



Karen L. Wooley

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Karen L. Wooley received a Bachelors of Science degree in Chemistry from Oregon State University in 1988 and then studied under the direction of Professor Jean M. J. Fréchet at Cornell University, obtaining a Ph.D. in polymer/organic chemistry in 1993. She then began an academic career as an Assistant Professor of Chemistry at Washington University in St. Louis, Missouri, was promoted in 1999 to Full Professor with tenure, was installed as a James S. McDonnell Distinguished University Professor in Arts & Sciences in 2006, and in 2007, received an appointment in the School of Medicine,

Department of Radiology. In July 2009, Karen relocated to Texas A&M University, where she has undertaken a professorship in the Department of Chemistry, as the W. T. Doherty-Welch Chair in Chemistry, with a joint appointment in the Department of Chemical Engineering.

Prof. Wooley's research interests include the synthesis and characterization of degradable polymers, unique macromolecular architectures and complex polymer assemblies, and the design and development of well-defined nanostructured materials. The development of novel synthetic strategies, fundamental study of the materials' properties, and their applications for the diagnosis and treatment of disease or for performance as non-toxic anti-biofouling coatings are particular foci of her research activities.

Natural Product-Based Engineering Polymers: A Special Emphasis Toward (Degradable) Materials for Orthopedic, Drug Delivery, and Other Applications

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. This presentation will highlight synthetic strategies for the development of polymer materials, which can be produced by relatively simple approaches from complex polyhydroxyl natural products and can be made to exhibit a range of properties, based upon the monomeric building blocks and, typically, carbonate or phosphoester linkages. Although Nature has several examples of engineering-type construction materials (*e.g.* cellulose, chitin, *etc.*) that are degradable, resorbable and recyclable, most synthetic materials are designed to be derived from renewable resources and degradable or from petrochemicals and perform as an engineering material. In one direction, polyhydroxyl natural products as the monomeric building blocks are

combined with carbonates, found in common engineering materials, as the linkages, for which hydrolytic degradation is expected to produce the polyhydroxyl compound plus carbon dioxide. Four classes of natural monomers, D-glucose, quinic acid, ferulic acid and quercetin, are being evaluated for the construction of polycarbonates. The polyhydroxyl natural product monomers provide reactive hydroxyl groups for establishment of the polycarbonate backbones and their rigid cyclic core units together with the polar, hydrogen-bonding hydroxyl groups in the resulting polycarbonates are expected to lead to strong and tough materials for engineering, biomedical and other applications, where the combined properties and degradation potential can be utilized. In a second direction, phosphoester linkages are utilized, again borrowing from Nature, in the use of phosphoesters commonly found in biological macromolecules, such as DNA or RNA. Polyphosphoester-based block copolymers that can be produced rapidly and then undergo multiple chemical transformations and direct assembly in water into functional nanomaterials are serving as a platform for several directions toward their development as biomedical devices for the treatment of lung infections and osteosarcoma lung metastases. If time allows, recent developments toward the preparation of functional polypeptides and their assemblies will also be described. As this work is in progress, it is expected that the physical, mechanical, supramolecular assembly and stability properties will be tuned by the chemical compositions and structures, controlled by the advancement of synthetic methodologies by which to prepare such materials.