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Coach	**Supervisor**	**Funding**
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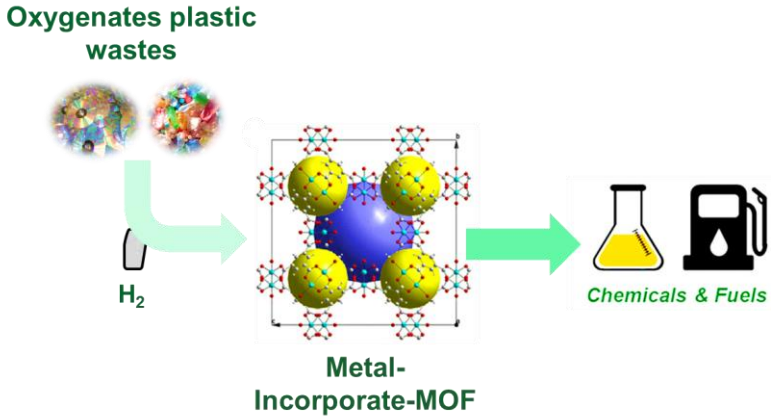
Optimizing Metal-Impregnated MOF Catalysts for Hydrogenolysis of Oxygenated Plastic Wastes (MOFHYD)

Aim

The Catalytic Hydrogenolysis of oxygenates plastic waste technology is an effective solution for plastic pollution and feedstock recycling. Studies show improved activity with reduced energy input, resulting in lower operating temperatures and higher yields of valuable compounds. We are seeking the best heterogeneous catalyst for this system. Recent research has faced challenges with catalyst deactivation and regeneration. This project aims to design stable catalysts for selective C-O bond cleavage in oxygenated plastic waste. Progress is being made in understanding catalyst-plastic interactions for efficient conversion (as illustrated in Scheme 1).

Justification

Metal–organic frameworks (MOFs) are porous crystalline materials with large surface areas that enable unique host–guest chemistry. They have hexagonal 1-D channels with diameters ranging from 1.2 to 9.8 nm, accommodating various substrate sizes. The isoreticular IRMOF-74(n) series can be synthesized with different metals (Mn, Ru, Ni, Cu, and Zn) and mixed-metal compounds with up to 10 different metals, offering reactivity flexibility. Our research focuses on evaluating Nickel and Copper-based HT catalysts, including Ni-MOF-74, for polyester hydrogenolysis. Cu and Ni metals (up to 5wt.% loading) exhibit better activity in selectively cleaving C-O bonds in polyesters to diols, yielding 60-75% products in batch reactors. However, these catalysts are unstable under high hydrogen pressure (e.g., 30 bar). In-house synthesized Ni-MOF-74 shows lower activity compared to HT-based catalysts under the same conditions. We are currently optimizing the synthesis process of metal-impregnated MOFs with metals like Cu and Zn, as well as mesoporous carbon-based Ni catalysts, to enhance catalytic performance. Our goal is to study tunable metal-incorporated MOFs to improve selectivity and stability, focusing on transition metals like Cu, Ni, and Fe that can modify acidity/basicity to influence product distributions. We are exploring catalytic characterizations using electron microscopy, X-ray diffraction, and infrared spectroscopy. Additionally, we will investigate regeneration methods for MOFs to address challenges in MOF-based technologies.



Scheme 1. Reaction schematic procedure

Program:

The following activities will be conducted:

I. Prepare a state-of-the-art report on metal impregnated MOF/Ni-Carbon….
II. Synthesize and catalysts characterization using XRD, BET-SA & PSD, TPD of ammonia, and FTIR.
III. Screen catalyst recipes for hydrogenolysis of polyesters/blends in a high-pressure batch reactor (PARR).
IV. Optimize process parameters.