3-D X-Ray Images of Nanoparticles

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Using a new x-ray microscope that can look at nanomaterials in three dimensions, an international research team has produced the first detailed atomic structure of a core-shell nanoparticle.

This team, led by Subhash Risbud, Ph.D., at the University of California, Davis, and Jianwei Miao, Ph.D., at the University of California, Los Angeles, published details about this new microscope in the journal Physical Review Letters. The detailed structural information obtained using this device could lead to new methods of making nanoparticles with specifically designed physical characteristics.

Transmission electron microscopy (TEM) has been the standard method used to study nanomaterial structure, but because electrons do not penetrate far into materials, the sample preparation procedure is usually complicated and destructive. Furthermore, TEM generates two-dimensional images.

The new method shines a powerful x-ray source onto a nanoparticle and collects the x-rays scattered from the sample. Then computers construct a three-dimensional image from that data using methods similar to those involved in generating computed tomography (CT) images. The microscope can resolve details down to 17 nanometers, or a few atoms across.

Using the new microscope, the investigators were able to take detailed three-dimensional pictures of a commercially available gallium nitride quantum dot. The images generated in this study not only revealed the

external structure of the quantum dot, but the arrangement of atoms within this nanomaterial.

The investigators noted in their paper that, “the present work hence opens the door for comprehensive, nondestructive and quantitative 3D imaging of a wide range of samples including porous materials, semiconductors, quantum dots and wires, inorganic nanostructures, granular materials, biomaterials, and cellular structure.”

This research is detailed in a paper titled, “Three-dimensional GaN-Ga_2O_3 core shell structure revealed by x-ray diffraction microscopy.” Investigators from the Institute of Physics in Taiwan and SPring-8/RIKEN (a high-energy synchrotron) in Japan also participated in this study. An abstract of this paper is available at the journal’s website.

Source: National Cancer Institute