IN-SITU AND TIME RESOLVED SMALL ANGLE X-RAY SCATTERING

B.G. Landes*, B.J. Kern. T.J. Hermel-Davidock, M. Demirors,
J.D. Weinhold, G.R. Marchand, K.Nanjundiah, R.E. Drumright
The Dow Chemical Company
S.J. Weigand
Northwestern University, DND-CAT

The abundant intensity of the synchrotron source allows researchers to acquire structural information from small sample volumes and in very short time intervals. This provides the opportunity for researchers to conduct both time and spatially-resolved structural and morphological studies, which can be critical to the understanding of material processes and/or molecular behavior. This is especially true when one couples this capability with other characterization methods (DSC cell, Instron tensile frame, capillary and shear rheometers) or processing equipment (fiber spinner, extruder, injection molder). Now the researcher can define and report real process / structure / property envelopes for both experimentally interesting and commercially relevant materials.

However, the unique information that is provided by these types of experiments poses some significant challenges. How does one efficiently extract quantitative information from the hundreds or even thousands of images/data sets that may be generated during interrogation of a single material or process? This obstacle can prevent the successful application of in-situ / time resolved studies.

This presentation will focus, by example, on time resolved studies of both real processes and property interrogation, and, on the methods developed to visualize, reduce, and analyze the large volume of information generated from these experiments. Examples will include tearing and impact properties in polyolefin film, temperature dependent physical properties of copolymers, solvent induced changes in optical behavior of block copolymer systems, and mechanisms of film formation in water based coatings. For each of these studies we will describe how the experiments are performed, data acquisition techniques, data analysis protocols, and efficient methods for delivery of information. Detailed process / structure / performance relationships will be described and discussed for each study.