Electrifying Ammonia Synthesis

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Of the four major energy-use sectors (transportation, residential, commercial, and industrial), the industrial sector accounts for the largest amount of energy use (~33 EJ/year). This energy use results in nearly 1500 million metric tons of carbon dioxide emissions yearly [1]. The large carbon footprint is due to the fact that coal, natural gas, and petroleum are the primary energy sources utilized. With rising concerns related to global carbon emissions, there is a strong interest in displacing a majority of this hydrocarbon demand with renewable derived electricity. However, displacing hydrocarbons directly with electricity is not always feasible, prompting the need to redesign many industrial processes to enable electrification.

Within the chemical commodity industry, transforming thermocatalytic and thermal based catalytic systems into a photo or electrochemical driven processes is one way to electrify and decarbonize the chemical industry. The primary aim of this talk is to detail how photochemical and electrochemical processes may aid in decarbonizing ammonia synthesis. Ammonia is the largest volume chemical produced globally with a market size of 179 million tons, and consumes 5.5 EJ of energy per year. In this presentation, I will aim to highlight the underlying catalytic mechanism and pathways, which may allow for the production of green ammonia. I will further highlight the critical targets, performance metrics, and systems related designs, which may enable direct competition with thermocatalytic systems.

Bio:

Marta Hatzell is an Associate Professor of Mechanical Engineering at Georgia Institute of Technology. Hatzell's research group focuses on exploring how to electrify catalytic and separation-based processes to enable sustainable industrial systems. Her group works on materials, characterization, and system analyses for electrolysis, fuel cells, desalination, and solar energy conversion processes. Hatzell completed her BS, MS, and PhD in Mechanical Engineering from Penn State University, and completed an M.Eng in Environmental Engineering from Penn State University. Hatzell's PhD research conducted with Prof. Bruce Logan explored environmental technologies for energy generation and water treatment. During her PhD, she was a NSF graduate research fellow and PEO fellow. Hatzell completed her post-doctoral research work within the Material Science and Engineering department at the University of Illinois Urbana- Champaign. Hatzell's post-doctoral research conducted with Prof. Paul Braun explore the intersection of electrochemistry and colloid science. Hatzell is currently a Woodruff Faculty fellow within the Mechanical Engineering department at Georgia Tech. She also received the Moore Inventor Fellowship (2021), ECS Toyota Young Investigator Award (2021), ONR Young Investigator Award (2020), Sloan Foundation Fellowship in Chemistry (2020), and the NSF Early CAREER award (2019).