Development of A Bifunctional Desiccant Polymeric Nanofiber Membrane Based on CAU-10 MOF for Efficient Water Harvesting

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Metal-organic frameworks (MOFs), especially highly desiccant aluminum-based MOFs such as CAU-10, have garnered considerable attention for water harvesting due to their remarkable porosity and tunable properties. The main limitation is that pure CAU-10-H only absorbs at high humidity, while the amine-functionalized only works at low humidity. This project aims to develop and test a bifunctional double-layer system comprised of a hygroscopic polymeric CAU-10-H/NH2 layer, integrated with a photothermal polymeric Multi Walled Carbon Nanotubes (MWCNTs) layer to enhance atmospheric water harvesting. Various mixed linker CAU-10 systems were examined utilizing isophthalic and amino-isophthalic acid. Various ratios were used to optimize the amine ratio within the framework tuning pore size. XRD was used to confirm MOFs crystalline structure. A novel hygroscopic polymeric nanofibers membrane was fabricated through electrospinning doping of mixed linker CAU-10-H/NH2 with polyacrylonitrile (PAN). This create highly attractive sites and stability of rough nanofibers layer for increased water vapor capture selectively Additionally, for increased desorption, another photo-thermal layer composed of MWCNTs with PAN was synthesized to catch sunlight directly. For the performance aspect, water uptake has been measured throughout DVS device. The CAU-10-H/NH2@PAN@MWCNTs membrane exhibited enhanced water harvesting efficiency across a large spectrum of humidity levels with 200 L in low humidity, 280 L at medium humidity and 330 L at high humidity. This project has the potential to support humanity providing drinkable water for arid areas and some countries with limited access for fresh water, while cleaner water for green energy sources and cooling systems contributing to a greener future.

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