Metal-organic framework (MOF)-based heterogeneous photocatalysts.

Photochemical transformations provide access to useful compounds that are thermally impossible; these include small molecule activation through high-energy transition states (and/or intermediates). Among various small molecules, CO_2 reduction to generate fuels is one foremost process due to its relevance as a sustainable energy resource. Light-driven synthesis of small hydrocarbons also defines a unique route to achieve useful compounds. Typically, ruthenium and iridium-based molecular photosensitizers with the long-lived excited state are used to drive these transformations. Heterogeneous catalysts provide a great advantage for easy separation in large (say industrial) scale implementations. Given that such activation would require to be accomplished within a rather short life span of the excited photosensitizer, it restricts the development of heterogeneous photocatalysts as it would be limited by molecular diffusion. It is therefore very important to carefully design a system that has unique photophysical properties and provides ways for efficiently transporting the photo-absorbed energy. Therefore, we will investigate how metal−organic frameworks (MOFs) can be exploited as scalable solid photocatalysts and if possible then how can we make selective heterogeneous photocatalysts. The project will involve carrying out organic synthesis and characterization, shining light into materials, characterization of products including stereochemistry. The project will need the usage of standard synthesis equipment, Schlenk line, glove box, HPLC, XRD, and absorption and emission spectroscopic methods.