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Department of Chemistry

Student Seminar Series

9:45 a.m. Tuesday, January 17, 2012 • 331 Smith Hall

Professor

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Molecular Shape in Materials Design: Triptycene Based Materials

Website:
http://www.mit.edu/~chemistry/faculty/swager.html

Abstract

This presentation will describe new design principles that make use of the three-dimensional shape persistent properties of triptycene and its homologues, collectively known as iptycenes. Iptycenes have been used to dramatically enhance the alignment of monomeric and polymeric chromophores in liquid crystal solutions. Stable solutions of conjugated poly(phenylene vinylene)s and poly(phenylene ethynylene)s in nematic liquid crystals have been produced. Iptycene units fused into the polymer backbones provide solubility in complex liquid crystalline media. This induces a chain extended highly conjugated structure, which is generally associated with the optimization of the polymer properties. Triptycenes having restricted rotation by multiple point attachment to the polymer backbone are shown to introduce free volume into the films, thereby lowering their dielectric constants. These characteristics are desired by the semiconductor industry for the creation of faster microelectronics. The use of triptycenes in the formation of new high strength materials will also be demonstrated. In this case, the free volume creates an interlocking structure capable of energy absorption, which also produces dramatic enhancements in the mechanical properties of materials.

Host: Vicki Chemistruck

Timothy M. Swager is the John D. MacArthur Professor of Chemistry at the Massachusetts Institute of Technology. He received a bachelor's degree from Montana State University in 1983, and a doctorate from the California Institute of Technology in 1988.

Swager has published more than 300 peer-reviewed papers. He serves on multiple editorial, governmental, and corporate scientific advisory boards. He has received a number of honors, including the John Scott Award, election to the National Academy of Sciences, the Lemelson-MIT Award for Invention and Innovation, election to the American Academy of Arts and Sciences, the Christopher Columbus Foundation Homeland Security Award, and The Carl S. Marvel Creative Polymer Chemistry Award.

Swager's research interests encompass the design, synthesis, and study of organic-based electronic, sensory, high-strength and liquid crystalline materials. In the field of liquid crystals, he developed new designs based on shape complementarity to generate specific interactions between molecules. He has recently developed fundamental mechanisms for increasing the order in liquid crystals by a new mechanism referred to as minimization of free volume. These organization concepts have also led his group to the creation of interlocked polymer structures with enhanced strength.

Swager's research in electronic polymers has been directed at the demonstration of new conceptual approaches to the construction of sensory materials. These methods are the basis of the FidoTM explosives detectors, which have the highest sensitivity of any explosives sensor. In particular, he has developed general sensory transduction schemes for both conducting polymers and carbon nanotube systems that translate molecular recognition events into readily measured signals.