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Poly(sodium vinylsulfonate)/chitosan membranes with sulfonate ionic cross-linking and free sulfate groups: preparation and application in alcohol dehydration

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Abstract

Polyelectrolyte complexes with sulfonate ionic cross-linking and free sulfate groups were fabricated from chitosan (CS) and poly (sodium vinylsulfonate) (PVS) *via* the “complexation-sulfation” method. Homogenous membranes (S-PVS/CS PECMs) were prepared exhibiting both high flux and water selectivity in dehydrating various alcohols and the separation performance was proportional to the content of free sulfate groups. For example, in dehydrating 10 wt% water/ethanol mixture at 70 °C, the flux and water content in permeate for the S-PVS/CS-3 PECM was 1980 g/m²h and 99.55 wt%, respectively. Moreover, the separation performance was stable versus an operation time of 120 h and could dehydrate an azeotropic water/ethanol mixture to fuel grade ethanol. Fourier transform infrared spectroscopy, X-ray photoelectron spectroscopy, and ζ potential were employed to characterize chemical structures, compositions, and charge properties of S-PVS/CS PECs. Scanning electron microscopy and contact angle measurement were exploited to investigate the morphology and hydrophilicity of S-PVS/CS PECMs. In addition, swelling and sorption behavior of S-PVS/CS PECMs were determined to interpret separation performances.

Keywords: Pervaporation, Alcohol dehydration, Sulfonate ionic cross-linking, Free sulfate groups

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