Production of cooling water by $Ti_3C_2T_x$ MXene interlayered forward osmosis membranes for post-combustion CO_2 capture system

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Abstract:

Forward osmosis (FO) technology has the potential to replace the trim cooler and to supply cooling water for a post-combustion CO_2 capture system. Herein, a high-performance MXene ($Ti_3C_2T_x$) interlayered FO membrane was fabricated. Thanks to the ability of MXene to adjust the structures of substrate and polyamide, the MXene interlayered FO (MXene-FO) membrane showed improved permeability and selectivity in a monoethanolamine (MEA) draw solution. The performance of MXene-FO membrane was investigated at different membrane orientations and temperatures with amino acid/salt (AAS) solutions (taurine/KOH and ß-alanine/KOH) as draw solutions. Because the osmotic pressures provided by AAS solutions (104.4 ± 0.3 bar for 3 mol/L taurine/KOH and 153.7 ± 0.2 bar for 5 mol/L ß-alanine/KOH solutions) are higher than that of 5 mol/L MEA solution (93.0 ± 0.1 bar), the MXene-FO membrane exhibited higher water fluxes in AAS solutions. Besides, the good performance of the MXene-FO membrane was shown with the presence of small specific amino acid fluxes and specific KOH fluxes. To investigate the feasibility of using saline water as the feed solution, 3.5 wt.% NaCl solution was applied and the results indicated that the MXene-FO membrane maintained stable water fluxes and small specific solute fluxes. This work demonstrates the potential of nanomaterials interlayered FO membranes for cooling water production in a post-combustion CO_2 capture system.

Keywords: forward osmosis; CO_2 capture; amino acid; draw solution; MXene