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Morphological study of co-extruded dual-layer hollow fibre membranes incorporated with different TiO_2 loadings

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Abstract

Dual-layer hollow fibre (DLHF) membranes prepared via phase inversion based co-extrusion technique offer a number of advantages, such as self-supporting structure, high active surface area to volume ratio, easy fabrication and ability to withstand high operating pressure. This paper reports novel DLHF membranes fabricated via a single step co-extrusion technique with immobilized titanium dioxide (TiO_2) nanoparticles embedded in their outer layer. In this work, the DLHF membranes were prepared by extruding two different dope solutions simultaneously, in which the inner layer consisted of poly(vinylidene fluoride) (PVDF) and solvent N,N-dimethylacetamide (DMAc) while the outer layer was a mixture of PVDF, TiO_2 and DMAc. The effect of TiO_2 loading, where the mass fraction of TiO_2/PVDF was varied from 0 to 1, on the morphologies and properties of the DLHF membranes were investigated using scanning electron microscopy (SEM), contact angle goniometer, surface roughness and filtration experiments. The SEM results showed that DLHF membranes have a good interfacial adhesion between layers with no delamination found. The structure of the membranes, characterized by the length of their finger-like voids was significantly affected by the TiO_2 addition. The void lengths were elongated by the rise of the TiO_2 loading up to certain fraction of TiO_2/PVDF. Based on all the findings, it can be concluded that the