Measurement Suite Established for Carbon Nanotube Standards

Supporting/Contributing Agencies: NIST

NIST has established a suite of critical measurement technologies that addresses a key challenge to the manufacture of products incorporating carbon nanotubes (CNTs). As synthesized, commercial CNT feedstocks typically include a complex mixture of tube lengths, diameters, and conductive properties, along with a variety of impurities. This heterogeneity is impeding the development of CNT-based technologies by preventing precise measurements of nanotube properties and performance, and by making it impossible to reliably assess their safety. To address this challenge, NIST has developed methods of sorting single walled carbon nanotubes into homogeneous samples of extraordinary purity, and built the measurement science required to measure their intrinsic physical properties. These purified materials and measurement tools have been used to make critical measurements on CNTs, including assessments of their safety, and fundamental characterization of their optical, electronic, magnetic and thermal properties. For example, NIST has determined that the toxicity of nanotubes is dependent upon their length; and NIST measurements can determine the fraction of metallic nanotubes in bulk specimens—a prerequisite for the development of CNT-based sensors. NIST's methods and technical experts are also playing a central role in defining the emerging international documentary standards and creating Standard Reference Materials for CNTs. By dramatically improving the ability to assess the quality of CNT feedstocks, these accomplishments will accelerate the production of safe and reliable CNT-based products, including advanced composites, electronics, sensors, and energy-saving materials.

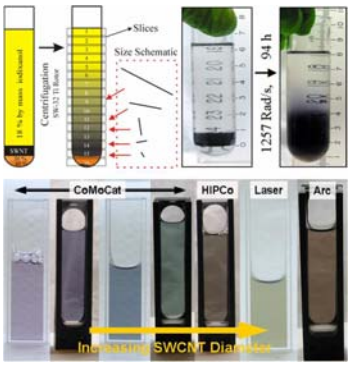

Figure 1. Schematic of centerfuge-based length sorting of CNTs (top), and solutions of 1 µm-lor CNTs extracted from different feedstocks (bottom).

References/Publications/Patents

Fagan, JA, et al. Centrifugal Length Separation of Carbon Nanotubes. Langmuir **24**, 13880-13889 (2008).

Fagan, JA, et al. Length-dependent Optical Effects in Single-Wall Carbon Nanotubes. Journal of the American Chemical Society **129**, 10607-10612 (2007).