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Fabrication of Layered Silica-Polysulfone Mixed Matrix Substrate Membrane for Enhancing Performance of Thin-film Composite Forward Osmosis Membrane

Xiao Liu and How Yong Ng*

Centre for Water Research, Department of Civil & Environmental Engineering, National University of Singapore, 1 Engineering Drive 2, E1A-07-03, Singapore 117576, Singapore

*Corresponding author. Tel: +65-65164777; Fax: +65-67791635

Email: howyongng@nus.edu.sg

Abstract

In order to mitigate the internal concentration polarization (ICP) phenomenon in the forward osmosis (FO) membranes, various strategies have been proposed to modify the substrate membrane layer before a final salt-rejecting active layer is deposited on the substrate membrane surface. One such strategy is the incorporation of nano-particles to produce mixed matrix membrane. However, such modifications on the substrate membranes would likely alter their top surface morphology and this in turn, would profoundly influence the subsequent process of active layer deposition via interfacial polymerization (IP) to form the resultant Thin-Film Composite (TFC) membrane. In the current work, we have comparatively studied the substrate membrane casting processes using a conventional single blade-casting and a facile double-blade co-casting technique for flat-sheet silica-polysulfone mixed matrix substrate membrane fabrication. A series of standardized characterization techniques, including ATR-FTIR, contact angle, zeta potential, pore size distribution, FESEM and EDX have been utilized to characterize the substrate membranes and resultant TFC-FO membranes. The co-casted mixed matrix membranes were demonstrated to have a layered configuration with enhanced structural features to mitigate ICP with the impregnation of nano-sized silica, yet retain an ideal, silica free top surface for the formation of an integral and highly salt-rejecting polyamide active layer. Overall the resultant TFC-FO membranes based on the double-blade casted mixed matrix substrate membranes showed improvement in water flux J_v with reduced apparent structural parameter, S

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