



# Metal-Organic Frameworks for Drug Delivery



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## INTRODUCTION

- The Cancer is the uncontrollable division of cells that leads to tumors(2). When Cancer is present within the body, the natural levels of Glutathione (GSH) are elevated which progresses Cancer and tumors(2).
- Metal-organic frameworks (MOFs) are organic-inorganic hybrid crystalline porous material that consist of a regular array of positively charged metal ions surrounded by organic "linker" molecules(1). MOFs also contain a high surface area, and their structure makes them ideal for storage of different materials.

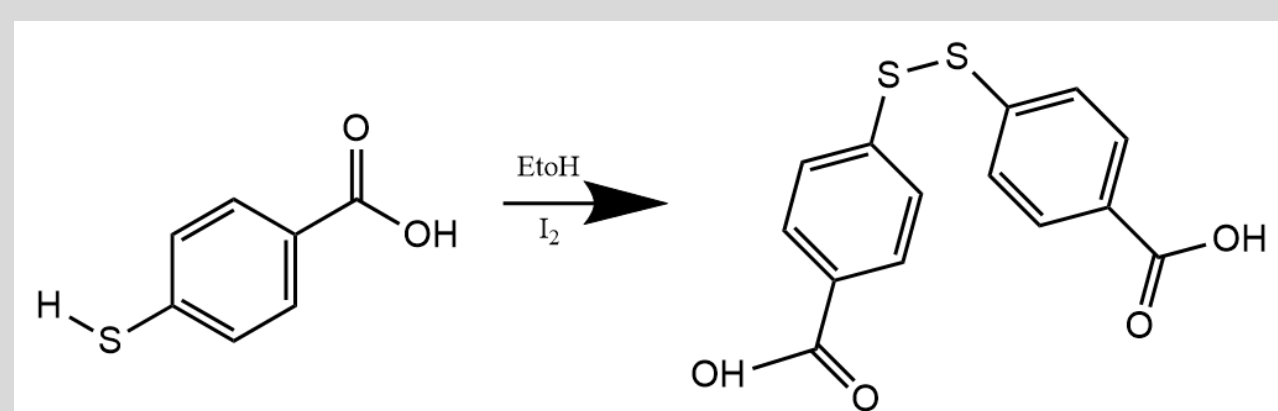


Figure 1 is the chemical structure of the MOF linkers

- The goal of this experiment is to create a MOF which reduces the cancerous cells directly to the area where the cancer is infected on the body(2). Chemotherapy is a non-specific drug therapy treatment that has side effects on physiology.

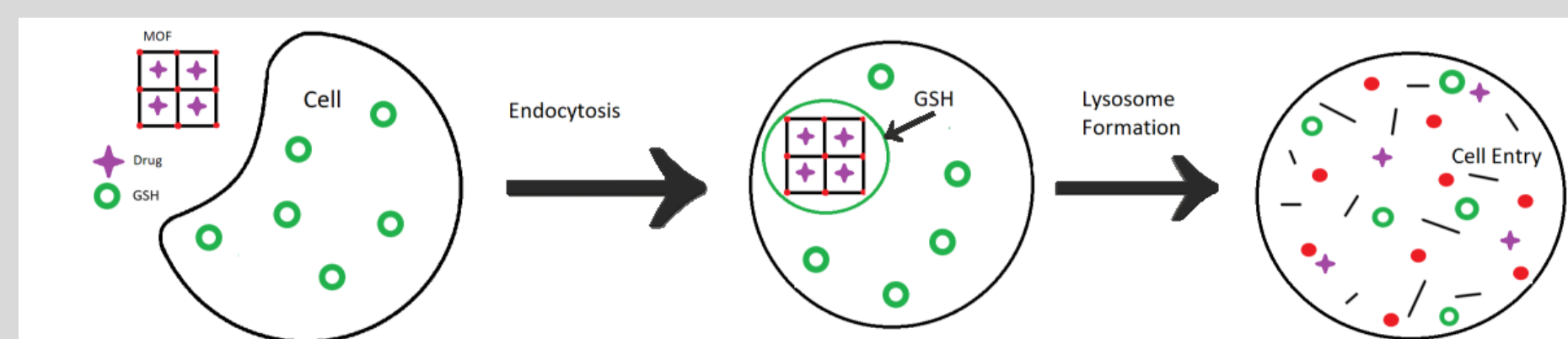


Figure 2 shows the MOF entering the cell and releasing the cancer fighting drug

## METHODS

The first part of the experiment focus on the synthesis of the ligand's solution (SPhCO<sub>2</sub>H)<sub>2</sub>. This was synthesized by using Iodine and 4-mercaptobenzoic acid with and ethanol rinse. After the synthesis of the ligand's, it was used to synthesize the Copper and Zinc MOF's. For the synthesis of both MOF's DI water was added to Cu(NO<sub>3</sub>)<sub>2</sub> \* 2.5H<sub>2</sub>O and Zn(NO<sub>3</sub>)<sub>2</sub> \* 6 H<sub>2</sub>O and Dimethylformamide (DMF) was added to the ligands in separate vials. After the vials containing each solution were mixed and HCl was added the vials were placed on a hotplate at 120°C for 20 hours. After the 20 hours the vials were filters using a vacuum filter and test were later conducted.

## RESULTS AND DISCUSSION

- The first experiment when trying to create a MOF resulted in failure. The first experiment involving the use of Copper ended in a failed experiment due to it being on the Hot Plate for longer than 20 hours, resulting in little product. No further testing could be conducted.
- The second experiment failed because instead of creating a Zinc based MOF the ligands had recrystallized. This could be caused by some errors during the synthesis.
- Thy synthesis of MOF's is unpredictable a difference reaction conditions can lead to the creation of a defects in the material.

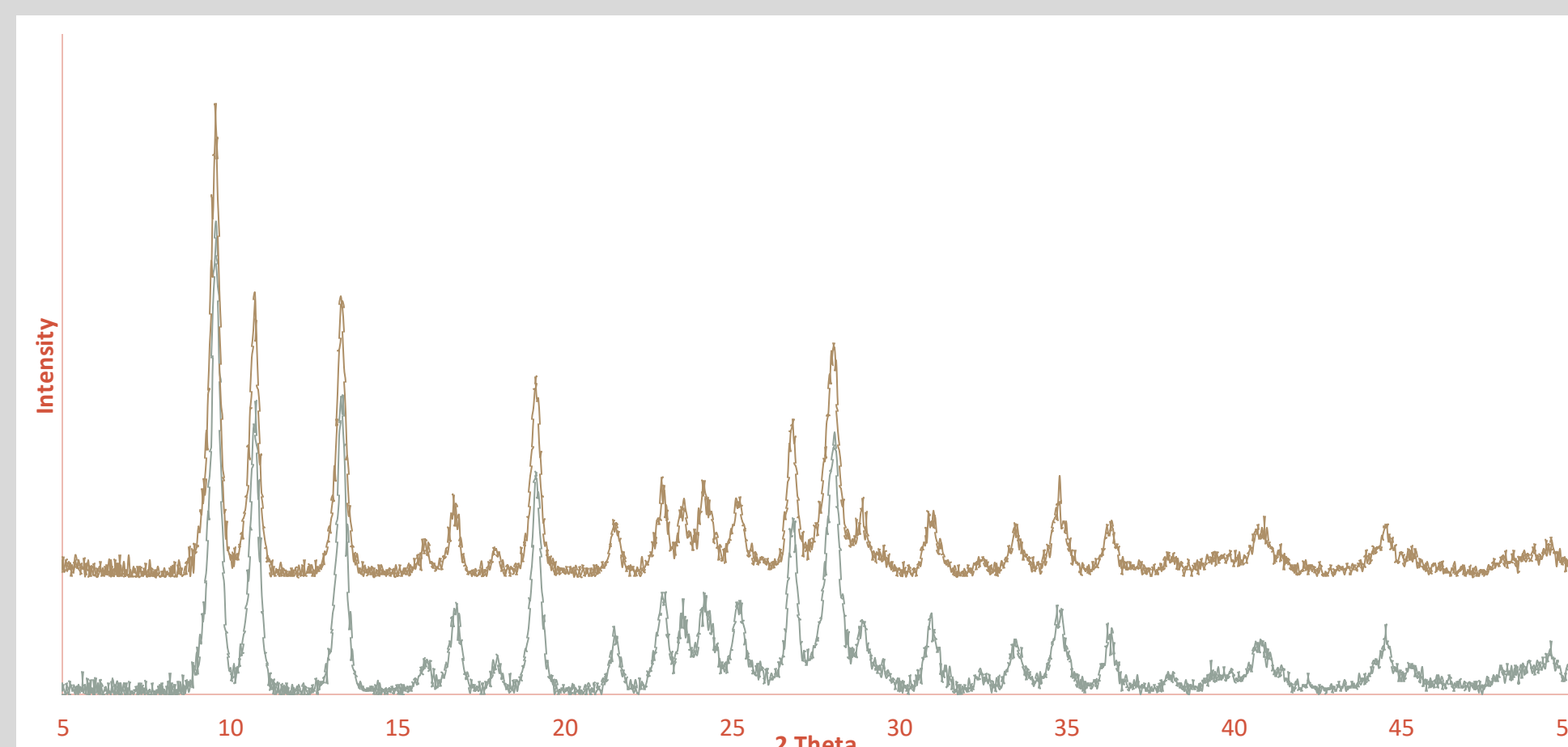


Figure 4 Powder X-ray diffraction pattern displaying the crystalline planes of Zinc MOF

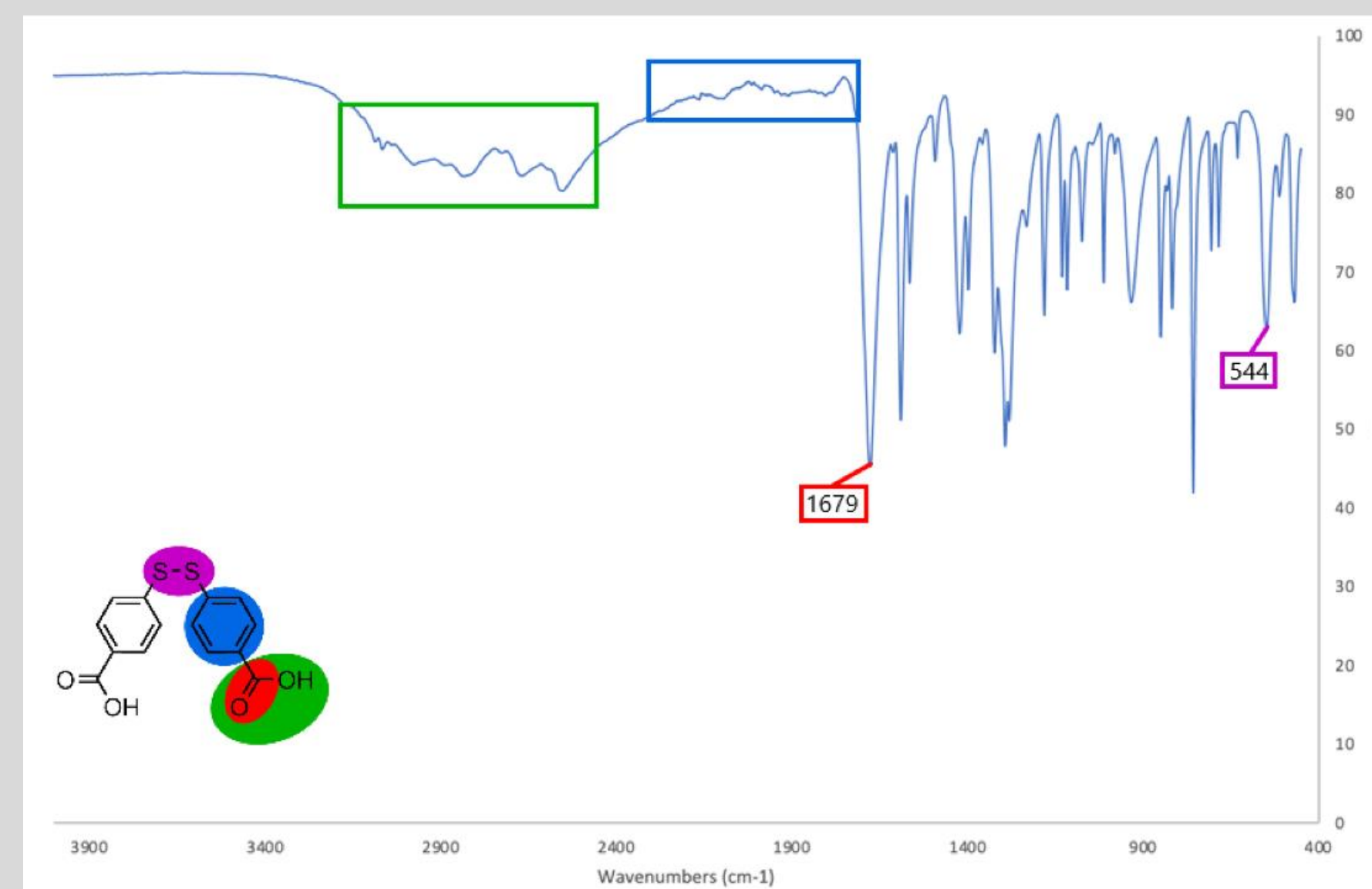


Figure 4 Fourier-transform infrared spectra of 4-mercaptobenzoic acid ligand

## IMAGE RESULTS

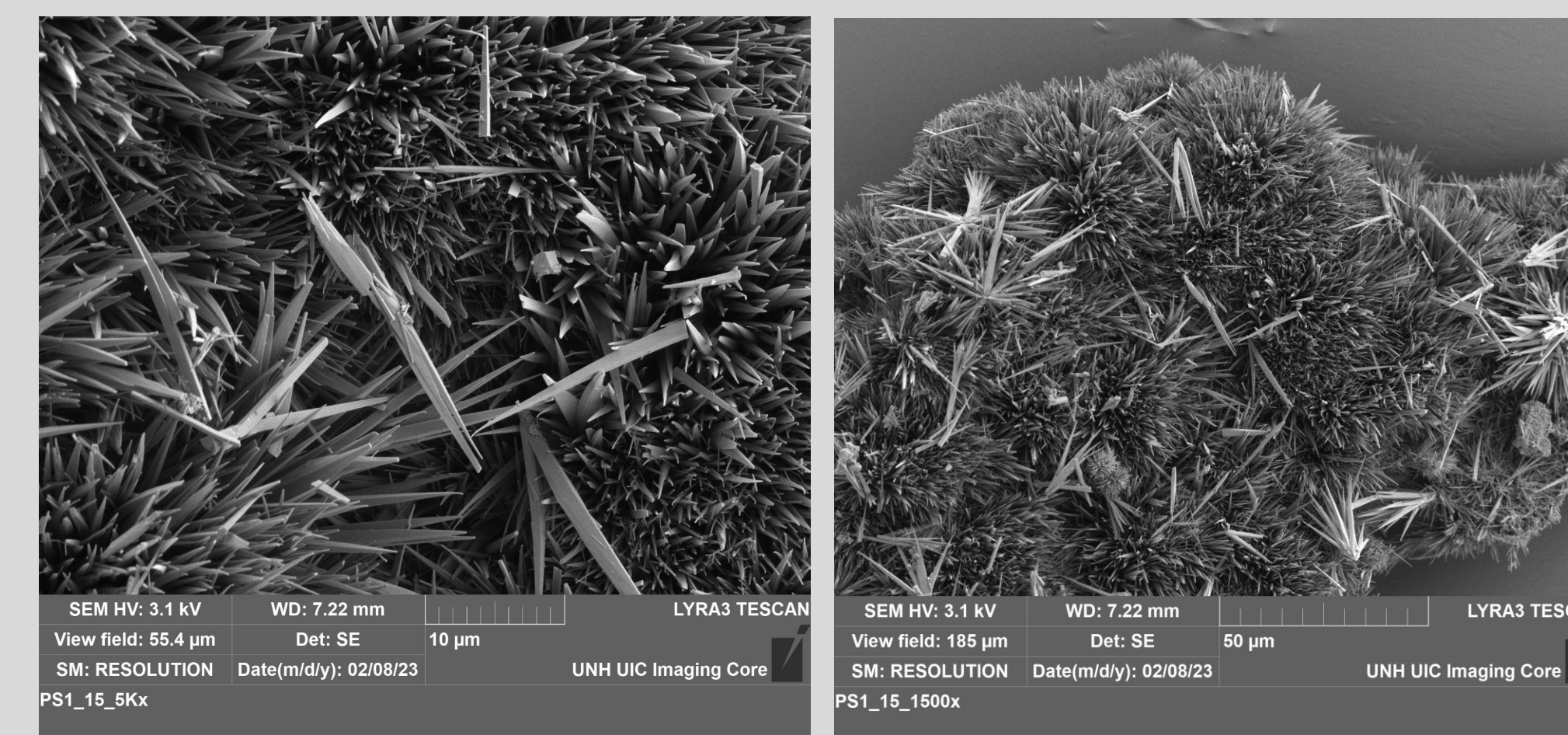


Figure 5 is a Scanning Electron Microscope analysis of the Zinc MOF

## FUTURE WORK

Current Cancer treatments are harsh and has devastating side effects. The use MOFs as a targeted treatment plan will reduce the risks that current cancer treatment has. The MOF targets the elevated Glutathione (GSH) in the cancer cell. The GSH breaks the disulfide bond which releases the drug inside. This new targeted treatment plan has the potential to save lives. If successful, this will create a better quality of life for cancer patients around the world.

## ACKNOWLEDGEMENTS

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## REFERENCES

- (1)ACS Publications: Chemistry Journals, Books, and References Published ... <https://pubs.acs.org/doi/10.1021/acs.inorgchem.7b03090>.
- (2) Kennedy, L., Sandhu, J. K., Harper, M.-E., & Cuperlovic-Culf, M. (2020, October 9). Role of glutathione in cancer: From mechanisms to therapies. Biomolecules. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7600400/#:~:text=Although%20in%20healthy%20cells%20it,increased%20resistance%20to%20chemotherapeutic%20drugs.>