Polymer Program

INSTITUTE OF MATERIALS SCIENCE

In-person Seminar: 11:10 am Friday, January 20

Host: Gregory Sotzing *Location: Science 1 - room 1002*

Richard Gross

Constellation Chaired Professor

Rensselaer Polytechnic Institute

Expanding the Role of Enzyme-Catalysis in Macromolecular Synthesis

Abstract: This presentation will provide selected vignettes of research performed by my group towards integrating biocatalytic and chemical routes to develop next-generation affordable green processes and products. Poly (glycerol sebacate), PGS, a polyol–polyester of glycerol with sebacic acid, has drawn significant attention given its advantageous bioresorbable matrix properties such as ductility, and low biotoxicity. Current chemical synthesis methods rely on polycondensation polymerizations that are not selective leading to gels unless reactions are quenched at low functional group conversions. We will discuss how a selective immobilized lipase catalyst and variable ratios of glycerol-to-1,8-octanediol avoid gelation and expand the physicochemical properties of the resulting bioresorbable polymers. ω-Hydroxyfatty acids derived from fatty acids provide a platform of biobased building blocks for polymers, surfactants, and other applications. A brief description will be given of an engineered *Candida tropicalis* strain from which 16 genes were identified and eliminated. The resulting strain can produce commercially viable yields of ω-hydroxyfatty acids. An example application is the biosynthesis of 14-hydroxytetradecanoic acid at 120 g/L and its conversion to poly(14-hydroxytetradecanoic acid) (T_m = 96 ^{o}C, M_w=160 000). Peptides bring numerous properties of great value such as self-assembly, antimicrobial, adhesion, suppress ice formation and much more but their use is currently limited to applications such as therapeutics due to high production costs. Protease catalyzed peptide synthesis can be run under aqueous and bulk conditions using amino acid ethyl esters as monomers. Examples of research progress will include protease-catalyzed synthesis of alternating oligopeptides and *in situ* self-assembling PEG-oligopeptide bloc copolymers. Considering the current state of plastic waste and a general lack of success in plastic recycling with few exceptions, it is imperative that alternative solutions are developed to unlock the latent energy of plastic waste. Our group is engineering enzyme catalysts that convert PET to its corresponding monomers for recycling by re-polymerization.

Bio: Richard A. Gross is a Full Professor and a Constellation Chaired Professor at Rensselaer Polytechnic Institute (RPI). His research focuses on developing sustainable routes to green chemicals by combining the best of enzymatic and chemical catalysis. He has over 500 publications in peer reviewed journals, been cited about 30,000 times (h-index 92, i10 321), edited 11-books, and has 26 patents (granted or filed). Prof. Gross received the 2003 Presidential Green Chemistry Award in the academic category. In 2010, he was the Turner Alfrey Visiting Professor and in 2017 he received the Lifetime achievement award from the Bioenvironmental Polymer Society and served as the Societies President in 2018. In 2014, he was named Fellow of the ACS Polymer Division and in 2019 Prof. Gross received the ACS Award for Affordable Green Chemistry. In January of 2022 Gross assumed the position of Editor-in-Chief for the journal Industrial Biotechnology.