From Heterogeneous Polymer Networks to Self-Repairing Materials

Marek W. Urban
The University of Southern Mississippi
School of Polymers and High Performance Materials
Hattiesburg, MS 39406

Abstract

Most studies on stimuli-responsive polymers have focused on their solution behavior. However, considerable challenges and opportunities lie in the developments of polymeric solid materials that maintain useful functions and, at the same time, are capable of self-repairing under various conditions. This seminar will focus on the design, synthesis, and formation of polymer networks that upon internal or external stimuli are capable of rearranging macromolecular segments. Novel approaches that have led to the development of heterogeneous polymeric networks which exhibit stimuli-responsiveness and self-healing attributes will be described with the focus on the role of local heterogeneous interfacial regions that facilitate polymeric chain motions in self-repairing process. Heterogeneity and stratification allow localized variations of the glass transition (Tg) and free volume, thus enabling spatial and energetic conditions for stimuli-responsiveness. Using these approaches green heterogeneous fluoropolymer colloidal dispersions were developed that upon coalescence form temperature and pH responsive solid films capable of self-healing. Also, the development of novel heterogeneous polyurethane (PUR) networks based on oxetane-substituted derivative of chitosan (OXE-CHI) which upon reactions with hexamethylene diisocyanate (HDI) and polyethylene glycol (PEG), form heterogeneous OXE-CHI-PUR networks with self-repairing characteristics will be discussed.