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Attend virtually: <https://udel.zoom.us/j/99615073260>

ELECTROCHEMICAL HYDROGENATION, HYDROGENOLYSIS, AND DEHYDROGENATION FOR REDUCTIVE AND OXIDATIVE BIOMASS UPGRADING

Due to growing energy demands as well as environmental concerns, the production of fuels and building block chemicals from renewable sources has become an important area of research. In particular, the use of biomass as feedstock for the production of fuels and building block chemicals holds great promise due to its abundance, accessibility, and worldwide distribution. Owing to the considerable and continuing decrease in the cost of electricity provided by renewable energy sources, electrochemical processes have become viable and appealing routes for reductive and oxidative biomass conversion. The use of electrochemical potential to drive oxidation and reduction reactions has the advantage of performing the reactions at ambient temperature and pressure without requiring the continuous consumption of reductants and oxidants. Most biomass intermediates contain multiple functional groups. Therefore, achieving reduction and oxidation of only the desired functional groups is critical for efficient and selective upgrading of biomass intermediates. For reductive biomass upgrading, many intermediates containing oxygenated moieties such as carbonyl and alcohol groups must be selectively reduced to form desired fuels and chemicals. Thus, controlling the selectivity between hydrogenation and hydrogenolysis is of great importance for these transformations. For oxidative upgrading, partial oxidation of biomass intermediates to molecules that have greater value than the starting molecules while avoiding their complete oxidation to CO₂ is needed. Since most biomass intermediates contain multiple alcohol and aldehyde groups, the ability to selectively dehydrogenate only the desired functional group (alcohol vs aldehyde, primary alcohol vs secondary alcohol) will be vitally important for efficient and selective chemical production via biomass conversion. In this presentation, we will discuss electrochemical hydrogenation, hydrogenolysis, and dehydrogenation processes and mechanisms that our group has been investigating for the conversion of biomass-derived molecules (e.g., 5-hydroxymethylfurfural, glycerol) to various valuable fuels and chemicals. Through this discussion, we hope to provide new insights to build general mechanistic frameworks for electrochemical hydrogenation, hydrogenolysis, and dehydrogenation reactions based on which more efficient and selective electrocatalysts and optimal reactions conditions to produce desired fuels and chemicals can be identified.

ABOUT THE SPEAKER

Prof. Kyoung-Shin Choi received her B.S. and M.S. degrees from Seoul National University in South Korea in 1993 and 1995, respectively. She received a Ph.D. degree from Michigan State University in 2000 (Advisor: Prof. Mercuri Kanatzidis), and then spent two years at the University of California, Santa Barbara as a postdoctoral researcher (Advisors: Prof. Galen Stucky and Prof. Eric McFarland). She joined the chemistry faculty at Purdue University as an assistant professor in 2002, and was promoted to an associate professor in 2008. She was a visiting scholar at the National Renewable Energy Laboratory (NREL) in 2008. In 2012, she joined the chemistry faculty at University of Wisconsin-Madison as a full professor. Her research interests include solar fuel production, (photo)electrochemical biomass conversion, and electrochemical desalination and water treatment. She is currently serving as an Associate Editor for Chemistry of Materials and a member of the Board of Directors for Materials Research Society. She is also a co-founder and president of a startup company, ChloBis Water, Inc.