Photophysical Properties of Anthracenic Metal Organic Frameworks

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Abstract: Luminescent metal organic frameworks (MOFs) are promising new materials with applications as sensors, photocatalysts, and other luminescent devices. Although MOFs retain the chemical and physical properties of their constituents, the properties of the MOF are often altered from those of its building blocks, making rational design and synthesis difficult.

Anthracene is a polyaromatic hydrocarbon whose photophysical properties have been found to be easily tuned through structural modifications. The tunability of anthracene makes it an ideal candidate for use in luminescent devices, such as photoprobes and organic light emitting diodes.

MOFs designed with π conjugated molecules like anthracene ligands possess similar photophysical properties such as absorption and fluorescence in the UV and visible spectrum. In hopes of better understanding how the photophysical properties of the organic ligand is altered upon incorporation into a MOF, the spectroscopic properties of anthracenedicarboxylic acids were studied before and after integration into zinc based MOFs.

Steady state and time resolved measurements were performed on three anthracenedicarboxylic acids: 9,10-anthracenedicarboxylic acid, 2,6-anthracendicarboxylic acid, and 1,4-anthracenedicarboxylic acid. The position of the carboxylic acid groups on anthracene was found to effect the position and structure of the absorption and emission spectra. The difference in the spectra is attributed to the

perturbation by the acid groups on certain electronic transitions with dipole moments across two of the three axes of anthracene. The position of the acid groups had different effects on the fluorescence quantum yields and lifetimes of the three anthracenic acids studied.

Two of the linkers were synthesized into MOFs through a solvothermal reaction with zinc nitrate, to form PCN-13, from 9,10-anthracenedicarboxylic acid, and [Zn(C16H8O4)(H2O)]n, from 2,6-anthracenedicarboxylic acid. The luminescent properties of the two MOFs were studied and compared to those of the free based linker. Incorporation of the luminescent anthracenedicarboxylic acids into Zn based MOFs were found to either increase or decrease the luminescent properties of the ligands.

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