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Synthesis of a Hydrophobic/Hydrophillic Nano-Patterned Metal-Organic Framework Material

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Objective

- The main objective of this research is to demonstrate that an MOF material with two different channels can be functionalized with two incompatible chemical groups resulting in the groups self-sorting into different channels.

Background Info

- Metal-organic framework (MOF) materials are formed from a reaction between an organic linker with multiple binding sites and a metal node, creating a porous 3D grid-like structure.

- MOF materials can be utilized in catalysis, gas storage, and filtration.

- MOF crystal structures affect their functionality, so structure manipulation is key for certain applications.

- Post-synthetic modification (PSM) is a process where an assembled MOF is chemically altered while keeping the crystal structure intact.

- In this project two PSMs are going to be performed onto a synthesized MOF to get hydrophobic and hydrophilic properties.

Reactions

- Scheme 1: KSU-1 Synthesis
- Scheme 2: KSU-1 Mono-Functionalization
- Scheme 3: KSU-1 Bi-functionalization

Conclusions

- The first PSM of KSU-1 successfully modified the amine group to an amide group.

- The mono-functionalized KSU-1 retained its solvent absorption capabilities.

- Mono-functionalized KSU-1 retained crystallinity.

Future Research

- In future studies, the second PSM will be done on KSU-1 along with spectroscopy to characterize it.

- Bi-functionalized KSU-1 will be tested with various polar and non-polar solvents to observe hydrophobic and hydrophilic qualities.

- Spectroscopy is needed to help identify where the PSMs are occurring.

Data/Results

- Figure 2: KSU-1 mono Powder X-Ray Diffraction Spectrum
- Figure 3: Thermogravimetric Analysis of KSU-1 and KSU-1 mono
- Figure 4: KSU-1 mono 1H-NMR Spectrum (d6-DMSO/D2SO4)
- Figure 5: KSU-1 mono 1H-NMR Spectrum (d6-DMSO/D2SO4)

References


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