Synthesis of ZIF-8 for Carbon dioxide Adsorption

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Introduction
Carbon dioxide adsorption is implemented to remove excess carbon dioxide exhaled by the crew and replenish oxygen in the International Space Station. Metal Organic Frameworks, MOFs, present promising candidates for CO₂ adsorption as a result of their high surface area and open crystalline structure.[1] The surface area of MOFs is typically higher than zeolites which are currently used to adsorb and concentrate CO₂. One class of MOFs is known as zeolitic imidazolate frameworks (ZIFs), such as ZIF-8 which consists of zinc ion as the metallic ion and 2-methylimidazole as the organic precursor, which have shown to be highly efficient for CO₂ adsorption. ZIF-8 as an adsorbent has shown promising capability to adsorb and concentrate CO₂.

Catalyst Synthesis
ZIF-8 was synthesized by mixing aqueous solutions of zinc nitrate hexahydrate and 2-methylimidazole. The mixture was centrifuged for 40 to 70 minutes, then washed 4 times with water. The residue was dried overnight at 65°C. The amount of 2-methylimidazole was varied to give ratios of zinc to 2-methylimidazole 1:20, 1:40, 1:60, 1:70 and 1:90.[2]

XRD Characterization
Samples of ratio 1:90 through 1:40 exhibited XRD pattern corresponding to ZIF-8 but the sample of ratio 1:20 appeared to lose its crystalline nature.

XRD is a method used to determine the crystal size and structure of a sample. XRD data was measured (with the machine to the right) from 5° to 60° at a rate of 1° per minute.

The synthesized ZIF-8 sample remained stable up to 300°C but decomposed to give zinc oxide above 450°C.

After 2 hours at testing conditions, the XRD pattern of the sample showed smaller crystalline size.

Conclusions
• We successfully synthesized ZIF-8.
• The synthesized ZIF-8 exhibited thermal stability as high as 300°C.

Future Work
• BET surface area characterization.
• Adsorption testing.

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References