



## Dr. Charles M. Schroeder

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### Self-assembly and single molecule charge transport in conjugated organic materials

A major challenge in organic electronics lies in the development of deformable and electronically active materials that can readily assemble into hierarchical structures. In this talk, I discuss our recent work on a new class of biohybrid materials based on conjugated synthetic peptides that readily assemble into ordered structures with interesting optical and electronic properties. First, I will discuss the hierarchical assembly of conjugated peptides that are designed to contain both natural polymers (peptides) and synthetic materials (pi-conjugated oligomers). We study the self-assembly properties of these materials using a combination of microrheology, optical microscopy, and electron microscopy. We systematically vary the chemical identity of the conjugated cores (oligothiophene and perylene diimide) and the flanking peptide sequences to determine the effect of sequence on structure and functional properties. Interestingly, we find that conjugated peptides assemble into beta-sheet-rich fiber-like structures only under certain conditions, such that the morphology of the assembled fiber network is tightly controlled by the assembly kinetics and is highly sensitive to the underlying chemical structure of the substituent molecules. An analytical reaction-diffusion model is used to describe the kinetics of the assembly process. Microrheology is combined with in situ confocal fluorescence microscopy and lifetime imaging (FLIM) to characterize the sol-gel transition, and phase diagrams are experimentally determined across a wide range of conditions. In the second part of the talk, I will focus on the fundamental mechanisms behind intramolecular charge transport in these materials. Here, we directly measure the charge transport properties of single molecules using a scanning tunneling microscope-break junction technique (STM-BJ), focusing on the conductance of donor-acceptor polymers and sequence-defined conjugated oligomers (oxazole-containing oligomers). These results provide a clear understanding of how the primary monomer sequence affects the electronic properties of these materials. Overall, our work provides new information regarding the charge transport behavior in organic materials, which will be useful for designing new molecular electronic devices.

DEPARTMENT OF  
CHEMICAL &  
BIOMEDICAL  
ENGINEERING  
GRADUATE SEMINAR  
SERIES

Where:

Aero-Propulsion,  
Mechatronics, & Energy  
(AME Center) Room 106

When:

Friday, September 6<sup>th</sup>,  
2019 at 11:00am

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Charles Schroeder is Professor and Ray and Beverly Mentzer Faculty Scholar in the Department of Chemical & Biomolecular Engineering and Co-Leader of the Molecular Science and Engineering Theme in the Beckman Institute for Advanced Science and Technology at the University of Illinois at Urbana-Champaign. He is a member of the Center for Biophysics and Quantitative Biology, with affiliate status in the Department of Materials Science and Engineering, the Department of Chemistry, the Department of Bioengineering, and the Illinois Materials Research Lab (MRL). He received his B.S. in Chemical Engineering from Carnegie Mellon University in 1999, followed by an M.S. and Ph.D. in Chemical Engineering at Stanford University in 2005 with Eric Shaqfeh and Steve Chu. Before joining the University of Illinois in 2008, he was a postdoctoral fellow at Harvard University and the UC-Berkeley. Professor Schroeder has been the recipient of several awards, including a Packard Fellowship, a Camille Dreyfus Teacher-Scholar Award, an NSF CAREER Award, the Dean's Award for Excellence in Research, the Arthur B. Metzner Award from the Society of Rheology, and an NIH Pathway to Independence Award (K99/R00).