Better Measurements

Reference Materials for Commerce and Safety Monitoring

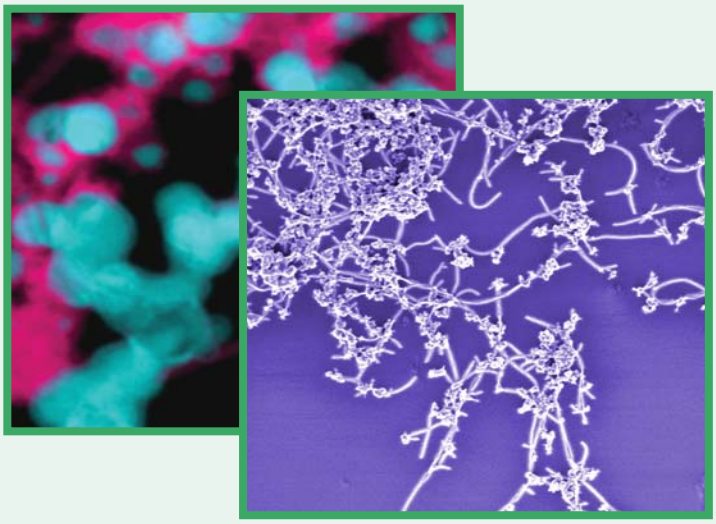
Interested Agencies: CPSC, EPA, DOD, DOL, FDA, NIH, NIOSH, NIST, USGS

The chemical composition and physical characteristics of today's engineered nanoscale materials can vary substantially between batches and from vendor to vendor. Products manufactured from such variable starting materials have inconsistent performance characteristics. Health and safety testing studies yield seemingly variable results. Accurate calibration of environmental monitoring systems is difficult.

A suite of reference standards (stable materials with rigorously characterized chemical and physical properties) could help to eliminate these problems. Reference standards are used in laboratories to perform instrument calibrations, by manufacturers to verify the composition or properties of their products, and in clinical laboratories to validate the accuracy of specific measurements. Material standards with property values that have been determined using established and definitive methods are essential in the validation of new measurement methods.

Standards are needed for engineered nanoscale materials. Different groups or classes of standards will be needed by different sectors. For example, materials necessary for performance evaluations in manufacturing may consist of nanocomposites or nanoclays relevant to a particular industry. Materials needed for toxicology and ecotoxicology research include titanium dioxide, zinc oxide, and carbon nanotubes. However, significant R&D is needed on many fronts. Pure samples are needed. The critical and relevant physical parameters (size, shape, composition, etc.) must be identified. Reliable methods of distributing these standards must be established. Instruments with the ability to determine the elemental composition, location, and chemical state of all atoms in nanomaterials must be developed.

Creating a suite of standards for engineered nanoscale materials will require a coordinated interagency research effort. Multiple NNI agencies will need to be involved in developing and validating instrumentation and methods. Agencies with needs to measure specific materials will play a role in selecting material for which standards will be developed. The research-sponsoring agencies will be critical to funding studies that identify relevant chemical and properties for standardization. Regulatory agencies will have an essential role in describing the use of these standards, for example in environmental and workplace monitoring settings.



Lower right: Electron micrograph of a carbon nanotube sample showing how the sample contains significant impurities such as metallic particles and other forms of carbon. Field width is approximately 4 µm. Upper left: Electron energy loss spectrometry reveal metallic impurities (pink) and along with carbon (light blue). Field width is approximately 100 nm. (Images courtesy of NIST.)