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Synthesis of ZIF-8 for Carbon dioxide Adsorption

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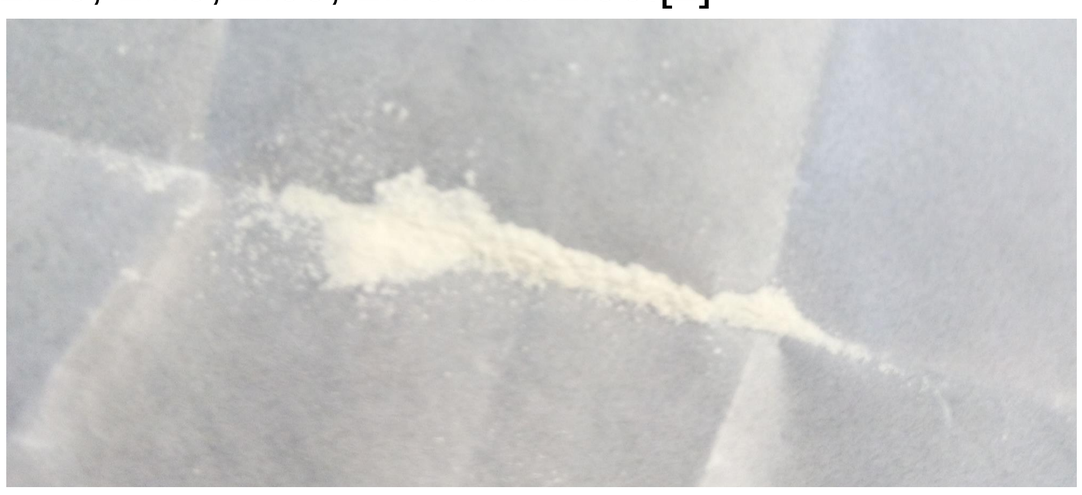
Introduction

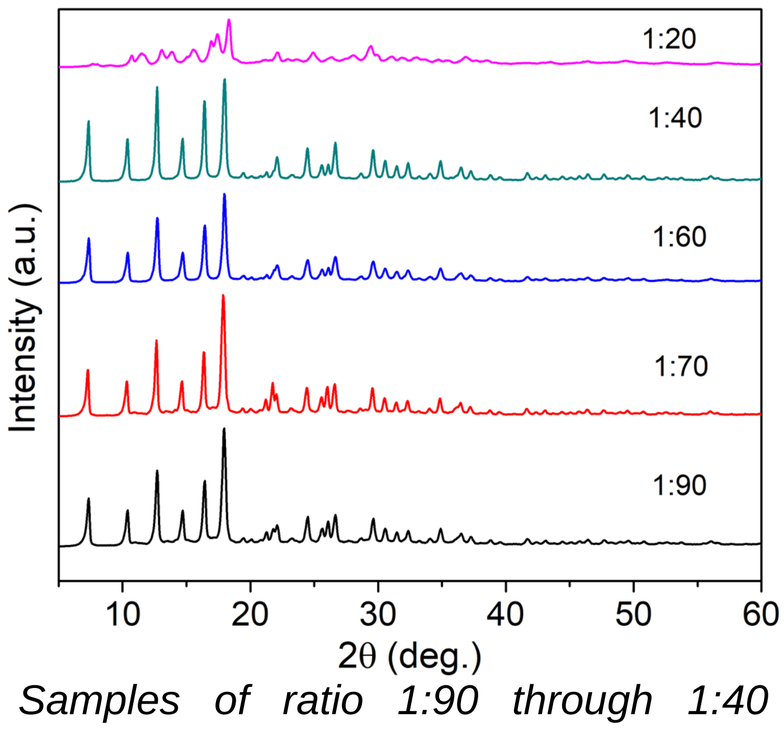
Carbon dioxide adsorption is implemented to remove excess carbon dioxide exhaled by the crew and replenish oxygen in the International Space Station.
Metal Organic Frameworks, MOFs, present promising candidates for CO_2 adsorption as a result of their high surface area and open crystalline structure.[1] The surface area of MOFs is typically higher than zeolites which are currently used to adsorb and concentrate CO_2. One class of MOFs is known as zeolitic imidazole 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 CO_2 adsorption. ZIF-8 as an adsorbent has shown promising capability to adsorb and concentrate CO_2.

Catalyst Synthesis

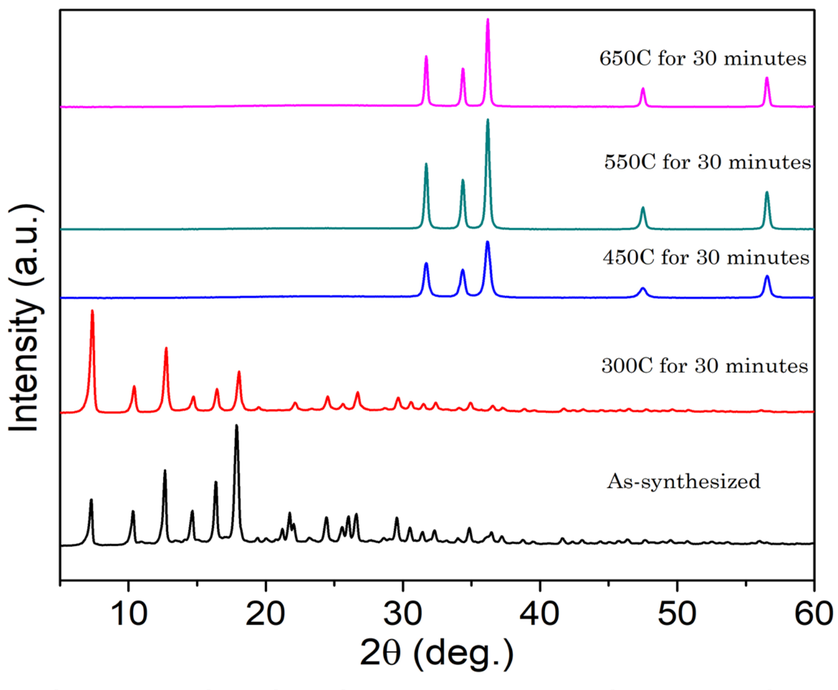
ZIF-8 was synthesized by mixing aqueous solutions of zinc nitrate hexahydrate and 2-methlimidazole. The mixture was centrifuged for 40 to 70 minutes, then washed 4 times with water. The residue was dried overnight at 65^oC. The amount of 2-methylimidazole was varied to give ratios of zinc to 2-methylimidazole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



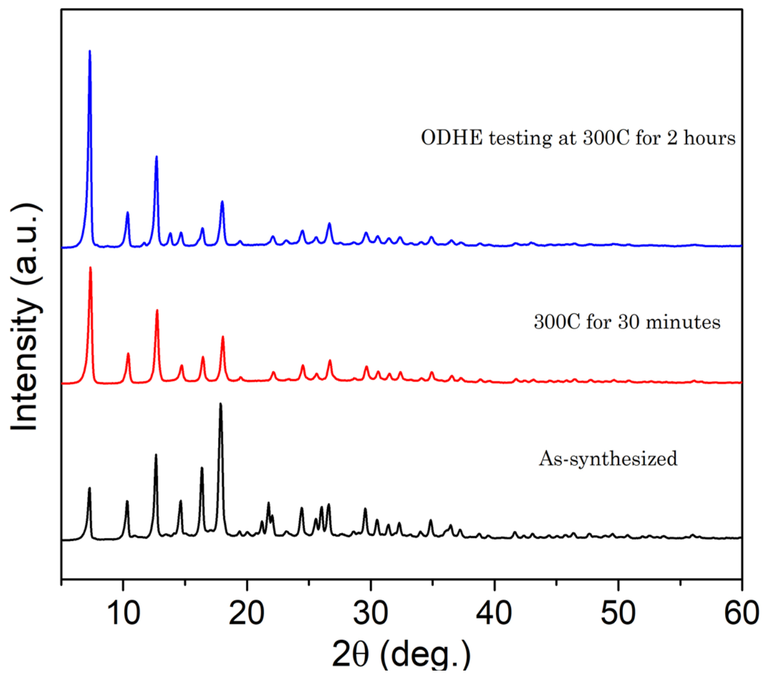
XRD Characterization



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.



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



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

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^o to 60^o at a rate of 1^o per minute.

Conclusions

- We successfully synthesized ZIF-8.
- The synthesized ZIF-8 exhibited thermal stability as high as 300^oC.

Future Work

- BET surface area characterization.
- Adsorption testing.

References

1) Zhang, Zj, et al. “Improvement of CO2 Adsorption on ZIF-8 Crystals Modified by Enhancing Basicity of Surface.” Chemical Engineering Science, 2011, 66, 4878–88, Doi: 10.1016/j.ces.2011.06.051.
2) Yichang Pan et al. "Rapid Synthesis of Zeolitic Imidazolate Framework-8 (ZIF-8) Nanocrystals in an Aqueous System." Chemical Communications, 2011,47, 2071-2073, Doi: 10.1039/C0CC05002D.

Acknowledgements

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