Department of Materials Science and Engineering,

PhD Defense

May 28th, 2021 at 11 AM

Zoom Link: https://drexel.zoom.us/j/87133794073

Synthesis Parameters of Chemically and Structurally Tailorable Macromolecular Grafted-Through Polymer Networks

Name: Jessica A. Weaver
Advisor: Professor Andrew J.D. Magenau

Abstract

Polymer networks have enormous potential for solving many materials engineering challenges in fields such as biomedicine, soft electronics, actuation, and additive-manufacturing. Application-relevant networks, however, are still hindered by poor performance, requiring strength enhancing modifications, or by a limited set of molecular-level dials to control network microstructure for tailored properties and function. For these key reasons, new synthetic approaches are an ongoing need in polymer network engineering, especially those which can impart multi-scale control of structure and architecture, along with, additional parameters for enhancing and controlling physiochemical properties. Macromolecular polymer networks

(MPNs), or polymer networks derived themselves from macroscale polymeric building blocks, are a relatively new class of material desired for their high degree of chemical and structural tailorability. In this dissertation, three completely new macromolecular polymer networks possessing enhanced structural tailorability were synthesized and systematically studied to determine the effects of these structures on morphology, viscoelasticity, and thermal behavior. First, grafting-through ring-opening metathesis polymerization (ROMP) was established as a synthetic route for MPNs with tailorable moduli and crosslink densities, with a focus on the fundamental effects of RAFT and ROMP chemistry on structure and property control. Secondly, routes to enhanced MPNs are proposed, by examining the effects of incorporating poly(vinyl-pyridines) and poly(acrylamides) into side-chain chemistries, imparting networks with stimuli-responsiveness and water solubility. Finally, the accessibility of co-continuous morphologies *via* ROMP-induced macrophase separation was determined. Overall, this knowledge was used to assess the effectiveness of newly applied grafting-through approaches in macroscale polymer network design.