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Polymer-$Ti_3C_2T_x$ composite membranes to overcome the trade-off in solvent resistant nanofiltration for alcohol-based system

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Abstract

Solvent resistant nanofiltration (SRNF) technology is an energy efficient and environmentally friendly alternative to purify alcohol-based mixtures, but there exists a challenge in overcoming the trade-off between membrane flux and rejection. Herein, as the representative of the emerging family of MXenes, $Ti_3C_2T_x$ nanosheets with abundant –OH groups are chosen as nanofillers to prepare SRNF composite membrane after being incorporated into two typical polymer matrixes: hydrophilic polyethyleneimine (PEI) and hydrophobic polydimethylsiloxane (PDMS). Systematic characterizations and measurements suggest that the uniformly dispersed $Ti_3C_2T_x$ nanosheets enhance the thermal/mechanical stabilities and solvent resistance for both polymer-based membranes through steric effects and/or interfacial interactions. Besides, the horizontally-lied $Ti_3C_2T_x$ nanosheets give significant promotion on the transfer of alcohol molecules by providing additional pathways along nanosheet surface using –OH as adsorption site. Particularly, they afford improvements of alcohol flux as high as 30% to PEI-based membrane and 162% to PDMS-based