Seminar Series

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School of Materials Science and Engineering

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1:30 PM – Room 152 Sirrine Hall

Multifunctional Fibers via Manipulation of Nanoscale Phenomena

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http://people.cornell.edu/pages/jh433/

Abstract

In this seminar we will discuss our research work on understanding complex phenomena at the nanoscale that are of fundamental relevance to fiber and polymer science. Initially we will present our use of **self-assembly phenomena to tailor the barrier properties of conventional textile materials**. We had successfully used electrostatic self-assembly techniques to deposit, for the first time, fully conformal nanolayers over irregular and heterogeneous natural fiber surfaces achieving a **significant increase in chemical selectivity due to the carefully controlled molecular architecture of the nanolayers. We use self-assembly to develop novel selectively permeable materials for protective clothing applications as well as active filtration**. Our group has also used atomic layer deposition ALD techniques to **covalently attach inorganic and metallic moieties to natural fibers opening a new avenue for the development of flexible electronic and smart textiles**.

A second thrust of our research efforts is concentrated on using external fields, transient plasticizers and associative polymers to induce self-assembly at the nanoscale during the electrospinning process. **The manipulation of the viscoelasticity of the precursor solutions allow for precise position control of embedded nanoparticles or active compounds inside and outside of polymeric fibers. Magnetic, photocatalytic and inorganic nanoparticles have been successfully encapsulated so far as well** (Figure 2)**.**

Finally we will present our developments on **using of scanning probe microscopy based techniques to probe nanoscale phenomena in fibrous systems.** We will present our use of electric force microscopy as a probing tool to quantitatively determine the electrical charge degradation on electret fibers media (Figure 3). We will also present the use of lateral force microscopy to probe lubrication phenomena in complex interfaces as well as acoustic force atomic microscopy to measure the mechanical properties of nanofibers.

Bio

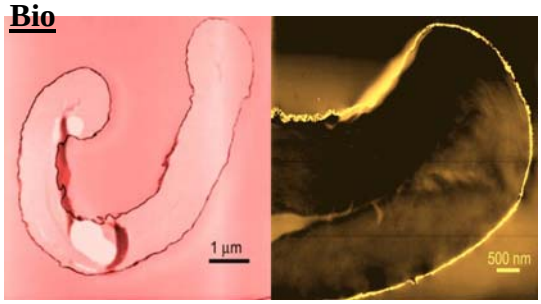

Figure 1. Transmission Electron Microscopy TEM images of cotton fibers coated with gold (L) and palladium (R) nanoparticles. Potential applications include catalytic mantles, structural coloration (color without dyes) and antibacterial flexible substrates

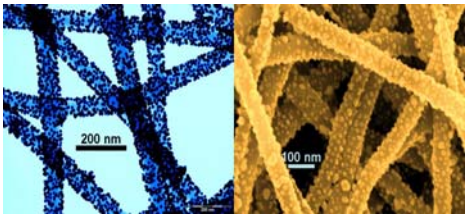

Figure 2 TEM and FESEM images of nylon nanofibers coated with gold (L) and silver (R) nanoparticles. Potential applications include active and catalytic filtration of hazardous gases and industrial toxic chemicals as well as anti-counterfeiting devices

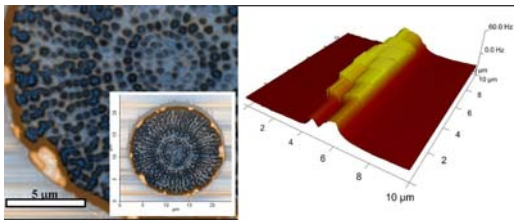

Figure 3. Acoustic Force Atomic Microscopy image of a conjugated fiber (Islands on the Sea) containing 1120 nanofibers of polyester in a sea of polyethylene (L). Topography and Electric Field Gradient Images for a polypropylene electret fiber obtained via Electrostatic Force Microscopy

Juan P.Hinestroza is Assistant Professor in the department of Fiber Human Ecology at Cornell University. Dr. Hinestroza obtained Design in the College of Engineering from Tulane University in May 2002. His doctoral research work was focused nical deformation on the barrier properties of polymeric materials and was funded by the fense and Department of Energy. Prior to graduate school, Dr. Hinestroza was a process control engineer l Company. Hinestroza received the NSF CAREER Award from the National Science nd the James D. Watson Young Investigator Award from the NY StateOffice of Science Technology ch in 2005. The Hinestroza Research group aims at understanding complex phenomena at the fundamental relevance to fiber, textiles and polymer science. Hinestroza has received over USD$ 4.5 MM s from government agencies and industry for his work on textile nanotechnology. In addition Hinestroza works with organizations such as SHPE, GEM and NSBE to increase the participation and enhancing the quality of education of underrepresented groups. In 2007, Hinestroza received the Educator of the Year Award from the Society of Hispanic Professional Engineers.