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Development of Charge Mosaic Membranes with High Ionic Permselectivity and High Mechanical Strength (Ⅲ): Desalination Performance by Piezodialysis

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Summary

The aim of this study is to prepare CM membranes having enough mechanical strength and same size of the anion and cation domains in the membrane for high salt transport in piezodialysis. Hence, we have optimized the preparation conditions for the CM membranes prepared by alternatively laminating method, and then investigated desalination performance of the prepared CM membranes by piezodialysis.

Poly(vinyl alcohol) (PVA)-based cationic- and anionic-membranes were prepared by coating the two polymer mixture solutions: (1) poly(vinyl alcohol-*co*-2-acrylamido- 2-methylpropane sulfonic acid) (AP-2) with poly(vinyl alcohol) (PVA) (AMPS content in the mixture = 2 mol%), and (2) poly(diallyldimethyl-ammoniumchloride) (PDADMAC) with PVA (PDADMAC content = 50 wt%) on a plastic plate, respectively, and dried over a hot stage at 50°C for overnight. The base membranes were annealed at 160°C for 20 min, and further cross-linked by immersing it in glutaraldehyde solutions. The respective base membranes were then altenatively laminated, hot-pressed and thinly sliced vertically with the thickness of 150 μm to obtain the striped domain petterned thin film. The obtained thin film was chemically cross-linked and then used as a CM membrane. Water and salt transport behaviors through the CM membranes were investigated by osmotic-driven and hydraulic-presssure driven (piezodialysis) experiments.

The microscope observation cleared the thickness, d, and the length, L, of the cationic- and anionic-domains were almost same (d = 360 μm, L = 180 μm) by tuning the respective swelling degree as same. Osmotic-driven water flow experiment showed that the prepared CM membranes showed negative osmosis flow because of highly selective salt transport through the membrane. Furthermore, the CM membranes showed hydraulic pressure tolerance exceeding 0.3 MPa and better desalination performance than that of the previous commercial CM membrane, Desalton®, especially about the recovery ratio in piezodialysis experiment using 500 ppm NaCl aqueous solution. These results indicated that the PVA-based CM membranes have a potential as a piezodialysis membrane.