Synthesis of a Photo-induced Multifunctional Zr Based Metal-Organic Framework for CO2 Capture and Conversion

Al Marzooqi, Mansour (School: Riyadh School for Boys and Girls)

Carbon capture and conversion is one of the essential factors to reducing carbon dioxide (CO2) emissions and strengthening the economy. Current CO2 reducing catalysts face poor adsorption properties of CO2, thus decreasing their overall efficiency. In this project, the first metal-organic framework (MOF) has been synthesized to capture, store, and reduce CO2. A comparative study has been carried out between multiple MOF samples in addition to the optimum seeding method of cadmium sulfide (CdS) into the MOF clusters in order to incorporate the photocatalytic activity of the nanocomposite. MOF-808 has been selected due to the structural steadiness and was synthetically modified through pre-synthetic and post-synthetic alterations. A novel pre-synthetic modification was executed via thermal nano-particle solvothermal synthesis. Five further synthetic modification techniques were conducted, including physical etching of the MOF-808 with CdS to attempt clogging the pores of the MOF in a tuned way. The synthesized MOF was characterized using X-ray diffraction (PXRD) to determine its structural outcome. Then, it was analyzed using SEM, BET, UV-Vis, TGA. CO2 isotherms and electrochemical studies were performed. The MOF tested has shown a highly crystalline phase even after CdS addition, which was furtherly justified using the scanning electron imaging. After, chronoamperometry was tested under light illumination in order to understand the photocatalytic activity, giving a 0.9 mA under light exposure. The successful synthesis of the MOF-808/CdS could help in establishing a beneficial approach through recycling the carbon dioxide emissions, which will therefore aid in impeding fossil fuel drawbacks.

Awards Won:

Second Award of $2,000