**TRACK-ETCHED MEMBRANE/ PVC@HKUST-1 ELECTROSPUN NANOCOMPOSITE MEMBRANE FOR CO2 CAPTURE**

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The escalating concentration of carbon dioxide (CO2) in the atmosphere, largely attributed to human activities such as fossil fuel combustion and industrial processes, is a primary driver of climate change. Mitigating the adverse impacts of rising CO2 levels necessitates effective capture and storage technologies [1]. Among various approaches, CO2 capture using membranes has garnered significant attention due to its potential for energy-efficient and scalable implementation [2]. In this context, metal-organic frameworks (MOFs) have emerged as a promising class of materials for membrane-based CO2 capture. MOFs are crystalline materials composed of metal ions or clusters coordinated to organic ligands, forming highly porous structures. These materials offer exceptional advantages for gas separation applications, including high surface area, tunable pore size, and functionalizable surfaces. The unique properties of MOFs enable selective adsorption and separation of CO2 from gas mixtures, making them ideal candidates for integration into membrane technologies. MOFs are an organic –inorganic hybrid material with ions coordinated by organic linker molecules [3]. It has been used as a sorbent due to its high porosity, high surface area, good thermal stability, excellent pore volume and regeneration ability. Among all the MOF, HKUST-1 is one of the most studied one. It contains Cu2+ ions coordinated to the oxygen atoms of benzene tricarboxylate (H-BTC) units [4].

In this work, we focused on the fabrication and characterization of a hybrid membrane based on poly(ethylene terephthalate) track-etched membranes (PET TeMs) and electrospun nanofibers. This membrane was used directly as an adsorbent material for CO2 capture. The HKUST-1 crystals were produced using the hydrothermal method. Nanofibers of PVC with MOFs were deposited on the PET TeMs surface using the electrospinning method. The nanofibre mats consisted of polyvinyl chloride with nanoscale HKUST-1. The crystals formed in the nanomats structure served as nucleation sites for the subsequent growth of MOFs on the surface of the hybrid membranes. The synthesized HKUST-1 samples were analyzed using various characterization techniques to examine and confirm their properties, such as thermogravimetric analysis (TGA), X-ray diffraction (XRD), scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDX), BET analysis, Fourier transform infrared spectroscopy (FT-IR) spectroscopy and contact angle measurement. The morphology of nanofibers affected strongly its ability to sorb dry CO2. The thickness of the obtained PVC@HKUST-1 layer was approximately 35 μm, while the TeMs thickness was 11 μm. All samples exhibited well-defined octahedrons with a particle size ranging from 3 to 7 µm. SEM images show that the layer formed by electrospinning adheres closely to the PET TeMs. X-ray diffraction patterns of the samples indicate that the original HKUST-1 powder has a cubic lattice with the space group Fm-3m. BET analysis results show a significant increase in surface area after HKUST-1 growth, from 1.97 to 135.26 m²/g and pore volume from 0.0079 to 0.014 cm3/g. TGA curves of the nanocomposite membranes show a three-step mass reduction. The first step is characterized by the removal of bound and free water forms. Then, at 210°C, dehydrochlorination of the PVC nanofibers occurs. In the temperature range from 300°C to 500°C, the structure of organic substances breaks down, followed by cyclization into aromatic compounds. Subsequently, the samples remained stable starting at 500°C as CuO. The adsorption test can be divided into two parts: degas and adsorption. Sorption and desorption were studied at different temperatures and for membranes with varying molar ratio Cu2+ and H-BTC. The samples demonstrated good CO2 capture performance, with an adsorption capacity of 1.4 mmol/g. CO2 adsorption performance could still retain up to 90% Additionally, this sample also showed excellent regenerative performance as it could be reused for at least 8 cycles with minimum drop in its adsorption capacity. Hence, membrane synthesized in this work is worth further study as potential sorbent for CO2 capture and storage

**References**

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