2011-2012

Graduate Seminar Series

The Department of Mechanical Engineering – Engineering Mechanics

Proudly Presents

Gregory B. McKenna, Ph.D.

Professor of Chemical Engineering, Paul Whitfield Horn Professor and The John R. Bradford Endowed Chair in Engineering

Texas Tech University

Dr. Gregory B. McKenna has a reputation as a pioneering researcher in four areas of polymer and plastics science and technology: Physical Aging and Structural Recovery of Polymer Glasses, Solid Mechanics and Nonlinear Viscoelasticity of Polymers, Thermodynamics and Mechanics of Elastomers and Gels, Molecular Rheology.

He received his Bachelor's in Engineering Mechanics at the U.S. Air Force Academy, and his MS in the area of composite materials from MIT. He entered active duty as a test and evaluation engineer at Hill Air Force Base in Ogden, Utah. In 1976 he received his Ph.D. in Materials Science and Engineering at the University of Utah. Dr. McKenna started at the National Bureau of Standards (now called NIST) as a National Research Council Postdoc and accepted a permanent position as a staff scientist in 1977. He served as the head of the Structure and Mechanics Group in the Polymers Division at NIST from 1992-99. In 1989 Dr. McKenna became a Fellow of the American Physical Society and was the recipient of the NIST E.U. Condon Award for excellence in technical exposition for his classic review article "Glass Formation and Glassy Behavior." In 1998, he was elected a Fellow of the Society of Plastics Engineers.

After NIST, he joined Texas Tech University as a Professor in the Department of Chemical Engineering and the John R. Bradford Endowed Chair in Engineering. In 2005 he became a Paul Whitfield Horn Professor at TTU.

He is the 2009 recipient of the Bingham Medal of the Society of Rheology, has received the International Award of the Society of Plastics Engineers, and the Mettler Toledo Award from the North American Thermal Analysis Society. He served on the Governing Board of the American Institute of Physics, the Executive Committees of the Society of Rheology and The Division of High Polymer Physics (DHPP) of the American Physical Society. He was the Chairman of the DHPP, the Society of Engineering Science, and the Polymer Analysis Division of the Society of Plastics Engineers. Currently he is vice-president of the Society of Rheology.

Thursday, Mar. 22, 2012 4:00 – 5:00 p.m. Room 112, ME-EM Bldg.

Using Mechanics to Interrogate the Physics of Soft Matter: From the Glassy to the Rubbery States and from the Macro-scale to the Nano-scale

Mechanical measurements offer a unique means of interrogating the physics of amorphous glass-formers and rubbery polymers. Here we present several vignettes to demonstrate the ability of both classical and novel rheological experiments to resolve important questions in condensed matter physics. First, results from torque and normal force measurements aimed at understanding the thermodynamics and mechanics of polymer networks in both dry and swollen states are presented. In particular, we examine the validity of the Frenkel-Flory-Rehner theory of rubber network swelling. Torsion and normal force measurements are also described for a series of polymeric glasses that exhibit similar shear moduli but, surprisingly, very different normal force responses, with one set of materials showing extreme deviations from neo-Hookean behavior and the other being close to neo-Hookean. We then describe the use of a novel torsional dilatometer, which allows simultaneous measurement of mechanical properties and volume recovery, to investigate the aging and rejuvenation behaviors of glassy polymers. The temperature dependence of dynamics is probed in glassy polymers that have been aged into equilibrium below the nominal glass transition temperature and evidence is presented that time-scale divergence may not be a true signature of the glass transition itself. Finally, we describe a reduction in scale of the classical membrane inflation test to allow measurement of the biaxial creep compliance of nanometer thick polymeric films using an atomic force microscope. In each instance emphasis is placed on how the measurements are designed to interrogate the physics of interest in the materials investigated.

Funding for the ME-EM Graduate Seminar Series is provided by Professional Plating, Inc. of Anoka, MN www.proplate.com and the Department of Mechanical Engineering – Engineering Mechanics www.me.mtu.edu/seminar