Augmenting Gaseous Adsorption Capabilities via Nanoporous Cyclodextrin Metal-Organic Frameworks (CD-MOF) Synthesized with Alkali Coordinating Ions

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Metal-organic frameworks (MOF) have a unique ability to adsorb gases into their solid, porous matrix structure. While there are many possible combinations of MOF, cyclodextrin metal-organic frameworks (CD-MOF) are particularly easy to synthesize and test. The objective of this inquiry was to analyze the synthesis and gaseous adsorption capability of various CD-MOF crystallized with three different cyclodextrins (?-, ß-, and ?-CD) and four different alkali cations (sodium, potassium, rubidium, and caesium). The engineering impetus was to establish trends based on properties such as atomic radius and cyclodextrin pore size. While the CD type did have a noticeable impact on the crystallized yield and gaseous adsorption, the effect of the ions was based solely on the chemical compatibility of the cation with each specific CD, not any periodic trends. This can be attributed to the ions' ability to maximize ligand bonding with the CD's exterior hydroxyl groups. In terms of yield, the ?-CDMOF synthesized with caesium ions produced the largest crystal mass. The least massive were the ?-CDMOF, with the exception of the large crystals formed with rubidium ions. In contrast, the ?-CDMOF had the highest average values for the specific molar adsorption of sublimated carbon dioxide; the ?-CDMOF had the lowest values. Although the latter may have formed larger crystals, the ?-CDMOF is the most beneficial in the commercial world because it can physisorb larger quantities of carbon dioxide per gram. These CD-MOF are resourceful because they can significantly increase the amount of gases in storage without utilizing chemical means.

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