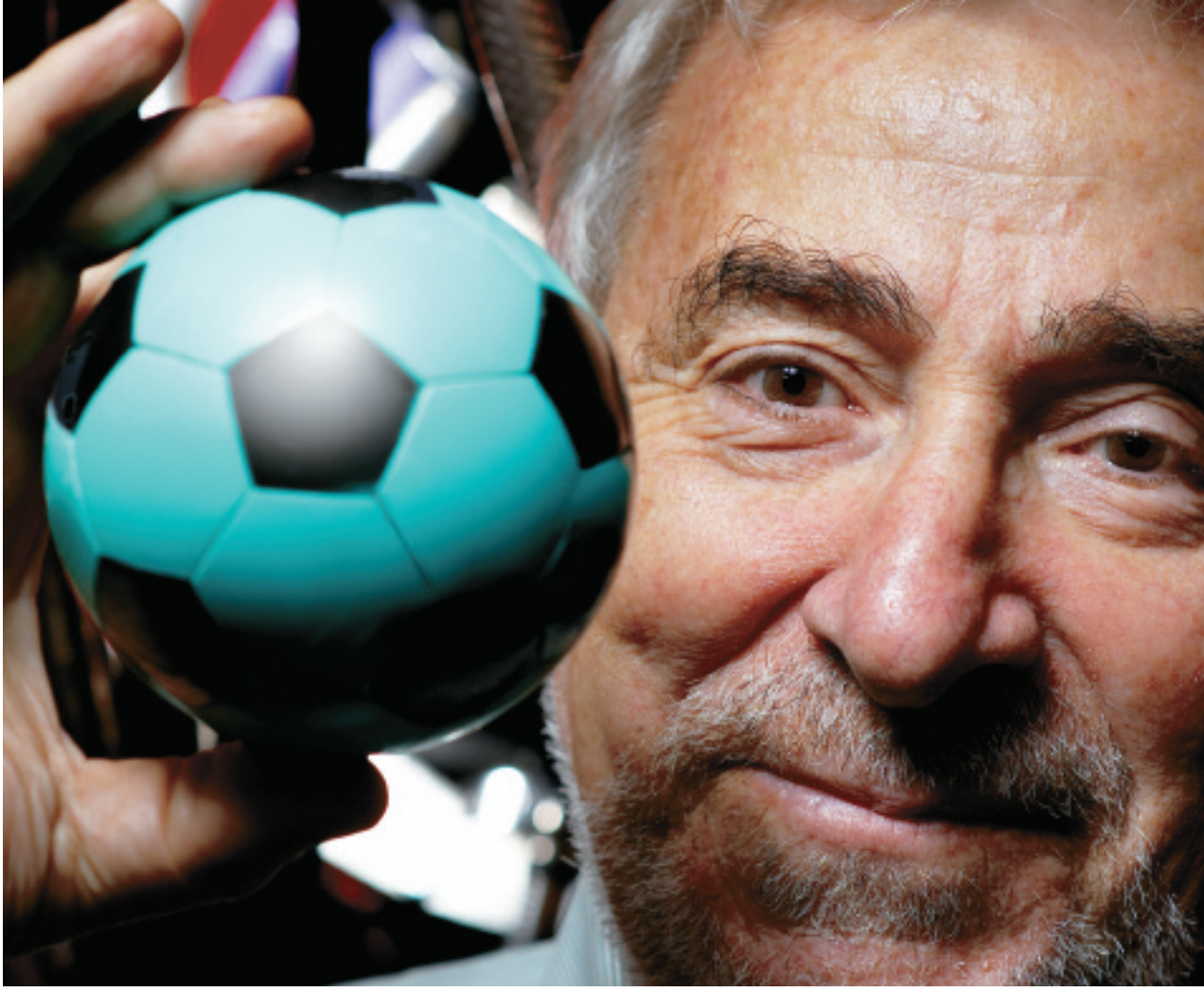
the challenge:

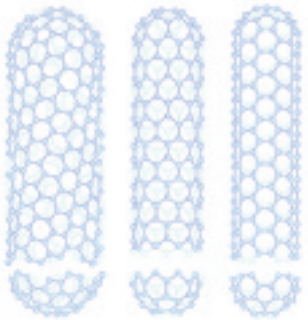
Strengthen three niche areas with high potential for NJIT and the State of New Jersey: nanotechnology, neural engineering, and engineered particulates.

the progress:

Research projects in the niche areas have garnered more than $3 million in NSF funding. Nanotechnology has industrial partnerships with Intel, Teledyne Technologies, Mach I, and Cougar Labs, Inc.; Engineered Particulates with Degussa, Cabot Corporation and Dupont. Neural Engineering partners with UMDNJ, the New Jersey Center for Biomaterials and Essilor, Inc.



strengthen



Keeping the Buckyball Rolling

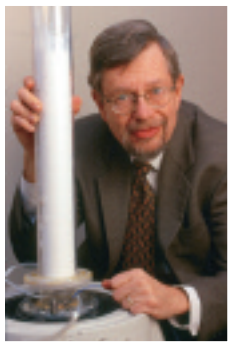
A new technique for producing fullerenes in large quantities at an economical cost is the invention of Roman Dubrovsky, (above with a model of a fullerene) associate professor of mechanical engineer, and his research team at NJIT's Surface Engineering Laboratory. Discovered only a decade ago, fullerenes, which come as spheres or "buckyballs" and as nanotubes or "buckytubes," are carbon molecules with unique properties that have the potential for a wide variety of commercial nanotechnology applications.

Up until now, engineering applications utilizing fullerenes have been limited by the feasibility and cost of producing large supplies of the molecules. The process developed at NJIT, for which the team has one patent and two more pending, is currently a demonstration project, but production of nanospheres and single-wall carbon nanotubes can readily be scaled up to commercial size.

Buckyballs and buckytubes have a wide range of potential uses in such areas as bioengineering, telecommunications, drug delivery, environmental engineering and polymer engineering, in which the molecules can be used to add functionality such as sensing and monitoring, resistance to wear or corrosion, or improved electrical or thermal conductivity. Dubrovsky's group has developed two such applications: adding fullerenes to lubricating oil to extend the life of the oil and improve the wear resistance of machine components, and adding fullerenes to polymers to create sturdier reinforced rubber products. The team is also studying the modification of gasoline with fullerenes to increase combustion efficiency.

In Other Projects

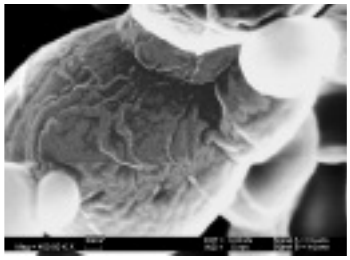
THE NEW JERSEY CENTER FOR ENGINEERED PARTICULATES, *directed by* **RAJESH DAVE,** *professor and acting chair of mechanical engineering, has developed into an important resource for researchers and industry alike in the rapidly expanding areas of nanoparticles and nanocomposites. The center is equipped with state-of-the-art electron microscopy capable of characterizing particles at the nano and submicron levels, and researchers work in partnership with industry to develop tailored particulate materials with unique properties for applications in pharmaceuticals, food processing, cosmetics, ceramics and electronics. Dave and* **ROBERT PFEFFER,** *who is a distinguished professor of chemical engineering, have collaborated on the invention of several coating techniques that have patents pending and are available for commercialization. The center's research team launched two new studies with NSF funding:*



Dave is leading a team of researchers from NJIT, Rutgers, Princeton and Auburn who are studying techniques for mixing nanocomposites to improve the performance of drugs, biomaterials and catalysts. The study is testing environmentally-benign substances such as carbon dioxide as a medium in which clusters of nanoparticles can be broken apart and mixed with other nanosized components to produce nanocomposites with unique properties for a variety of industrial applications.

Pfeffer is leading a study to test the efficiency and cost effectiveness of nanoparticles for removing ultrafine aerosol particles from gas streams. His preliminary research shows that nanofilters have a significantly greater capacity than the traditional fiber-based HEPA filters currently in use in industrial processes as well as in homes.

A new technique that uses microwaves to change the chemical characteristics of carbon nanotubes has been developed by **SOMENATH MITRA,** *professor of chemistry, and* **ZAFAR IQBAL,** *research professor of chemistry. Microwave heating makes the tubes chemically reactive and soluble. Once modified, the nanotubes can be used to make new kinds of "smart" films, coatings, paints and nanocomposite materials. The team has a patent pending for their discovery, and presented their findings at the annual conference of the American Chemical Society and in the journal* Carbon.



An image created by a team of NJIT researchers was recognized by Nano World News as "Image of the Month." The image came from "Formation of Polymer Nano-particles in Supercritical Fluid Jets," a paper presented at NANOTECH 05 by **ABHIJIT GOKHALE,** *a graduate student in mechanical engineering,* **BORIS KHUSID,** *associate professor of mechanical engineering,* **RAJESH DAVE,** *professor of mechanical engineering, and* **ROBERT PFEFFER,** *distinguished professor of chemical engineering.*

LEONID TSYBESKOV, *associate professor of electrical and computer engineering, is working in collaboration with Motorola and Freescale Semiconductor to develop and test a new generation of ultrafast, non-volatile memory devices using silicon nanocrystals. He is developing three-dimensional nanostructures that can be used as light emitters and integrated optical interconnects to increase computer processing speed. He has grant support from the NSF and Intel.*

TARA ALVAREZ, *assistant professor of biomedical engineering, received a prestigious Faculty Early Career Development Award from the NSF to support her work in neural engineering and vision research and to enhance the Vision and Neural Engineering Laboratory. The grants support the early career development of teacher-scholars who integrate research and education. Her research focuses on how the brain learns when visually locating objects in three-dimensional space to gain a better understanding of basic motor control and motor learning. She also plans to offer courses for undergraduates and to develop educational programs for pre-college girls to attract them to the field of neural engineering.*