Title:
Synthesis and Application of Metal Organic Frameworks for the Removal of Indoor and Outdoor Air Pollutants

Abstract:
Metal organic frameworks (MOFs) are a class of porous materials comprised of inorganic metal nodes, which are traditionally transition metal-based (e.g., Zr, Zn, etc.), connected via organic linkers, which can vary in both length and functionality (e.g., imidazoles, carboxylic acids, etc.). These nodes and linkers combine to form three-dimensional porous frameworks, often possessing high internal surface areas, which can be utilized for a variety of applications including, but not limited to; catalysis, separations, storage, and, most importantly for this work, the removal of both outdoor and indoor gas phase pollutants. This work primarily focusses on the use of MOFs for the removal of both nitrogen dioxide (NO₂), which belongs to a class of pollutants referred to as nitrogen oxides (NOₓ), as well as one of its most common radical reservoirs, nitrous acid (HONO), both of which impact indoor and outdoor air quality. Briefly, NO₂ is produced primarily through combustion processes in the transportation and energy sectors. When NO₂ reacts with surface-bound water it results in the formation of HONO, which acts as a radical reservoir for NOₓ at night, or in the absence of light. In the presence of light, either solar irradiation or indoor lighting, HONO photodissociates to form hydroxyl radicals and nitric oxide (NO) which can then aid in the reformation of NO₂, resulting in a null NOₓ cycle. In this interdisciplinary research presented herein we focussed on the how MOFs can interact with, and remove, a variety of pollutants including nitrous acid (HONO), nitrogen dioxide (NO₂), semi volatile organic compounds (SVOCs), and sulfur dioxide (SO₂).

This seminar will begin by laying the ground work for my doctoral research by detailing the trials and tribulations of MOF synthesis, specifically of both Zn- and Zr-based MOFs, both of which were experimentally tested for the removal of atmospheric pollutants HONO and NO₂. Next, we will discuss the creation and fine-tuning of novel permeation sources for the lab-scale production of pollutants (e.g., HONO and SO₂) at concentrations akin to those observed in...
traditional indoor and outdoor environments. Subsequently, we will look at the use of MOFs to remove both HONO and NO₂ at relevant concentrations, and the impact that both dry and wet desorption conditions have on pollutant desorption from MOFs. Lastly, we will assess the impacts that sticky indoor air pollutants, such as SVOCs, can have on the efficacy of MOFs in real world environments.

References: