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Improvement of poly(piperazine-amide) composite nanofiltration membranes by incorporating of hollow polypyrrole nanospheres with mesoporous shells

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ABSTRACT

Incorporation of nanospheres into membranes is a potential strategy to improve the performance of the nanofiltration membranes, including permeation/separation performance and antifouling performance. In this study, we used the hollow polypyrrole nanospheres with mesoporous shells as fillers in a selective layer to prepare poly(piperazine amide) composite nanofiltration membranes by interfacial polymerization. The effects of the hollow nanospheres with mesoporous shells on the physical properties of the membrane surfaces (water contact angle, zeta potential, and roughness), permeability, rejection of inorganic salts, and antifouling performance against humic acid were investigated. The incorporation of the hollow polypyrrole nanospheres increased permeability with a pure water flux increasing from 43.9 to 90.1 L m^{-2} h^{-1} at 0.5 MPa without a significant decrease in rejection. The rejection of modified membranes was up to 99.7% for Na_2SO_4, 99.4% for $MgSO_4$, 68.7% for $MgCl_2$, and 49.3% for NaCl. The antifouling property against humic acid was also improved owing to the increased hydrophilicity.

Keywords: Nanofiltration; Composite membrane; Mixed matrix membrane; Hollow nanosphere

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