Polymer Seminar

Friday, October 4, 2024

11:15 am Science 1 - Room 1002

Coffee, Tea, and Cookies will be available at 11:00 am

Dr. Wei Fan

Chemical Engineering

UMass, Amherst

Host: Greg Sotzing

Synthesis of Zeolite Catalysts with Controlled Morphology and Composition for Lignocellulosic Biomass Conversion

Abstract: Increasing demand for energy and commodity chemicals has led to accelerated research efforts in the conversion of renewable resource into chemicals and fuels for a sustainable economy. The processing of lignocellulosic biomass, an inexpensive, abundant and sustainable source of carbon, offers the promise of sustainable chemicals and carbon-neutral liquid transportation fuels. The International Energy Agency (IEA) laid out a 'roadmap' to ramp up the use of biofuels converted from biomass feedstocks from around 2% of global transport fuel at 2011 to 27% by the year 2050. Zeolite catalysts have shown superior catalytic activity and selectivity for converting lignocellulosic biomass into fuels and chemicals including aromatics and olefins because of the intrinsic ordered micropore structures and unique catalytic activity of zeolite catalysts.

However, the micropore structures and high intrinsic activities frequently lead these materials to be subject to diffusion limitations that restrict reactant accessibility to the active sites on the interior surfaces of zeolites, inhibit the full utilization of zeolite catalysts, and cause fast catalyst deactivation. In addition, the acid strength of zeolite catalysts should be tunable due to multiple reactions involved in biomass conversion. In our group, we have developed a series of methods to synthesize hierarchical zeolites with controllable microporosity and mesoporosity, and develop zeolite catalysts with varying acid strength for converting lignocellulosic biomass into chemicals and fuels.

In this talk, I will first focus on the introduction of synthesis of hierarchical zeolites. The mass transport properties and catalytic properties of these hierarchical zeolites for biomass conversion will be discussed along with the future aspect regarding the rational development of hierarchical zeolites. I will also introduce a new approach to control the defect density in zeolite materials by precisely fine tuning the charge balance in their crystallization process, which can lead to the zeolite materials with different hydrophobicity. At the end, I will show a new type of zeolite catalyst, phosphorous-containing siliceous zeolites. The catalysts are active, stable and selective for producing renewable *p*-xylene by cycloaddition of biomass-derived dimethylfuran (DMF) and ethylene with an unprecedented *p*-xylene yield of 97%.

Biography: Wei Fan is a Professor in the Chemical Engineering Department at the University of Massachusetts Amherst. Dr. Fan's research group focuses on the rational synthesis of nanoporous materials for biorefinery catalysts and carriers, engineering their pore structure and size, surface properties, and active sites based on a comprehensive understanding of their crystallization mechanism. Dr. Fan received his PhD from the University of Tokyo, Japan, and worked with Prof. Michael Tsapatsis at the University of Minnesota from 2007 to 2010 as a postdoctoral researcher. He started his research group at the University of Massachusetts Amherst in 2010. He has published more than 100 peer-reviewed papers in over 10 international journals, including Science, Nature, Nature Materials, Journal of the American Chemical Society, and Angewandte Chemie International Edition.

Awards and Honors

2024 Distinguished Teaching Award of Umass Amherst
2021 iCons Teaching Fellow
2020 Edward S. Price Chemical Engineering Faculty Fellowship
2016 Barbara H. and Joseph I. Goldstein Outstanding Junior Faculty Award
2016 Outstanding College of Engineering Teaching Award
2014 - 2017 3M Non-Tenured Faculty Award

UCONN
UNIVERSITY OF CONNECTICUT

IMS INSTITUTE OF MATERIALS SCIENCE