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Development of Hydrophilic Polymer Based Ion-Exchanged Membranes Having Nano-Order Charged Structure

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Summary

In this study, we have prepared cation-exchange membranes with high charge density and low electrical resistance by blending a hydrophilic polymer, poly(vinyl alcohol) and a polyanion, changing the polyanion content and the cross-linking conditions. The ionic transport properties of the membranes have been examined.

An aqueous solution of a mixture of poly(vinyl alcohol) and polyanion, AP-X was cast on a plastic plate to obtain a self-standing membrane. AP-X is a kind of PVA which contains 2 or 4 mol% of 2-acrylamido-2 -methylpropane sulfonic acid groups as a copolymer, and hence provided negatively-charged sites. The membrane obtained was annealed at 180 ^{o}C for 30 min. and cross-linked in a glutaraldehyde solution.

The water content of the membranes increases with the polyanion content, C_{PA} because the osmotic pressure in the membranes increases with increasing the number of the charged groups in the membranes. The water content of the membranes can be controlled by changing cross-linking conditions: annealing temperature and glutaraldehyde conditions.

The charge density of the membranes increases with C_{PA}, and has a maximum value. The charge density is defined as the division of the number of the charged groups by the water content. Since the water content increases with increasing C_{PA}, the charge density decreases after it has a maximum value. The higher is the annealing temperature, the higher maximum charged density the membranes have.

The membrane resistance decreases with increasing water content, and is independent of C_{PA} because the ionic path in the membranes increases with increasing water content. The data indicate that the membrane resistance can be estimated from the water content.

The membranes are prepared cheaply and have high mechanical strength. Although their ionic selectivity at high salt concentrations is inferior to commercial ion-exchange membranes, the membranes in this study will have potential application to the desalination of salt water.

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