Keynote speaker

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Electrifying the Synthesis of Nitrogen and Carbon-based Fuels and Fertilizers

Of the four major energy-use sectors (transportation, residential, commercial, and industrial), the industrial sector accounts for the largest amount of energy use (~32 quad/year). This energy use results in nearly 1500 million metric tons of carbon dioxide emissions yearly[1]. The large carbon footprint is because 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 most 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 separations and catalytic processes to enable widespread electrification.

Within the chemical commodity industry, movement away from thermocatalytic processes and toward electrocatalytic processes is one way to electrify catalysis. Likewise, movement away from thermal distillation-based separations and toward membrane-based processes is one way to increase electrification associated with separations. However, there are many thermodynamics and kinetic-based challenges with transitioning toward these electrified processes. Thus, there is a growing need to understand at a molecular scale the inefficiencies of these emerging technologies. The primary aim of this talk is to describe progress associated with the electrification of industrial catalytic processes, and detail efforts by the Hatzell lab aimed at elucidating molecular scale insights related to transport and kinetics within these technologies. Specifically, we will highlight our work aimed at electrifying the synthesis of carbon- and nitrogen-based fuels and chemicals.