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Metal Organic Framework Hollow Fibers for CO2 adsorption and Chemical Warfare Agent Degradation

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MOFs are excellent candidates for the capture of CO2, in particular for the environmental control for life support systems in space suits and onboard the space shuttle. Traditionally, beads of lithium hydroxide, zeolites or polyamines have been employed for CO2 removal for the aforementioned applications. However, the use of beads can generate unfavorable large pressure drops. By employing a high CO2 capacitance material such as MOF-74 in a novel form factor such as a hollow fiber we have fabricated a composite with a higher than conventional CO2 capacitance that also alleviates large pressure drops. Using a customizable injection molding process developed in-house, we can control the dimensions of the hollow fiber (inner diameter, fiber wall, MOF loading) by tuning a combination of parameters both at the macroscopic and nano scales. With the ability to fine tune fiber dimensions and properties, the transport phenomena (CO2 vapor) through the fibers, and subsequently through fiber arrays can be precisely controlled. Our approach is sub divided into three aims and are as follows: 1) fiber dimensions can be controlled through a combination of nanoscale and macro scale parameter tuning, 2) tuning of the fiber dimension results in difference performance for mass transfer, and 3) multiple fibers can be bundled into an array resulting in an flow through the array that approximates laminar flow. The fibers resulting from these aims have been characterized by N2, CO2 adsorption, X-ray diffraction and diffuse reflectance infrared fourier transform spectroscopy (DRIFTS) in order to assess the structure-performance relationships of the fibers. The development of these metal organic framework hollow fibers have broad implications beyond filtration, and may serve as a lightweight alternative to conventional filtration media employed the across the defense, space and healthcare industries.

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