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Effect of post-polymerization anion-exchange on the rejection of uncharged aqueous solutes in nanoporous, ionic lyotropic liquid crystal polymer membranes

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Abstract

The selectivity of a bicontinuous cubic, lyotropic liquid crystal (LLC) polymer nanofiltration membrane containing uniform cationic nanopores was manipulated via anion-exchange at the pore wall by soaking the fabricated membranes in aqueous salt solutions. Monovalent organosulfonate anions of various sizes were completely exchanged as the counterion at the pore walls to explore the impact of anion size on uncharged molecular solute rejection and water permeance. It was found that larger organosulfonate anions associated at the pore walls induced a higher rejection of uncharged solutes and a lower water permeance. The change in selectivity of the nanopores was described quantitatively through the calculation of the effective pore radius. The effective pore radius in these modified membranes was found to vary from 0.9 ± 0.2 to 0.55 ± 0.08 nm depending on the resident organosulfonate anion, demonstrating sub-1-nm resolution in pore size manipulation. An empirical model was used to demonstrate that physicochemical properties (molecular volume and hydrophobicity) of the resident anion

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