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Promoting Catalytic Science and Technologies

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Catalysis Club of Philadelphia

Thursday, February 27th, 2020

Crowne Plaza Wilmington North

630 Naamans Road, Claymont, DE 19703

Speaker: Prof. Elizabeth J. Biddinger

Catalysis Club of Philadelphia February Meeting

The City College of New York, CUNY

Electrosynthesis of chemicals and fuels: Electrochemistry at the Biorefinery

Meeting Schedule:

Social Hour ....5:30 PM

Dinner......................6:30 PM

Meeting...................7:30 PM

Meal reservations – Please register online by ***Friday, February 21st*** at http://catalysisclubphilly.org/ or notify your company representative or our Treasurer Josh Pacheco (Josh.Pacheco@pqcorp.com) or Chair Jacob Dickinson (Jacob.G.Dickinson@dupont.com)

Meeting Fees:

Members: $40.00

Non-Members: $45.00

Stud. & Retired Members: $25.00

Membership - Dues for the 2019-20 season will be $25.00 ($5.00 for the local chapter and $20.00 for the national club). Dues for students, post-docs and retirees will be $10.00 ($5.00 for local club and $5.00 for national club).

Menu

Italian wedding soup, spinach salad, lemoncello cake desert, and your choice of 3 entrees:

1) Maryland crab cakes – *Served with Remoulade sauce*
2) Roast pork loin – *Spice rubbed, apple cider demi glaze*
3) Eggplant Parmigianino – *Served with mozzarella and bread crumbs*

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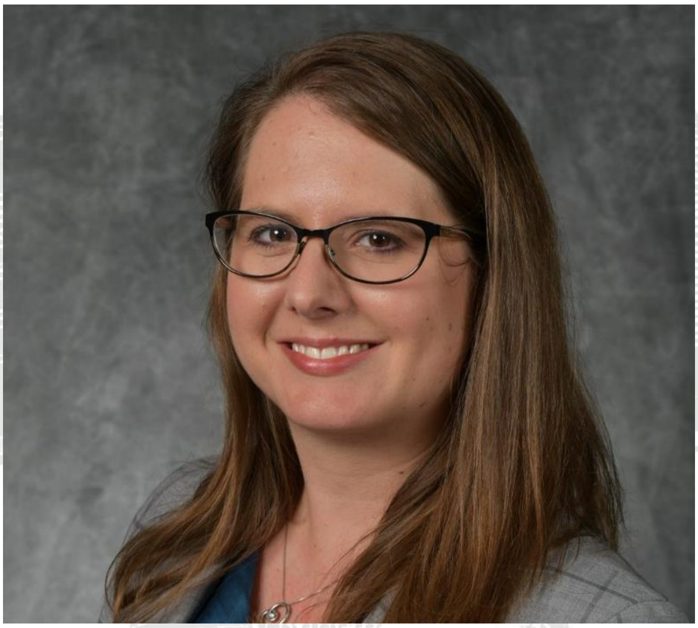


Prof. Elizabeth J. Biddinger

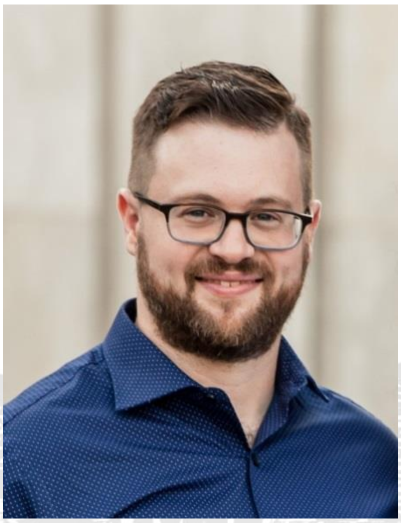
Electrosynthesis of chemicals and fuels: Electrochemistry at the Biorefinery

The City College of New York, Department of Chemical Engineering

Abstract: As electricity prices continue to drop and intermittent sources of electricity grow, electrochemically synthesizing chemicals becomes feasible. Electrochemical synthesis methods offer opportunities to perform reactions under benign reaction conditions (at or near room temperature and pressure), use less harmful or waste-generating reaction steps, and perform selective reactions. In electroreduction reactions, externally-supplied hydrogen gas that is generally needed for reduction is not required. Rather, electrons, frequently paired with the electrolyte, are the reducing agents. An example ripe for electrochemical synthesis implementation is that of the biorefinery. Once the initial biomass-derived chemicals have been formed, they need to be upgraded to more stable species for transportation and use elsewhere. Biorefineries are much smaller and more locally distributed compared to their petrochemical refinery counterparts, making complex processes more difficult to operate. There are benefits to using electrochemical processes on a skid-scale at these biorefineries. Electrochemical hydrogenation and hydrogenolysis (ECH) will be presented as an example of replacing a traditional heterogeneously-catalyzed synthesis with an electrochemical synthesis. The specific ECH reaction that will be focused on is furfural, a biomass-derived species, to furfuryl alcohol and 2-methyl furan, a resin intermediate and a fuel alternative, respectively. The work presented here will illustrate the concept of electrochemical upgrading using electrochemical hydrogenation and hydrogenolysis (ECH) of furfural to 2-methyl furan and furfuryl alcohol, a fuel and chemical intermediate, respectively. By tuning the reaction conditions, the desired products can be formed and the undesired products

minimized. Modifications to the copper electrocatalyst can improve reaction rate and reduce fouling of the catalyst. I will then present recent unpublished work on commensurate knitting of 1-dimensional MEL (1D-MEL) in 2D-MFI and its implications in transport and mechanical properties and potential applications in isomerization membrane reactors. I will also discuss our efforts to quantitatively describe reaction and diffusion in 2D and thicker MFI nanosheets (AIChE Journal 65(3), 1067-1075 (2019)) using classical reaction-diffusion models. I will close with unexpected findings regarding nanosheet coarsening in the presence of superheated steam and its implications for regulating external surface catalysis by 2D-MFI.

Speaker Details: Elizabeth J. Biddinger joined the Department of Chemical Engineering at The City College of New York as an Assistant Professor in the Fall of 2012 and received her tenure promotion notice in Fall 2019 to be effective for Fall 2020. Her research interests encompass green chemistry and energy applications utilizing electrocatalysis and ionic liquids. Prior to joining CCNY, Professor Biddinger was a Post-doctoral Fellow at the Georgia Institute of Technology 2010-2012. She received her PhD in 2010 in Chemical Engineering from The Ohio State University and her BS in 2005 in Chemical Engineering from Ohio University. Professor Biddinger has been recognized for her work including the 2018 DOE Early Career Award for biomass electroreduction, the 2016-2017 Electrochemical Society – Toyota Young Investigator Fellowship Award for reversible ionic liquid systems as electrochemical safety switches, and the 2014 CUNY Junior Faculty Award for Science and Engineering from the Sloan Foundation for CO_2 electroreduction. Professor Biddinger has held multiple leadership posts including serving as the student awards chair for the Industrial Electrochemistry and Electrochemical Engineering Division of the Electrochemical Society (ECS) (2014-Present); a member of the ECS Publications Sub-Committee (2017-Present); a Director of the Catalysis and Reaction Engineering Division of the American Institute of Chemical Engineers (AIChE) (2017-Present) and; chair (2009-2010) and vice-chair (2008-2009) of the Central Ohio Professional Section of AIChE.



Benjamin M. Moskowitz[1], Yuanyuan Li[2], Zhenghong Bao[3], Zili Wu[3], Anatoly I. Frenkel[2,4], and Israel E. Wachs[1]

Structure-activity relationships in the conversion of ethanol to 1,3-butadiene over supported $ZnO/ZrO_2/SiO_2$ catalysts

Lehigh University, Department of Chemical and Biomolecular Engineering

Abstract: Abundant and low-cost shale gas has replaced naphtha as the feedstock of choice for C_2-C_4 olefin production. This change has led to a shortage of 1,3-butadiene (BD), a critical intermediate for the manufacture of synthetic rubber. The constrained BD supply has triggered price fluctuations and interest in on-purpose BD production. Cellulosic ethanol is a sustainable feedstock quickly becoming mainstream and its conversion into BD significantly reduces lifecycle greenhouse gas emissions when compared to petroleum-derived BD. Supported $ZnO/ZrO_2/SiO_2$ catalysts show particular promise for the one-pot conversion of ethanol to BD, yet little is known about the atomic structures giving rise to catalytic activity. We report how insights about catalytic activity and selectivity, as probed by Temperature-Programmed Surface Reaction spectroscopy, are made possible via *in situ* X-ray Absorption, Raman, UV-vis, High Sensitivity-Low Energy Ion Scattering and Near-Ambient Pressure X-ray Photoelectron spectroscopies. These new fundamental insights point towards structure-activity/selectivity relationships to guide the rational design of improved catalyst performance.

Speaker Details: Benjamin M. Moskowitz is a Ph.D. candidate in the Department of Chemical & Biomolecular Engineering at Lehigh University advised by Professor Israel E. Wachs. Benjamin applies *in situ* and *operando* methods to examine the conversion of ethanol to 1,3-butadiene over $ZnO/ZrO_2/SiO_2$ catalysts.

Benjamin is a 2017 Department of Energy Office of Science Graduate Student Research (SCGSR) awardee and worked on his doctoral thesis research at Oak Ridge National Laboratory with Dr. Zili Wu. Also in 2017, Benjamin was honored as a Rossin Doctoral Fellow by the P.C. Rossin College of Engineering and Applied Science at Lehigh University. For his research, Benjamin received a 2016 AIChE Catalysis and Reaction Engineering Division Poster Award.

Prior to his graduate work, Benjamin worked as a Process Engineering Associate at Primus Green Energy from 2012 – 2015, where he applied for two patents. In 2011, Ben received his A.B. in

Engineering Sciences from Dartmouth College and his B.E. in Chemical Engineering from the Thayer School at Dartmouth College.

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