UW Chemical Engineering

Spring 2013 Seminar Series

Date: Monday, May 20

Time: 4:00 - 5:00 p.m.

Place: PAA A110

Unraveling Cellulose for Renewable Plastics and Fuels

Paul Dauenhauer
Assistant Professor
Chemical Engineering
University of Massachusetts Amherst

Biography

Paul Dauenhauer is director of the University of Massachusetts Reaction Engineering and Catalysis Laboratory and Assistant Professor of Chemical Engineering at the University of Massachusetts Amherst. Paul received his B.S. in Chemistry and Chemical Engineering from the University of Wisconsin Madison in 2004. In 2008, he received his Ph.D. in Chemical Engineering from the University of Minnesota with a focus on catalytic reforming of biomass advised by Professor Lanny Schmidt. Paul has also worked for the Dow Chemical Corporation as a Senior Research Engineer and Cargill, Inc. He currently serves as Thrust Leader of the DOE-funded Catalysis Center for Energy Innovation, associate editor of *Chemical Engineering Science*, and manager of the Waste-to-Energy engineering program at UMass. His work focusing on catalytic biomass conversion has been recognized for its achievements in renewable biofuels and chemicals, and Prof. Dauenhauer has received the NSF-CAREER, the Dept. of Energy Early Career, and the 3M Nontenured Faculty awards supporting his research efforts.

Abstract

Utilization of non-food, lignocellulosic biomass such as trees and grasses provides unprecedented opportunity to sustain a lifestyle which benefits from plastics, chemicals and fuels. These feedstocks are rich in the carbohydrate polymers cellulose and hemicellulose, which can be broken down and chemically reduced to the same fuels and chemicals that we currently derive from petroleum. With a focus on production of chemicals including p-xylene, we demonstrate a new technology to convert sugars derived from cellulose to furans and eventually six-carbon aromatics. Combination of a zeolite catalyst with favorable reactor conditions results in a new process capable of achieving 75% selectivity to p-xylene. Alternatively, a focus on producing renewable fuels targets a mixture of oxygenated hydrocarbons with properties necessary for direct replacement of gasoline, diesel or jet fuel. Our strategy utilizes a two-step process to initially convert lignocellulosic biomass to a liquid called bio-oil, which is subsequently catalytically refined to liquid fuel. Production of bio-oil remains the key problem, because conventional mixtures are too acidic and unstable for conventional refining operations. Using a new technique called 'thin-film pyrolysis' developed at the University of Massachusetts, we reveal the chemistries that determine the quality of biomass-derived bio-oil and demonstrate the potential for producing higher quality bio-oil directly from woody biomass.