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Facilitated water-selective permeation via PEGylation of graphene oxide membrane

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Abstract

Manipulating the chemical structure of GO interlayer channels is an efficient strategy to improve the selective molecular transport through the resultant GO membrane. In this work, PEGylation of GO membrane was performed to incorporate hydrophilic ether bonds into the interlayer channels in GO membrane for efficient separation of ethanol and water mixtures via pervaporation. Poly(ethylene glycol) diamines (PEGDA) was adopted as the intercalation molecule to covalently bond with GO through the reaction between amine and epoxy groups. Numerous ether bonds increase membrane hydrophilicity and promote water adsorption, while the covalent cross-linking confers the membrane robustness for operation, thus achieving an increase in separation factor and stability. On this basis, highly hydrophilic sodium alginate (SA) was then coated on the surface of PEGDA-GO composite membrane to further strengthen the adsorption of water molecules on the membrane surface. Compared with pristine graphene, the SA/PEGDA-GO membrane shows a concurrent enhancement in the permeation flux and separation factor. The sodium alginate coated PEGylated GO composite membrane possesses an exceptional pervaporation performance with the permeation flux of 3595 g m^{-2} h^{-1} and water purity in permeate of 98.5% under the conditions of 70 °C and water concentration in feed of 20 wt%. The membrane performance remains stable during a long-term operation test for 120 h at 70 °C.

[1] These two authors made equal contribution.