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Plastic Deformation and Morphological Evolution of Precise Acid Copolymers L. ROBERT MIDDLETON, University of Pennsylvania, JASON AZOULAY, DUSTIN MURTAGH, JOSEPH CORDARO, Sandia National Laboratories, KAREN WINEY, University of Pennsylvania — Acid- and ion-containing polymers have specific interactions that produce complex and hierarchical morphologies that provide remarkable mechanical properties. Historically, correlating the hierarchical structure and the mechanical properties of these polymers has been challenging due to the random arrangements of the polar groups along the backbone, ex situ characterization and the difficulty in deconvolution the effects of crystalline and amorphous regions along with secondary interactions between polymer chains. We address these challenges through in situ deformation of precise acid copolymers and relate the structural evolution to bulk properties by considering a series of copolymers with 9, 15 or 21 carbons between acid groups. Simultaneous synchrotron X-ray scattering and room temperature uniaxial tensile experiments of these precise acid copolymers were conducted. The different deformation mechanisms are compared and the microstructural evolution during deformation is discussed. For example, the liquid-like distribution of acid aggregates within the bulk copolymer transitions into a layered structure concurrent to a dramatic increase in tensile strength. Overall, we evaluate the effect and control of introducing acid groups on mechanical deformation of the bulk copolymers.

L. Robert Middleton
University of Pennsylvania

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