2011-2012

Graduate Seminar

The Department of
Mechanical Engineering – Engineering Mechanics

Proudly Presents

Professor Donggang Yao
School of Materials Science & Engineering
Georgia Institute of Technology

Donggang Yao is currently an associate professor in the School of Materials Science & Engineering at Georgia Institute of Technology. He received his Ph.D. and Master's degrees both from University of Massachusetts Amherst, and his B.S. degree from Shanghai Jiao Tong University, China. He teaches and directs research in the broad area of polymer engineering. His current research focuses on miniature polymer processing, composites manufacturing, constitutive modeling and process modeling. He was a recipient of the 2003 NSF Career Award. He has published about 60 journal papers and over 70 conference papers and given over 100 talks on polymer processing.

Thursday, Feb. 16, 2012 4:00 – 5:00 p.m. Room 112, ME-EM Bldg.

General Maxwell Model with Logarithmic Strain Measurements

Analysis of 3-D viscoelastic flows is of particular interest in polymer processing. Classical approaches rely on the Finger tensor and its inverse for strain evaluation. In this work, a framework for formulating general Maxwell models using the Eulerian logarithmic strain tensor has been established. Compared with the Finger tensor, the logarithmic strain tensor is a more natural selection for strain evaluation, leading to more uniformly measured strain in different directions. This facilitates the determination of physically sound models for the elastic stress tensor and the relaxation process. With the logarithmic strain tensor, simple coaxial and network relaxation models can be developed, and yet realistic recovery and relaxation effects can be incorporated. Compared with some second-order relaxation models such as the Leonov model, the logarithmic relaxation model is of first order and therefore more suitable for analytical analysis. Case studies with shear and elongation showed that even with limited parameters from linear viscoelasticity, the logarithmic Maxwell model is able to predict almost all known viscoelastic effects for these deformations. With implementation of nonlinear stress-strain relations, controllable adjustment of shear thinning and elongational thickening can be achieved in a single model that fits some known experimental results well. Particularly in the steady-state (or quasi-steady state) flow case, a nearly closed-form stress to velocity gradient relationship can be derived with which shear thinning and elongational thickening can be simultaneously considered while computational advantages of a classical GNF model (Generalized Newtonian Flow model) is retained.

Funding for the ME-EM Graduate Seminar Series is provided by Professional Plating, Inc. of Anoka, MN www.proplate.com
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