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Hydrophilic Matrix Composite Ion-Exchange Membranes with Low Resistance and High Permselectivity

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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, changing their cross-linking conditions.

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 to l cross-link the polymer chains physically. The membrane was cross-linked chemically with glutaraldehyde (GA) under the three different types of cross-linking processes: type A, cross-linking with a mixed aqueous solution of saturated Na_2SO_4 and GA solution; type B, cross-linking with 3 M NaCl and GA solution; type C, cross-linking with type B solution after cross-linking type A solution.

The water content of all 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, GA concentration and the types of the chemical cross-linking.

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 membrane resistance decreased and the dynamic transport number increased with increasing C_{PC}. The membranes with type A cross-linking have lower membrane resistance than those with type B cross-linking. The dynamic transport numbers of the latter membranes are higher than those of the former. The membranes cross-linked at high GA concentration have almost the same transport number as a commercially available anion-exchange membrane, AM-1 (Astom Co.).

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. Hence, the membranes in this study will have potential application to the desalination of salt water.