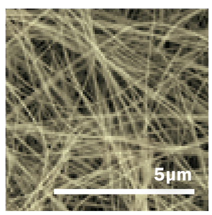
Nanofiber processing becomes serendipitously easier

Animesh Kundu was doing research for his Ph.D. thesis when he inadvertently came upon a new and more efficient method of growing titanium oxide-based nanofibers.

In an effort to develop new strategies for processing ferroelectric thin films, Kundu added organic salts to stabilize the material. What he ended up with, however, were long (a few hundred microns) and ultrathin (less than 100 nm) fibers with a unique rectangular cross-section, as opposed to the circular cross-section typical of nanofibers.



"I realized these were oxide nanofibers, and that they represented an entire field of their own to explore," says Kundu, now a research scientist at the Center for Advanced Materials and Nanotechnology.

Current methods of processing titanate nanofibers require multiple steps and take 50 to 120 hours. Kundu's method requires a single step and a mere two to eight hours.

"I stumbled onto this," he says. "It was a complete accident, and really serendipitous."

With help from Lehigh's Office of Technology Transfer, Kundu patented the technology. The invention earned a National Innovation Award at the 2014 TechConnect World Conference and Expo in Washington, D.C.

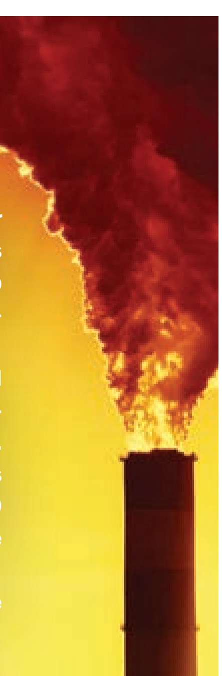
Titanate- and other oxide-based nanofibers have applications in solar cells and lithium ion batteries, as antimicrobial agents, and more.

Kundu grows the titanate nanofibers in water pressure-heated to 120 to 150 degrees centigrade. "The growth of the nanofibers is similar to the way minerals underwater are formed in hydrothermal conditions," he says.

The nanofibers contain titanium oxide powder, sodium hydroxide and other agents. Their composition can be tuned for specific applications.

At the TechConnect conference, a Nike representative suggested that Kundu weave the titanate nanofibers into antimicrobial fabrics. It's a promising idea, he says.

"I'm hoping to develop an application to bring more value to the nanofibers beyond lithium ion batteries. I have to find my own niche for this material."



dopants on acid gas interactions with ordered porous materials.

Wachs, a leader in the first and second thrusts, is renowned for using molecular spectroscopy to study the surfaces of heterogeneous catalysts under processing conditions and for exploring the relationship between catalysts' structure and their activity for photocatalysis, environmental catalysis, fuels, chemicals and other applications.

"Supported amines, carbide-derived carbons and other disordered porous materials attract acid gases," said Wachs. "We want these materials to have long-term sustainability and not be poisoned by the acids.

"We're looking at the interaction of acid gases with interior pores and with the surfaces of porous materials, and learning to make 2D oxides, nanoporous materials and metal organic frameworks. Very little work has been done in this area.

"This new research center gives us an army of people to collaborate with. It's a fantastic and exciting opportunity."

MAKING A MARK WITH MATERIALS

MRS Fellow tapped to help lead online* Science *journal.

Zakya Kafafi, adjunct professor of electrical and computer engineering, was recently named deputy editor for chemical, physical and materials sciences, and engineering of *Science Advances*, an online, open-access offshoot of *Science* magazine that will post original papers and review articles weekly.

"*Science Advances* will publish the crème-de-la-crème as far as scientific quality goes," says Kafafi, who is also a core faculty member of Lehigh's Center for Photonics and Nanoelectronics.

"One of our goals is to include papers that are really interdisciplinary in nature. We also want to create some excitement among new scientists, and give them a vision of what they can do to change the world."

Kafafi, author of 235 journal articles and several book chapters, has done pioneering work in organic optoelectronic materials and devices, leading to applications in flat panel displays and solid state lighting. She has earned an Edison Patent Award from the Naval Research Laboratory for inventing a method of patterning electrically conductive polymers and an R&D 100 Award for inventing a cryogenic link that moves vertically and rotates in a vacuum at very low temperatures.

In a collaboration with Filbert Bartoli, department chair of electrical and computer engineering; Ph.D. candidate Beibei Zheng; and Qiaoqiang Gan '10 Ph.D., assistant professor of electrical engineering at SUNY-Buffalo, Kafafi is studying metallic plasmonic nanostructures that are integrated within organic solar cells to improve their efficiencies.

Kafafi, a Fellow of the Materials Research Society, began her career doing research in low-temperature spectroscopy and then organic electroactive materials and organic light-emitting diodes.

"In the 1990s," she says, "there were no flat panel displays or smartphones. It has been very rewarding to see the impact of the science and research I was working on."

At the Naval Research Lab, where she worked for more than 20 years, Kafafi founded and directed the Organic Optoelectronics section. From 2007 to 2010, she served as head of NSF's Division of Materials Research.

"NSF has a policy that allows you to devote one day a week to research," says Kafafi. "That's 52 days a year, and if you add in weekends, you can get some serious work done."