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Development of Charge Mosaic Membranes with High Ionic Permselectivity and High Mechanical Strength

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Summary

A charged-mosaic (CM) membrane is made up of parallel arrays of cation and anion exchange elements passing through the membrane. The membrane shows negative osmosis and permselectivity for electrolytes. The permselectivity for electrolytes through the CM membranes is desirable for the desalination of water or purification of biochemical materials or food additives. The aim of this study is to prepare CM membranes having enough mechanical strength to perform piezodialysis. A CM membrane was prepared by coating the two solutions of PVA-based polyanion: poly(vinyl alcohol-block-2-benzil sulfonic acid sodium salt) and polyanion: poly(vinyl benzene trimethyl ammonium chloride) on a support membrane. The membrane was annealed at 160°C for 30min, and further cross-linked by immersing it in glutaraldehyde solutions. The CM membrane was soaked in an aqueous solution of methyl violet for 24h to stain the the cation-exchange domain in violet color so that the thickness of the domain size could be measured by using a microscope. To determine permselectivity for electrolytes, permeation experiments were performed in a diffuion dialysis system consisting of a CM membrane and two aqueous solutions.

The cross section image of the CM membrane indicated that the thickness of the charged layer and the support membrane were 30 and 50 μm, respectively, and the surface image of the membrane showed that the width of cation- and anion-exchange layers were 1,600 and 360 μm, respectively. The permeation experiments of KCl and sucrose showed that the permselectivity for KCl through the CM membrane prepared in this study was about 6 times higher than that through Desalton®, which was prepared by a micro-phase separation method. The CM membrane showed high mechanical strength, and the ionic permselectivity will increase by optimizing the coating conditions and cross-linking conditions. Hence, the CM membrane will have potential application to desalination at low salt concentrations.