Synthesis and Characterization of Zeolitic Imidazolate Framework – 4 (ZIF – 4) Film

Cameron Schwabe, Chemical Engineering
Mentor: Dr. Bin Mu
Arizona State University

How can the metal organic framework ZIF – 4 be used in separation processes?

Introduction & Background

• There is much interest in the use of porous membranes for gas phase separation
• Metal organic frameworks can have surface areas ranging from 1000 to 10,000 m²/kg
• Metal organic frameworks can be used as adsorbents for gas/liquid separation techniques
• Zinc Imidazolate Framework – 4 (ZIF – 4) is a type of MOF that can be used in separation processes
• ZIF-4 has four membered rings which contribute to its ability to have flexible porous membranes
• Major applications of MOF’s include practical uses in greenhouse gas capture and natural gas/energy storage

Methodology & Materials

• Zinc Imidazolate Framework – 4 [ZIF - 4] exhibits an amorphous phase that still maintains structural stability
• DMF (Dimethylformamide) was used as a solvent for holding the crystals prior to heating
• A performed synthesis was composed of zinc nitrate hexahydrate and imidazolate linkers
• Imidazole is essential for holding the metal zinc together, which establishes the structure of ZIF – 4
• Sonication was done to suspend the crystals in the solution
• Solvothermal heating was performed in a vacuum oven in order to heat the sample above 130 degrees Celsius
• Filtration was performed to isolate the ZIF – 4 from the remaining DMF
• BET analysis and adsorption machine were considered for characterization purposes

Conclusions

• BET analysis was performed on a 0.1303-gram sample in order to discern surface area of the ZIF – 4
• The BET scans prove that the MOF was able to withstand high temperatures and maintain it’s porous structure, since surface area was detected
• SEM imaging was used to observe the crystals formed from the solvothermal synthesis
• Adsorption machine was considered in this experiment to study the ability of ZIF-4 in separating/adsorbing different gases such as carbon dioxide and methane
• Linear and logarithmic isotherms were plotted to show surface area adsorption and desorption

Recommendations

• In order to conduct further analysis, a larger sample should be used in order to measure greater surface area capacity
• The use of an adsorption machine would be useful for analyzing the ability of ZIF-4 to separate gases
• Gases such as methane, carbon dioxide, and hydrogen could be adsorbed in a laboratory setting
• Incorporating electro-spun fibers with the MOF may be more effective in adsorption behavior

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References