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Polyethyleneimine, an effective additive for polyethersulfone ultrafiltration membrane with enhanced permeability and selectivity

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Abstract: Ultrafiltration (UF) membrane with enhanced simultaneously permeability and selectivity is highly desired. This work reports that polyethyleneimine (PEI) can be used as an effective additive to achieve the objective by tailoring the morphology of polyethersulfone (PES) UF membrane. In order to understand the role of PEI on PES UF membrane formation, a series of membranes were prepared by adding different amount of PEI (0, 0.1, 0.3, 0.6, 0.9 wt%) to the casting solution. Field emission scanning electron microscope (FESEM) results indicate the introduction of PEI can essentially increase the pore density and thickness of skin layer. The results of filtration performance demonstrate that the permeability and selectivity of the resultant membranes can be improved simultaneously by optimizing the PEI content in the casting solution. When the PEI content was 0.3 wt%, the water flux reached a maximum standing at 359.0 L/m²h under 0.1 MPa, which is 35.9 times that of pure PES membrane. Meanwhile, the bovine serum albumin (BSA) rejection was at a relatively high point of 96.1%. The optimized membrane outperforms the commercial membrane with analogous characteristics on both water flux and molecular weight cut-off (MWCO) of polyethylene glycol (PEG). Moreover, the demixing evolution during non-solvent induced phase separation (NIPS) process was in-situ observed by using optical microscope and analyzed by UV-vis spectrophotometer. The effect of PEI on the morphology of PES membrane was elucidated and the membrane formation mechanism was proposed.

Keywords: Polyethersulfone, Polyethyleneimine, Ultrafiltration membrane, Phase separation, Permeability and selectivity.

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