Nanoengineering of Metal-Organic Frameworks (MOFs) for Carbon Capture

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Abstract

Metal organic frameworks (MOFs), a new class of nanoporous crystalline materials built of metal atoms bridged by organic ligands, are promising materials for CO_2 capture from flue gas and ambient air. These materials possess unique structural characteristics such as uniform pore structure in nanometric scale, extremely high surface areas, and framework flexibility. The Mg/DOBDC MOF reports the highest and competitive adsorption capacity of 0.38 g CO_2/g sorbent at low CO_2 partial pressures (flue gas conditions). However this material may become unstable under humid conditions and after repetitive cycles of adsorption and desorption operations. One of the proposed ways to enhance its performance is introduction of amine groups onto the pores of material. In this project, functionalization of open metal sites with ethylene diamine (ED), as a grafting agent was performed. After four adsorption/desorption cycles CO_2 uptake stayed stable at 1.5 mmol/g, which implies improved working capacity and overall stability/regenerability of the material. Due to the hydrophilic nature of MOFs, exposure to humidity could lead to structural degradation where H_2O molecules could replace framework ligands causing defects in crystal lattice. Since both flue gas and ambient air environments contain some degree of moisture, stability evaluation of functionalized Mg/DOBDC under humid conditions is important. This presentation will also include discussion about accelerated steam stripping experiments to be performed for investigation of the role of humidity in bare and functionalized Mg/DOBDC MOFs.