Natural Product-based Polymers that Address Health-Food-Energy-Water Challenges: Structural, topological and morphological diversities for sustainable, degradable polymers derived from carbohydrates

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A primary interest in the Wooley laboratory is the production of functional polymers from renewable sources that are capable of reverting to those natural products once their purpose has been served. A long-standing focus has been the development of synthetic methodologies that transform sugars, amino acids and other natural products into polymer materials. This approach allows for the production of functional polymers from renewable sources that are capable of reverting to those natural products once their purpose has been served. This holistic life cycle approach is of importance from the perspectives of sustainable sourcing of materials feedstocks, while creating mechanisms for breakdown of the polymer materials after useful lifetime is complete, and providing for biological and environmental resorption of breakdown products. The overall process impacts the need to address the increasing accumulation and associated hazards of plastic pollution from the environmental persistence of non-degradable, petrochemically-sourced polymer systems. Moreover, inherent diversities of natural products provide opportunities to expand the scopes, complexities and properties of polymers, by utilizing fundamental organic chemistry approaches. This presentation will highlight the development of synthetic methodologies for the preparation of sustainable polymers, block polymers and crosslinked network materials from carbohydrates, taking advantage of their stereochemical complexities and invoking *in-situ* structural metamorphoses to produce degradable polymers of diverse compositions, regio- and stereochemistries, and that can be made to exhibit a range of properties. Target materials are designed for potential applications in diverse areas, from energy, to medicine, to the environment. Examples will highlight contributions that polymer chemistry can make toward bulk technological materials that are capable of impacting global needs, such as water-food-energy-health, and the grand challenges that must be solved in the coming decade, while also emphasizing fundamental synthetic chemistry advances.