

**North Carolina Section of the American Chemical Society  
ACS Polymer Discussion Group**



**Thursday May 4, 2006  
(FIRST THURSDAY)**

University Club: North Carolina State University

\*Social Hour: 5:30 PM

\*\*Dinner: 6:00 PM

Program: 7:00 PM

**Nanomechanics of Natural and Biomimetic Silk Polymers**

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A detailed understanding of hierarchical structure-property relationships of natural biomaterials can lead to improved biomimetic materials design. Nature has found ways to combine disparate materials to create composites with superior mechanical properties to any of the individual components. For example, mollusk shells (nacre) and bone are both strong and tough because they combine a strong ceramic with a polymeric interface to provide toughness. Spider silk is also thought to gain its unique toughness from its hierarchical structure: repeated amino acid sequences in silk fibroin protein allow the protein to form highly aligned, strong crystals within a less ordered extensible matrix. In my talk, I will present some of the current research in the Chemistry Division at the U.S. Naval Research Laboratory in the area of silk nanomechanics. We have been characterizing the mechanical and structural properties of both natural spider silk fibers and synthesized silk protein films from collaborators at Oxford University and Tufts University. By coupling nanoindentation with micro-Raman spectroscopy, we have shown that the mechanical properties of silk films depend on the secondary structure of the fibroin protein, which in turn can be controlled by film processing techniques. We have also investigated the anisotropic mechanical and structural properties of spider silk fibers using nanoindentation and atomic force microscopy. The goal of these studies is to provide information that will allow us to understand how the hierarchical structure of spider silk contributes to its mechanical properties, and guide development of improved biomimetic materials with properties that more closely mimic natural fibers. Understanding the micro- and nanoscale structural and mechanical properties of natural biomaterials can help engineers and materials scientists learn to design new composite materials with enhanced materials properties at the macroscale.

\* Social hour will consist of a cash bar.

\*\* Contact Russell Gorga at (919) 515-6553 or regorga@ncsu.edu (email preferred) for dinner reservations by noon on Wednesday, May 3, 2006, to guarantee a reservation for dinner. If you are unable to make a reservation by that time, check with Russell regarding the availability of places. Dinner is \$15 for Members and \$8 for students. Reservations are *not* required to attend the seminar without dinner.