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Improved Understanding of Polyolefin Structure-Property Relationships through Characterization of Topology, Molecular Mass, and Chemical Composition Distributions

Sara Orski, Ph.D.

Research Chemist, Materials Science & Engineering Division

National Institute of Standards & Technology (NIST)

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Abstract: Commercial polyolefins, which often involve mixtures and copolymers of linear, short-chain branched, and long-chain branched macromolecules, can be very challenging to characterize as species with similar hydrodynamic sizes or solubility often co-elute in various chromatographic methods. Quantifying the molar mass, chemical composition, and architectural distributions within these materials is crucial for determining accurate structure-property-performance relationships. A family of model linear low-density polyethylenes (LLDPEs) were synthesized where the alkyl branch frequency along the polymer backbone was fixed, while systematically varying the short-chain branch length. These model materials were analyzed by high-temperature size exclusion chromatography (HT-SEC), where a systematic decrease of intrinsic viscosity is observed with increasing branch length across the molar mass distribution. In addition, applications of HT-SEC in conjunction with elemental analysis and differential scanning calorimetry measurements will be discussed to investigate the environmental degradation of polyolefins recovered from marine environments. Bulk and depth profiling measurements of discarded polyolefins were conducted to identify the polymer and determine the extent of degradation, towards (ultimately) providing information to develop predictive quantitative models of polymer degradation pathways and kinetics in marine ecosystems.

Biography: Sara Orski is currently the project lead of the *Macromolecular Architectures* project in the Materials Science and Engineering Division at the NIST. Her current research focuses on using design, synthesis, and characterization of model materials to quantify the effect of macromolecular chemistry and architecture on dilute solution and bulk material properties. Sara earned a B.S. in Chemistry from The College of William and Mary and a Ph.D. in Chemistry from The University of Georgia studying functional polymer brush thin films for sensor applications. Following her Ph.D., Sara worked as an NRC Postdoctoral Fellow studying stability of enzymatic catalysts on polymeric supports for greener polymer catalysis in the Sustainable Polymers group at NIST.