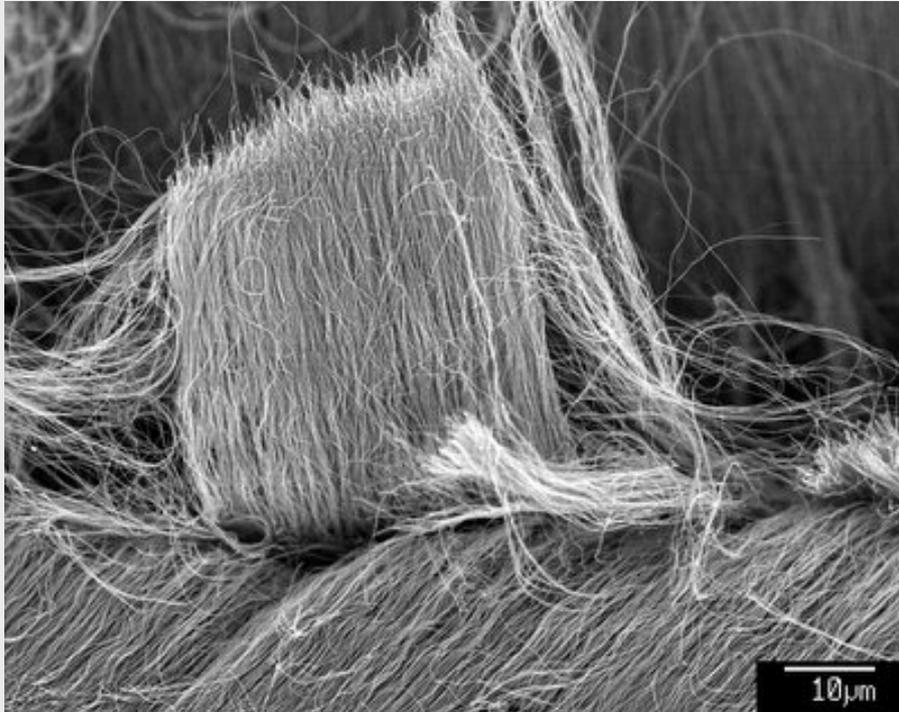
Nanoflowers



Nanotube (Armchair)



Nanobud



Carbon Nanotubes



Fullerens



Products in the General Market Place



Products on the Market

- 610 products already on the market (disclaimer: based on manufacturer claims, not verified)

- Cosmetics
- Shampoos
- Sunscreens
- Drugs/Supplements
- Wound Dressing
- Tennis Rackets & Balls
- Cleaners
- Filtration
- Toys
- Food
- Tableware
- Batteries
- Paints...



Source: Project on Emerging Nanotechnologies (<http://www.nanotechnologiesproject.org/>)

Brookhaven Science Associates

6

BROOKHAVEN
NATIONAL LABORATORY

Source: D. Bower, Brookhaven Laboratory



Current DOE Research



- ◆ Pure Science / Theory, Modeling, Imaging, Characterization, Fabrication
- ◆ Tubes, Wires, Dots, Films, Composites
- ◆ Water Purification / Chemical Extraction
- ◆ Catalytic Properties
- ◆ Drug Delivery / Tumor Destruction
- ◆ Surface Area Science
- ◆ Battery / Solar Cell / Hydrogen Cell



DOE Nanoscale Science Research Centers



- ◆ LBNL – Molecular Foundry
- ◆ ORNL – Center for Nanophase Materials Science
- ◆ BNL – Center for Functional Materials
- ◆ ANL – Center for Nanoscale Materials
- ◆ SNL/LANL – Center for Integrated Nanotechnology

--- Funded by the Office of Science ---



Challenges

- ◆ Difficult to See or Detect
- ◆ Potential Health Risk
- ◆ Little Toxicological Data Available
- ◆ Expensive to Image / Electron Microscope
- ◆ No Specific Occupational Exposure Limits
- ◆ Limited Instrumentation / Particle Counters
- ◆ No Formal Requirements or Guidance
- ◆ Public Perception



Some History



DOE Nano Policy



- ◆ 7/04 – White Paper, “Ensuring the Safety and Viability of Nanotechnology”
 - ◆ Paper Sent to NA-1 and SC-1 by Former EH Organization
 - ◆ Presents Concerns of Not Having Departmental Policy

- ◆ 3/05 – First Meeting of Emerging Technology Workgroup to Discuss Nanotechnology
 - ◆ Attempted to Establish a Path Forward in the Development of Departmental Wide Nano Policy

- ◆ 5/05 – Safety Bulletin, “Good Practices for Handling Nanomaterials”
 - ◆ Developed as an Interim Step in the Development of Nano Policy



DOE Nano Policy



- ◆ 9/05 – DOE P 456.1, *Secretarial Policy Statement On Nanoscale Safety*
 - ◇ Establishes Overarching Philosophy and Values to Nano Safety and Health
- ◆ 2/06 – 10 CFR 851, Appendix A 11, *Nanotechnology Safety -- Reserved*
 - ◇ HSS Felt there was Insufficient Data to put into Place Specific Regulations
- ◆ 4/07 – Justification Memo for DOE N XXX.X, *The Safe Handling and Transfer of Nanoscale Materials*
 - ◇ Interim Step that Would Provide Baseline Requirements Flexible Enough to Allow Sites to Tailor to Their Specific Needs



Additional Guidance



- ◆ National Science Resources Center (NSRC)
Approach to Nanomaterial ES&H (Rev. 3a)
- ◆ American Society for Testing and Materials (ASTM) – Standard Guide for Handling Unbound Engineered Nanoscale Particles in Occupational Settings (E 2535 – 07)
- ◆ ASTM – Terminology for Nanotechnology (E 2456-06)
- ◆ National Institute for Occupational Safety and Health – Interim Guidance for the Medical Screening of Workers Potentially Exposed to Engineered Nanoparticles



DOE IG Audit Report



- ◆ Recommended: HSS Adopt and Disseminate the NSRC Working Group’s “Guidance” as the Department’s Expectation of Safety Policies and Procedures at the Laboratories for:
 - ◆ Medical Surveillance
 - ◆ Exposure Rate Monitoring
 - ◆ Training
 - ◆ Engineering Controls, such as HEPA Filtered External Exhaust



HSS Special Review



- ◆ Request by the Secretary of Energy
- ◆ Focus on Work Practices Against the NSRC Approach Document, DOE P 456.1, DOE P 450.4, *Safety Management System Policy*, and 10 CFR 851, *Worker Safety and Health Program*
- ◆ Onsite Field Reviews of 8 of the 16 Laboratories Performing Nanoscale Projects



Key Observations



- ◆ Most Sites in Early Stages of Implementation
- ◆ Many Examples of Proactive, Innovative Practices, Including Worker Identification and Tracking, Ventilation, and Containment
- ◆ Weaknesses Found in Chemical Management, Medical Surveillance, Contamination Control, Communication, Personal Protective Equipment, Workplace Monitoring, Labeling, Transportation, Waste Management



Conclusions



- ◆ “Voluntary Compliance” Management Method Has Resulted in Mixed Nanosafety Implementation
- ◆ Level of Implementation Related to the Focus of Laboratory Management, ES&H Staff and/or Laboratory Space Owners
- ◆ Many Sites Have Initiated Corrective Actions



Recommendations



- ◆ Correct Identified Deficiencies
- ◆ Utilize the DOE Directives Management System to Ensure Clear Requirements and Expectations are Established and Communicated (implementation of SC approach document)
- ◆ Accelerate Performance-Based Assessment Activities (DOE and Labs)