SCHOOL OF
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College of Engineering, Architecture and Technology

CHE SEMINAR SERIES

Chemical and biological strategies for plastics recycling and redesign

GREGG BECKHAM, PH.D.

LEGACY HALL 101

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This talk will cover recent progress from our group and collaborators related to the development of sustainable processes and products using both biological and chemical catalysis for plastics recycling and redesign. Since 2005, the concept of using enzymes to depolymerize synthetic polyesters, most prominently polyethylene terephthalate (PET), has been pursued by the academic, and more recently, industrial communities, with manufacturing facilities being scaled up now. While most research efforts to this end still focus on increasing enzyme rates, we have shown via process modeling, techno-economic analysis, and life cycle assessment that enzyme rate has little additional economic and sustainability impact once a threshold activity is reached. Rather multiple process factors, including waste generation and energy demand for separations, are major drivers for enabling process feasibility. The first part of this talk will cover our recent, analysis-guided efforts to stack multiple, relatively simple process changes to make enzymatic PET recycling more economical and sustainable than primary PET production. Secondly, while many approaches have been developed to date for recycling C–O-linked thermoplastics, such as polyesters, epoxy-amine thermosetting resins such as those found in carbon fiber composites represent a considerable challenge for recycling. However, the energy and emissions-intensive manufacturing of carbon fibers necessitates the development of recycling methods to this end. The second part of this talk will cover a solvolytic strategy to cleave both C–O and C–N bonds simultaneously in epoxy-amine resins. We have demonstrated this process concept up to the 1-L scale, and process modeling has shown that it can be both economically feasible and sustainable relative to primary manufacturing Lastly, and time permitting, this talk will cover our recent developments of chemo-catalytic strategies to produce bio-based monomers for circular polymer

Gregg T. Beckham is a Group Leader and Senior Research Fellow at the National Renewable Energy Laboratory (NREL). He received his PhD in Chemical Engineering at MIT in 2007. He currently leads and works with an interdisciplinary team of biologists, chemists, and engineers at NREL on conversion of biomass to fuels, plastics upcycling, chemicals and materials included in metabolic engineering, catalysts, fermentation, separations, biopolymer and carbon fiber production, theory and simulation to design biological and chemical catalysts, and lignin and waste valorization.