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Synthesis of Electrospun Polydimethylsiloxane (PDMS)/Polyvinylidene Fluoriure (PVDF) Nanofibrous Membranes for CO_2 Capture

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Abstract : Carbon dioxide emissions are expected to increase continuously, resulting in climate change and global warming. As a result, CO_2 capture has attracted a large amount of research attention. Among the various CO_2 capture methods, membrane technology has proven to be highly efficient in capturing CO_2, because it can be scaled up, low energy consumptions and small area requirements for use by the gas separation. Various nanofibrous membranes were successfully prepared by a simple electrospinning process. The membrane contactor combined with chemical absorption and membrane process in the post-combustion CO_2 capture is used in this study. In a membrane contactor system, the highly porous and water-repellent nanofibrous membranes were used as a gas-liquid interface in a membrane contactor system for CO_2 absorption. In this work, we successfully prepared the polyvinylidene fluoride (PVDF) porous membranes with an electrospinning process. Afterwards, the as-prepared water-repellent PVDF porous membranes were used for the CO_2 capture application. However, the pristine PVDF nanofibrous membranes were wetted by the amine absorbents, resulting in the decrease in the CO_2 absorption flux, the hydrophobic polydimethylsiloxane (PDMS) materials were added into the PVDF nanofibrous membranes to improve the solvent resistance of the membranes. To increase the hydrophobic properties and CO_2 absorption flux, more hydrophobic surfaces of the PDMS/PVDF nanofibrous membranes are obtained by the grafting of fluoroalkylsilane (FAS) on the membranes surface. Furthermore, the highest CO_2 absorption flux of the PDMS/PVDF nanofibrous membranes is reached after the FAS modification with four times. The PDMS/PVDF nanofibrous membranes with 60 wt% PDMS addition can be a long and continuous operation of the CO_2 absorption and regeneration experiments. It demonstrates the as-prepared PDMS/PVDF nanofibrous membranes could potentially be used for large-scale CO_2 absorption during the post-combustion process in power plants.

Keywords : CO_2 capture, electrospinning process, membrane contactor, nanofibrous membranes, PDMS/PVDF
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