Designing UiO-67 Metal-Organic Frameworks (MOFs) Loaded with Cadmium Sulfide Quantum Dots: Developing a pH-Responsive Drug Delivery System for Melanoma Treatment

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Metal-organic frameworks (MOFs), characterized by their porous, three-dimensional crystalline structure created by repeated organic linkers and inorganic nodes, have recently been introduced as a possible pH responsive drug delivery system. Such a system would have the potential to release toxic anti-cancer drugs in a selective manner, reducing the amount of healthy tissue that is generally killed during cancer treatments. Cadmium sulfide quantum dots (CdS QDs) are nanoparticles that have recently been found to damage cancer cells, specifically melanoma cells, extensively, leading to necrosis. The overall purpose of this project was to evaluate the pH responsiveness of a system comprised of MOFs with CdS QDs in their pores. It was hypothesized that the MOFs would release the greatest amount of drug in acidic conditions. To test this, UiO-67 MOFs were loaded with CdS QDs through a simple double-replacement reaction. X-ray powder diffraction (XRD) results indicated that the UiO-67 MOF without CdS QDs had 19 common peaks, supporting their crystalline structure. After loading the drug, however, the crystal structure seemed to have been partially damaged, as XRD results showed only 2 peaks and an irregular diffraction pattern. After characterization, pH release studies indicated that UiO-67 MOFs released the greatest amount of CdS QDs in an acidic pH of 6.0. Statistical analysis in the form of an ANOVA suggested strong statistical significance for the pH release study. The results of this experiment strongly support the use of MOFs loaded with CdS QDs as a selective anti-cancer pH responsive system.

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