NIST 'how-to' website documents procedures for nano-EHS research and testing

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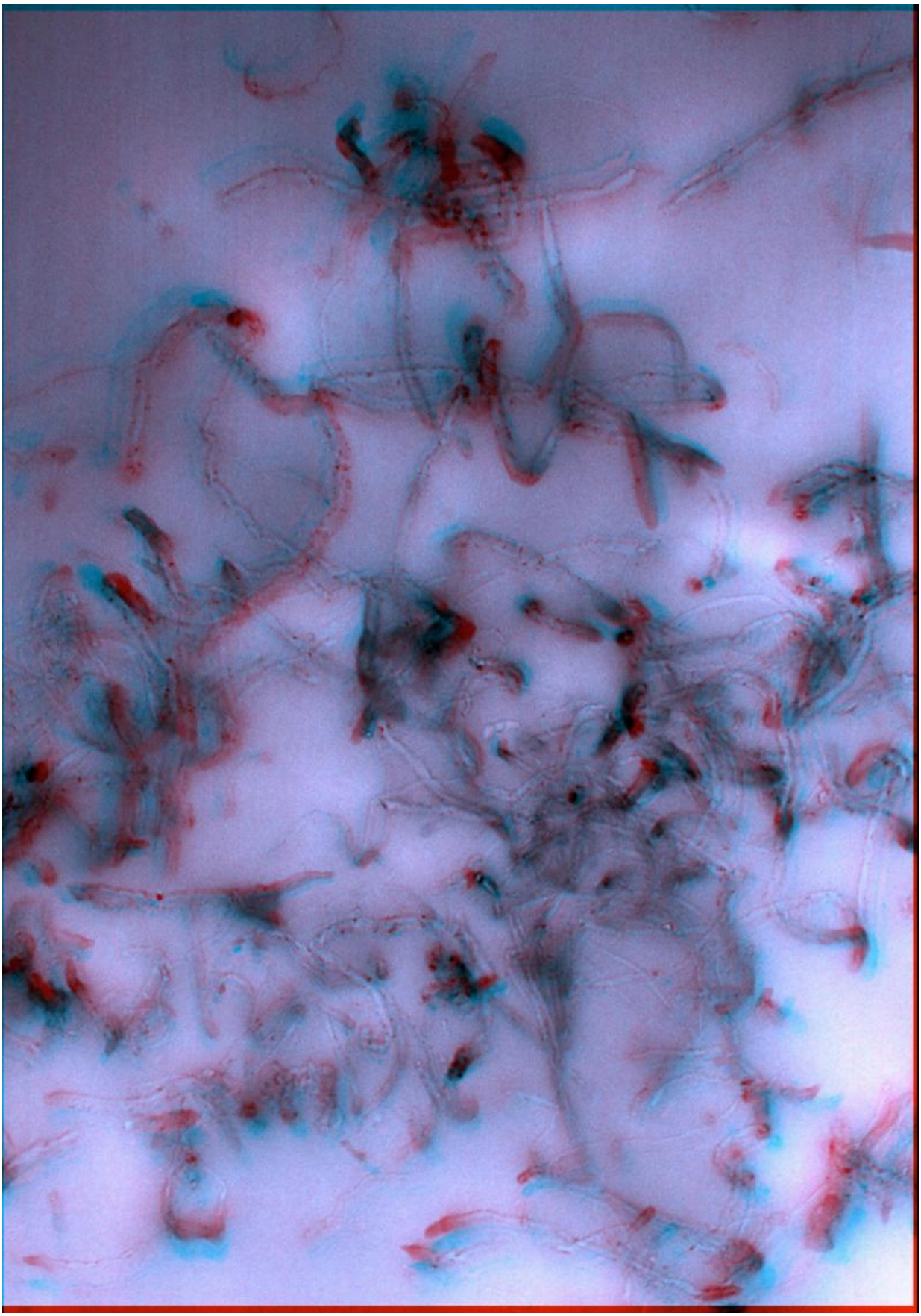

Rigorous measurement protocols are key to unraveling the complex physical structure of carbon nanotubes [CNTs] embedded in a polymer composite, shown here in a three-dimensional scanning electron microscope image. The sizes, shapes and distribution of CNTs in the polymer can be measured from this image. N.B. This image is an anaglyph 3-D version using red-cyan image separation. It is meant to be viewed with the common red-cyan 3-D glasses. Credit: Vladar

As engineered nanomaterials increasingly find their way into commercial products, researchers who study the potential environmental or health impacts of those materials face a growing challenge to accurately measure and characterize them. These challenges affect measurements of basic chemical and physical properties as well as toxicology assessments.

To help nano-EHS (Environment, Health and Safety)researchers navigate the often complex measurement issues, the National Institute of Standards and Technology (NIST) has launched a new website devoted to NIST-developed (or co-developed) and validated laboratory protocols for nano-EHS studies.

In common lab parlance, a "protocol" is a specific step-by-step procedure used to carry out a measurement or related activity, including all the chemicals and equipment required. Any peer-reviewed journal article reporting an experimental result has a "methods" section where the authors document their measurement protocol, but those descriptions are necessarily brief and condensed, and may lack validation of any sort. By comparison, on NIST's new Protocols for Nano-EHS website the protocols are extraordinarily detailed. For ease of citation, they're published individually—each with its own unique digital object

identifier (DOI).

The protocols detail not only what you should do, but why and what could go wrong. The specificity is important, according to program director Debra Kaiser, because of the inherent difficulty of making reliable measurements of such small materials. "Often, if you do something seemingly trivial—use a different size pipette, for example—you get a different result. Our goal is to help people get data they can reproduce, data they can trust."

A typical caution, for example, notes that if you're using an instrument that measures the size of nanoparticles in a solution by how they scatter light, it's important also to measure the transmission spectrum of the particles if they're colored, because if they happen to absorb light strongly at the same frequency as your instrument, the result may be biased.

"These measurements are difficult because of the small size involved," explains Kaiser. "Very few new instruments have been developed for this. People are adapting existing instruments and methods for the job, but often those instruments are being operated close to their limits and the methods were developed for chemicals or bulk materials and not for nanomaterials."

"For example, NIST offers a reference material for measuring the size of gold nanoparticles in solution, and we report six different sizes depending on the instrument you use. We do it that way because different instruments sense different aspects of a nanoparticle's dimensions. An electron microscope is telling you something different than a dynamic light scattering instrument, and the researcher needs to understand that."

The nano-EHS protocols offered by the NIST site, Kaiser says, could

form the basis for consensus-based, formal test methods such as those published by ASTM and ISO.

NIST's nano-EHS protocol site currently lists 12 different protocols in three categories: sample preparation, physico-chemical measurements and toxicological measurements. More protocols will be added as they are validated and documented. Suggestions for additional protocols are welcome at nanoprotocols@nist.gov.

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