# Metal-Organic Frameworks (MOFs) As Catalysts and Catalyst Precursors For Small-Molecule Conversions

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**MAE Seminar Series**

**Metal-organic frameworks (MOFs) are porous materials that are formed by nodes of metal ions or metal oxide clusters linked by organic ligands; this modularity results in a large set of diverse pore networks useful in various applications, including wastewater treatment, gas capture and separations, energy storage, sensing, and catalysis. Here, we investigate MOFs as catalysts and catalyst precursors for oxidation and reduction reactions. First, we probe the kinetic mechanism and recyclability of MIL-101, one of the more thermochemically tenable MOFs, for styrene oxidation with hydrogen peroxide, an oxidant with primarily benign byproducts (i.e. water). Specifically, we assess the intrinsic reactivity and stability differences between MIL-101 in its Cr and Fe forms, the latter of which is a more abundant (cheaper) and environmentally benign metal. Second, we utilize MOFs as catalysts precursors that result in unique nanomaterials upon high temperature treatment or under an applied potential. The efficacy of these MOF-derived catalysts, in monometallic Cu form, was tested for CO2 electrocatalytic reduction, respectively. The effect of external applied on the phase and/or structure of the catalysts, as determined from various characterization techniques, was evaluated along with their catalytic performances. The work shown here provides examples of using MOFs as catalysts and as precursors to synthesize unique, stable catalyst structures with desired rates and selectivities for hydrocarbon processes.**

**Michele L. Sarazen is an Assistant Professor in the Department of Chemical and Biological Engineering at Princeton University, where she joined in Spring 2019. Her research group at Princeton couples synthetic, kinetic, and theoretical investigations of porous crystalline materials as catalysts and adsorbents for sustainable fuel and chemical production with an emphasis on reaction and deactivation mechanisms. She earned her BS in Chemical Engineering, summa cum laude, at the Pennsylvania State University and her PhD in Chemical Engineering from the University of California, Berkeley. Her thesis, completed under the guidance of Enrique Iglesia, investigated zeolite-catalyzed alkene and alkane chain growth reactions through both experimental and theoretical approaches. She was a postdoctoral fellow at the Georgia Institute of Technology, working with Christopher Jones on the synthesis of hybrid adsorbents for direct air capture of CO2 and metal-organic framework-based catalysts. Her recognitions include the National Science Foundation Graduate Research Fellowship, Howard B. Wentz, Jr. Junior Faculty Award, National Academy of Engineering Frontiers of Engineering, as well as a Division Director for the American Institute of Chemical Engineers and Chair of the Catalysis Society of Metropolitan New York.**

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