Department of Chemical & Biomolecular Engineering
Spring 2018 Seminar Series

Biorenewable Polymers for Energy and the Environment

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2:00-3:00 P.M.
100 Earle Hall

A great challenge to overcome is the replacement of traditional petroleum-based plastics with polymers derived from sustainable, alternative resources. Though there are many facets to the design of truly sustainable materials, including the raw material source, energy demands of processing, and fate of the material post-consumer use, utilization of a more eco-friendly raw material source is an important first step. Ultimately, the full life cycle of the materials must be evaluated, including end-of-life options such as recycling, composting, and disposal in landfills. Of particular interest to our research group is the design of structured polymers from sustainable, plant-derived sources with well-defined molecular characteristics and competitive properties to conventional, petroleum-derived materials. We are developing a diverse array of polymers derived from plant sources spanning many classes of materials, such as thermoplastics, thermoplastic elastomers, and elastomers. The raw material sources that we have employed are vegetable oils (such as soybean and castor oils), plant sugars, biobased phenolic acids (found in fruits and vegetables), rosin acids (found in conifers), and lignin (the structural component of plants).

Three project areas will be discussed. In the first project, long-chain polyacrylates derived from vegetable oil-based fatty acids are investigated as components of thermoplastic elastomers, polymers which behave as an elastomer at room temperature yet are processable at elevated temperatures. Vegetable oils are an attractive source for polymers, due to their low cost, abundance, annual renewability, and ease of functionalization. The thermal and mechanical behavior of the polymers can be readily tuned through variation of the alkyl chain length of the fatty acid. In the second project, soft thiol-ene elastomeric networks (appropriate for applications such as coatings and adhesives) are derived from plant-based phenolic acids, found in a variety of natural sources such as the skins, seeds, and leaves of fruits and vegetables. Finally, sustainable and non-toxic components are explored for epoxy resins, polymers dominant in composite applications, applied in aerospace and automotive industries, coatings, adhesives, and wind turbine blades. The presence of hydrolytically degradable groups is investigated as a means to develop (bio)degradable epoxy resins which may potentially be composted at the end of the their useful lifetime.

Dr. Megan L. Robertson joined the Department of Chemical and Biomolecular Engineering at the University of Houston in the Fall of 2010. Dr. Robertson received a Ph.D. in Chemical Engineering from the University of California, Berkeley in 2006, advised by Nitash P. Balsara. Following graduation, Dr. Robertson worked as a senior scientist at Rohm and Haas (now Dow Chemical) in Spring House, Pennsylvania. She then went to the University of Minnesota as a postdoctoral research associate in the Department of Chemistry, working with Marc A. Hillmyer. Dr. Robertson's research interests include nanostructured and microstructured polymers, self-assembly processes, thermodynamics of polymer mixtures, and structural characterization with light, neutron and x-ray scattering. The Robertson Research Group works in diverse areas including sustainable polymers derived from renewable resources, biodegradable polymers, advanced resins for polymer composites, structure and dynamics of block copolymer micelles, antifouling polymers and polymer brushes, and thermodynamics of polyolefin and polydiene blends.