

# 2007 NSF-CAREER Award Winners in Chemical Engineering at Texas Tech University



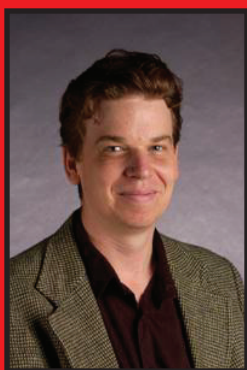
**Dr. Lenore Dai**  
Associate Professor

“Heterogeneous and Competitive Self-assembly at Liquid-Liquid Interfaces.”

This award focuses on integrating research and education centering on heterogeneous and competitive self-assembly at liquid-liquid interfaces. This state-of-the-art research is of both fundamental and practical significance. Heterogeneous and competitive self-assembly at liquid-liquid interfaces is important in various natural and industrial processes. The expansion of Pickering emulsion concept to double emulsions is another innovative usage

for particles and is anticipated to overcome the current major limitation of double emulsions that inhibited them from featuring in practical and commercial applications. The molecular dynamics simulations of self-assembly of nanoparticles in the presence of surfactants will provide in-situ and molecular information and a better fundamental understanding of the phenomenon that exists in many industrial processes.

With a strong commitment to education, Dai will also establish research-related open-ended projects in the existing courses, promote undergraduate and graduate research, establish a new summer program to broaden the participation of under-represented groups, participate in the Teacher Training Institute, and promote technology transfer.



**Dr. Brandon Weeks**  
Assistant Professor

“Understanding Nanoscale Properties of Energetic Materials.”

The stated goals of this research are to determine properties of energetic materials experimentally at the nanometer scale, to link these findings with bulk properties, and to use these findings to develop new energetic materials.

Key techniques will be nanoscale lithography and property measurement with an atomic-force-microscopy tip and with small-angle X-ray scattering, used to study changes due to physical, chemical or thermal loads in a nanoscale domain.

In addition, a key part of this award is to create substantial societal impact through its education plan. Weeks's CAREER educational includes: participation in an undergraduate-mentoring program, work with a 7th-grade teacher at Atkins Junior High School to introduce a math/science "application activity," to develop courses and a minor in energetic materials, and to participate in continuing-education activities. The goal is to get the students excited about science at the height of their intellectual curiosity and creativity and encourage them to pursue education in science and engineering fields.

# Past NSF-CAREER Award Winners in Chemical Engineering at Texas Tech University



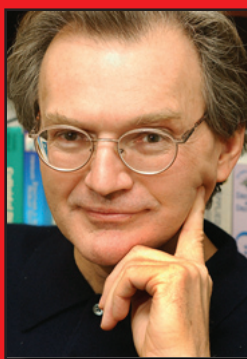
Dr. Karlene Hoo  
Professor

NSF-CAREER in 1997

“Studies in the Transition Control of Multi-Product Chemical Reactors.”

The objective of the proposed research is the development of a rigorous theoretical framework that can be used to design an effective feedback control strategy for multiproduct chemical reactors. The motivation is provided by a global market economy which demands that the manufacture of multiple grades of a single product be made efficient using the same equipment while simultaneously minimizing the production of off-spec material. This project proposes a fundamental approach to this problem that starts with modeling and analysis of the multiple nature of the operations leading to a framework that permits the design of a hybrid supervisory control strategy.

The expected results will enhance the education of chemical engineers. Examples of the include: the development of numerical programs to introduce multi-resolution identification; the inclusion of transition control to the existing process control course; the development of a laboratory experiment to provide active experimentation and concrete experience of the proposed concepts; the collaboration with industry through cooperative / externship programs to expose students to multi-product processes.



Dr. Mark Vaughn  
Associate Professor

NSF-CAREER in 2002

“Lipid Membrane Organization in the Presence of External Fluid Flow”

This project uses both experiment and computation to address the effect of flow and composition on the molecular organization of lipid and lipid/protein bilayer membranes. We have developed model membranes for both experimental and computational use. Our experimental work has focused on fluorescent microscopy, total internal-reflectance microscopy and fluorescent correlation spectroscopy to investigate the effect of composition and flow on protein and lipid mobility.

Our computational work has focused on understanding molecular-scale interactions. To incorporate macroscopic effects, we are developing a multi-scale first-passage/molecular dynamics model of the membrane. This multi-scale approach allows modeling long-time processes, such as diffusion, with an efficient stochastic approach, but still accounts for discrete atomic interactions. In this way, the simulations allow investigation of long-range motion and order.

The educational component of this proposal involved undergraduates in long-term multidisciplinary research