MSE SEMINAR

Materials Science and Engineering
Michigan Technological University

Tuesday, October 7, 2014
11:00 am – 12:00 pm
Room 610 M&M Building

Properties of Glassy Polymers at the Nanoscale versus the Bulk State

John & Virginia Towers Distinguished Lecture Series

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Abstract

The need for more energy efficient processes continues to drive interest in polymeric membranes for gas separations; removal of carbon dioxide and other impurities from natural gas is one of the important targets for this technology. There is interest in the discovery of new polymer structures for membranes that are more permeable, more selective or more robust particularly with regard to resisting plasticization by highly soluble gases like carbon dioxide. In general, the best polymers for these applications have high glass transition temperatures.

To achieve commercially attractive levels of flux or productivity, most membranes have an asymmetric or composite structure where the separating layer is very thin, of the order of 100 nm in thickness. It is generally assumed that these thin layers have the same permeation properties as thick films, tens of microns in thickness, which are easily prepared in the laboratory for evaluation of membrane materials. In fact, the usual method for estimating the thickness of the separating layer is to compare its gas permeance or flux to the permeability of a thick film. However, there is growing evidence that thin films of glassy polymers with thicknesses of a few hundred nanometers behave quite differently than thick films. A major factor is the observation that thin glassy films undergo physical aging, i.e., approach towards equilibrium, much more rapidly than do bulk glasses presumably due to high segmental mobility at free surfaces. This presentation will summarize recent evidence concerning the differences between thin and thick films with regard to aging, plasticization and thermal history based on gas permeation observations.

BIO

Dr. Donald R. Paul is the Ernest Cockrell, Sr. Chair professor in Department of Chemical Engineering at University of Texas at Austin. Prof. Paul got his bachelor degree from North Carolina State College and his master and Ph.D. degree from The University of Wisconsin at Madison. Professor Paul's research interests include the broad areas of polymer science and engineering and chemical engineering with more than 700 papers published in prestigious journals. He obtained many awards and honors. He is an Elected Member of National Academy of Engineering (1988), Mexican Academy of Sciences (2001), and the Academy of Sciences of Bologna (2011). He is a Fellow for numerous important societies, including the Society of Plastics Engineers (2004), the American Chemical Society (2009), the Materials Research Society (2009), and the ACS Polymer Division (2011). He won Outstanding Lifetime Achievement Award (SPE-TPM&F) (2011), General Motors R&D Most Valued Colleague Award (2009), AIChE Founders Award (2008), Herman F. Mark Polymer Chemistry Award (American Chemical Society) (2005), Alan S. Michaels Award for Innovation in Membrane Science and Technology (NAMS) (2005); NAMS Founders Award (2005); American Chemical Society E.V. Murphree Award (1999); Council for Chemical Research Malcolm E. Pruitt Award (1999); AICHE William H. Walker Award (1998); Society of Plastics Engineers International Award (1993); Society of Plastics Engineers Education Award (1989); AIChE Materials Engineering and Sciences Division Award (1985); American Chemical Society Phillips Award for Applied Polymer Science (1984); Engineering News-Record Award (1976); and the American Chemical Society Arthur K. Doolittle Award (1973) etc. He was the Director of Texas Materials Institute (1998-2011) and the editor-in-chief of Industrial & Engineering Chemistry Research (an ACS journal).