IMPACT PROFILE
RESEARCH AT THE UNIVERSITY OF MARYLAND

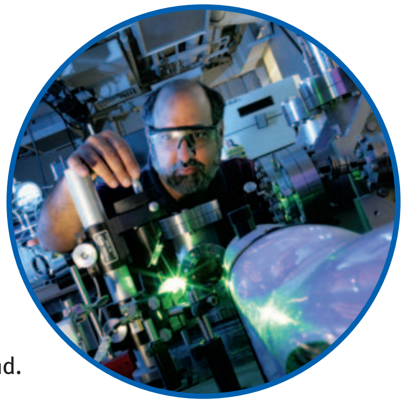
MICHAEL ZACHARIAH

Partnership with NIST on Nanoparticles

A fundamental challenge for scientists who work with nanoparticles is knowing exactly what they have in hand. The particles are obviously too small to see with the naked eye but too large for analyzing with standard chemical techniques. For everything from quality control to toxicology studies, researchers need to be able to assess just what they're dealing with.

An alliance set up between the University of Maryland and the National Institute of Standards and Technology, or NIST, is meant to do just that—to help figure out how to make, and also how to measure, different kinds of nanoparticles.

A new Center for Nano Manufacturing and Metrology has been established to support the partnership. "This is a new mechanism by which university faculty and NIST scientists can



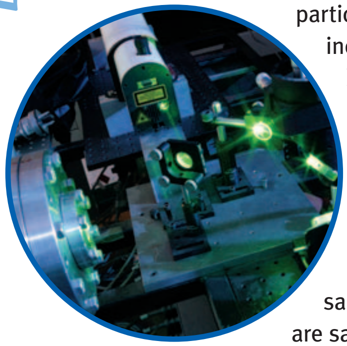
collaborate efficiently," says Michael Zachariah, director of the center who holds dual appointments at the University of Maryland in mechanical engineering and chemistry. The center was established in October 2005, and within four months had 12 projects in progress. Among other benefits, this collaboration allows students from the university to spend time at NIST to use world-class instrumentation, such as high resolution electron microscopes.

"All this requires a champion on both sides," says Zachariah. The center helps bridge College Park and Gaithersburg. As Zachariah notes, there is still no substitute for face-to-face contact among researchers.

Zachariah works on a range of research projects, from the characterization of carbon nanotubes to work on gold particles that may be used for drug delivery, but the projects are bound by the need for careful measurement. This need also extends to an area of growing interest to the public: demonstrating that nanoparticles are safe.

Researchers who work with nanomaterials are increasingly asked to confront issues of safety and regulation. "No one is in a position to say at this point what the health impact of nanoparticles will be," Zachariah says. "We won't know until we invest in developing the research protocols to find out."

Research labs constantly invent new material, a process that is probably outside the scope of regulation, says Zachariah. Once material starts being manufactured on a larger scale, safety becomes a priority. While nanoscience may seem like a brand new field of study, Zachariah points out that nanomaterials have been used for a long time. For instance, about 10 percent of the weight of a car tire is made up of nanoparticles, specially designed particles embedded in rubber to increase a tire's traction and durability. Paint contains clusters of titanium dioxide whose size is tuned to optimize the brightness of paint. Even clusters of water droplets in clouds start out as nanoparticles.



Toxicology studies are necessary to show that new nanoparticles are safe. To that end, Zachariah is collaborating with toxicologists at the University of Rochester Medical Center. In a recently launched project, he supplies particles of defined size, and the toxicologists test how cultured cells or lab animals respond. While this may seem relatively straightforward, nanomaterials tend to aggregate, yet coating the particles to prevent them from clumping introduces a new variable: Are you measuring the toxicity of the nanoparticle or of the material that prevents clumping? To keep things under control in this kind of situation, nanoparticle measurements are, again, critical.

Many researchers are excited about the possibility of using nanomaterials for drug delivery. A crucial first step is to prove that the drug carriers don't have harmful side effects. Especially in the context of medicine, scientists worry about verifying that the particles they create are of the size and shape they expect. Being able to measure and control the sizes and doses of drug-delivery devices will be essential to making nanoparticles useful in medicine.

Another and quite different area where nanoparticle measurements are proving useful is in the matter of diesel soot. While very efficient, diesel engines produce more soot than gas engines. Soot happens to be a nanoparticle, and one of Zachariah's projects is to examine those particles. For example, he's found that diesel soot contains particular metals, which suggests ideas for how to transform the soot so it won't be released.

Zachariah is also studying soot's optical properties, since soot coated with sulfate may be able to absorb large amounts of light and heat. Some researchers speculate that coated soots may constitute the second most important contributor to global warming—surpassed only by carbon dioxide. By measuring the optical properties of these particles, Zachariah will provide better data for those who create computer models for global warming. As often happens, a quick leap can link invisible materials with global issues.

—*Karin Jegalian*

Nanoparticles

UNIVERSITY OF MARYLAND

Impact Profile is a supplement to *Impact*, a quarterly research digest from the University of Maryland. To learn more about research at Maryland, go to www.umresearch.umd.edu.

Produced by the Office of University Publications for the Vice President for Research, University of Maryland.