A Super Soaker for Greenhouse Gas: The Design and Synthesis of a Novel Metal Organic Framework for Adsorption and Storage of Gases like CO2

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According to NASA, 2015 is the warmest year since modern record keeping began. The majority of assessment models designed to mitigate global temperature rise above 2 degrees Celsius indicate that this constraint cannot be met without carbon capture and storage (CCS) technologies. However, most of the existing CCS technologies suffer from high costs, extensive infrastructure, and sideline emissions. Metal organic frameworks function as molecular sieving fibers that offer a greener method of filtering and storing CO2. In this study, a novel 2-(dimethylamino)terephthalic acid metal organic framework was designed and synthesized. The placement of amine groups along with hydroxyl groups in the chemical structure of the organic linker was functionalized through a reductive amination thereby increasing surface area. Through a solvothermal crystallization, repeated units of 2-(dimethylamino)terephthalic acid linker chemically bonded to zinc metal oxide groups for the stable extended 3-D crystalline structure. Porosity and surface area properties of the novel MOF were evaluated and demonstrated a high volumetric uptake of carbon dioxide of 930cm3/g (20wt%), which is significantly higher than the next best MOF, MOF-177 (10wt%), of 481cm3/g as well as a BET surface area of 1229 m2/g, surpassing many of the preceding MOF surface area discoveries such as MOF-5 and MOF-74. The novel MOF was also chemically stable in extreme heat, pressure, water, methane, and other constituents of flue gas. This robust crystalline structure is an imperative initial step in efficiently capturing and storing tons of carbon dioxide to be recycled into useful products such as cement, fertilizers, and fuel.

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