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Development of Hydrophilic Polymer Based Ion-Exchanged Membranes Having Low Membrane Resistance

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Summary

Anion-exchange membranes with a semi-interpenetrating network structure were prepared by blending poly(vinyl alcohol) and a polycation in varying polycation ratios. The membranes obtained were physically cross-linked by annealing them at various temperatures and/or chemically cross-linked by reaction with glutaraldehyde aqueous solutions to obtain heterogenerously cross-linked structure in the membrane.

An aqueous solution of a mixture of poly(vinyl alcohol) and polycation, poly(diallyl dimethyl ammonium chloride) was cast on a plastic plate to obtain a self-standing membrane. The membrane obtained was annealed at 160 ^{o}C for 30 min. and cross-linked in a glutaraldehyde solution.

The water content of the membranes increases with the polycation content, C_{PC} 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_{PC}, 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_{PC}, 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_{PC}, because the ionic path in the membranes increases with increasing water content. The membranes are prepared cheaply and have high mechanical strength. The membranes have enough permselectivity for ions and have almost same value of membrane resistance as commercially available ion-exchange membranes with styrene-divinylbenezene matrix. Hence, the membranes in this study will have potential application to the desalination of salt water.