

# The Future is Small:

## *Nanoworld Paves the Way in Innovation*

### Vesselin Shanov, PhD

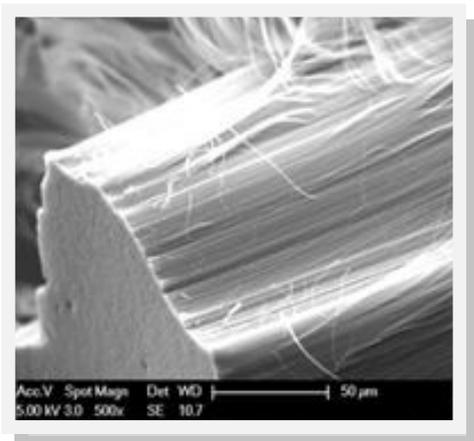
What if we could improve technology in medicine, computers, and materials by focusing on their properties at a sub-atomic level? Nanotechnology seeks to do just that, by shrinking the focus of engineering way down—to one hundred thousandth of the width of a human hair. In fact, to be considered “nano,” devices and other structures must have at least one dimension sized from 1 to 100 nanometers. Dr. Vesselin Shanov, along with Mechanical and Materials Engineering professor Dr. Mark Shulz, directs [UC's Nanoworld Laboratories](#), a nationally and globally recognized research base with members from a variety of disciplines, including engineering, physics, chemistry, and medicine. Their mission is simple: to produce new, trailblazing nano inventions and then turn them over to industry for commercialization.



Dr. Shanov (left) and Dr. Shulz (right) work with students to develop innovative nanotechnology.

### The Future is Small

While nanotechnology is a relatively new field, much has already been accomplished since Nanoworld's inception. Researchers are currently working on applications in composites reinforcement, cancer screening, electromagnetics for electric motors, elastic electromagnetic smart material, and sensors. Because of its large surface area to volume ratio, nanotechnology often has newer and better properties than macroscale bulk materials, so while the components are small, the implications are great: nanoparticles are improving airplanes, automobiles, cancer diagnosis, and cancer therapy.



A forest of carbon nanotubes shown under a scanning electron microscope.

### Synthesis of Carbon Nanotubes

Specifically, Dr. Shanov has been focusing on synthesizing carbon nanotubes. Carbon nanotubes are carbon atoms arranged in hexagonal patterns to form a tube; Shanov, along with his students, have grown the longest carbon nanotube forests in the world. Nanoworld researchers are then processing these forests into intermediate materials such as nanotube yarn and sheets. Similarly, Shanov and colleagues are working to create graphene, a sheet of carbon hexagonal material whose properties could improve the creation of transistors and other devices. Through nanoscale manipulation, this material has great implications for improving composite materials, sensors, electromagnetics, and cancer sensing.



The 2012 Nanotechnology Materials and Devices (NMD) Workshop was held at the University of Dayton, hosted by the University of Cincinnati, the University of Dayton, and the Air Force Research Laboratory (ARL).

## Educational Outreach

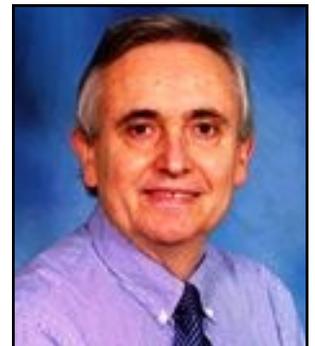
Both undergraduate and graduate students work with the Nanoworld lab, where they have the unique opportunity to collaborate with industry professionals. Moreover, the Nanoworld Lab is committed to inspiring a love of science in the community. Each year, the lab holds a Nanotechnology Materials and Devices (NMD) Workshop, a free event that educates students about nanotechnology. The lab recently hosted 50 pre-engineering students from the local Hughes High School. The students worked on a composite design project, used UC equipment to tensile test their composites, and learned about nanomaterial characterization instruments from Dr. James Boerio. There are also three nanoscience and technology courses taught by Dr. Shanov that attract students from different colleges at UC.

## Nanoworld's Current Projects

- Synthesis of carbon nanotubes and graphene for manufacturing thread, sheet, nanocomposites and sensors for advanced applications
- Mobile Microscopic Robots for Human Diagnostics and Therapy: to help diagnose and treat disease
- Magnetic Nanoparticles
- Nanoscale Electromagnetic Materials: to replace iron and copper for lightweight electric motors

## More about Dr. Vesselin Shanov

Shanov, a Professor of Chemical and Materials Engineering, has developed facilities and technologies for processing nano-structured materials and thin films. His work has earned him a number of awards, including the Fulbright Award for Research and Teaching in the United States, the German Academic Foundation (DAAD), and the Bulgarian Patent Office Award for Distinguished Patent. He has 15 patents and 5 books to his name, and has earned funding from the National Science Foundation, United States Navy, Air Force, ARMY, and NASA.



## Recent Publications

- V. Shanov, W. Cho, R. Malik, N. Alvarez, M. Haase, B. Ruff, N. Kienzle, T. Ochmann, D. Mast, M. Schulz, "CVD Growth, Characterization and Applications of Carbon Nanostructured Materials", *Surface and Coatings Technology*, 230, pp. 77-86, (2013).
- Edited Book, **NANOTUBE SUPERFIBER MATERIALS, Transforming Engineering Design**; Mark Schulz, Vesselin Shanov, Zhangzhang Yin, (Elsevier Science). Published 9/13.