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Abstract: Separation membranes with high perm-selectivity, good stability and anti-fouling properties are critical for water treatment and green chemical processing. We synthesized soft polymeric particles, zwitterionic nanogels (ZNGs), using a facile and straightforward surfactant-free emulsion polymerization. Novel thin-film nanocomposite membranes (TFNMs) containing ZNGs were prepared by interfacial polymerization using piperazine and trimesoyl chloride. The ZNG particles were well compactible with the polyamide membrane matrix, rendering high separation performance. Both the water permeability and solute selectivity, e. g., J_{H2O} = 106.3 $L.m^{-2}.h^{-1}.MPa^{-1}$, R_{Na2SO4} = 97.8 %, R_{NaCl} = 31.6 %, were increased compared to conventional polyamide thin-film membranes. The mechanism of this high performance was firstly studied in depth at molecular level with the positron annihilation spectroscopy. The existence of nanoscale pores in ZNGTFNMs provide preferential flow paths for water molecules, thus fostering the exceptional perm-selectivity coupled with remarkable stability and anti-fouling properties. Moreover, the as-prepared ZNGTFNMs were used for antibiotics desalination and concentration. For example, the antibiotic erythromycin content in mixed feed solution increases almost linearly from 100 to 360 mg L^{-1} (the value is 3.5 times higher than the original concentration) within 6 h continuous operation. Therefore, this ZNG embedded TFNMs exhibit great potential applications in water purification and salts/organics separation.

Keywords: Nanocomposite membrane; Separation; Polyamide; Zwitterionic nanogel; Pore structure

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