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Photothermal-enhanced and fouling-resistant membrane for solar-assisted membrane distillation

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Abstract

Membrane distillation (MD) has been gaining increasing attention as a promising alternative to the more conventional separation processes like distillation and reverse osmosis (RO), due to the higher rejection, lower fouling propensity and ability to treat water using low-quality waste heat. Hydrophobic membranes with high mass transfer and low heat conduction are desirable in direct contact membrane distillation (DCMD), and this contradicting transport properties, along with the chemical and thermal stability required, remains a challenge to date. Herein, we report a membrane modification strategy based on the array of functionalities conferred by emerging 2D materials. Specifically, the current effort targeted at investigating the potential of MXene, a novel 2D material with both photothermal and anti-fouling functionalities, as a coating to improve DCMD performance. Feeds containing bovine serum albumin (BSA) and sodium chloride (NaCl) were filtered through uncoated and MXene-coated PVDF membranes for 21 h, with results indicating a reduction of 12% of heater energy input per unit volume distillate, along with a reduction in flux decline in the range of 56 - 64%. This study demonstrated that MXene is a promising 2D material for improving the practical feasibility of MD.