Stimuli-Responsive Coordination Constructs

C. Michael McGuirk, Ph.D.
Department of Chemistry
University of California, Berkeley

The performance of enzymes is reliant on the spatially defined active site environment that encompasses catalytically participatory atoms. Many enzymes leverage this dependence to desirably regulate their function through reversible stimulus-induced structural changes to the active site. Inspired by this control, my work has focused on the realization of stimuli-responsive coordination architectures for the by-design regulation of catalytic activity and chemically selective gas adsorption. In the Mirkin Group at Northwestern University, we demonstrated that by integrating hydrogen bond-donating organocatalysts into a stimuli-responsive hemilabile coordination construct, catalytic activity could be regulated through the steric modulation of competitive intermolecular interactions, creating opportunities for the in situ regulation of polymer composition. Since joining the Long Group at UC–Berkeley, efforts have focused on harnessing stimuli-responsive metal–organic frameworks (MOFs) that display non-classical gas adsorption behavior for a range of applications. In particular, we have reported the profound influence of metal-substitution on CO₂ and CH₄ adsorption behavior in a class of flexible frameworks with “gated” adsorption. Additionally, we have shown that diamine-appended MOFs are capable of reversibly adsorbing the toxic commodity chemical CS₂ through a cooperative chemical adsorption pathway. Taking together, these works demonstrate the power of coordination constructs to mimic biology in using structural responses to a stimulus to desirably regulate function.

References: