

Structural Modification of Ion Exchange Membranes and Relative Transport Number Between Ions with Same Charge in Electrodialysis

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Summary

Two methods were examined to prepare an anion exchange membrane with permselectivity to specific anions : 1) anion exchange membranes having various anion exchange groups with different hydrophobicity and 2) composite membrane prepared from an anion exchange membrane and polypyrrole.

1) The anion exchange membranes having various anion exchange groups were prepared by reaction of a membranous copolymer composed of chloromethylstyrene and divinylbenzene with various amines : trimethylamine, triethylamine, tri-n-propylamine, tri-n-butylamine and tri-n-pentylamine. The larger the molecular weight of the amines, the lower the ion exchange capacity of the membrane. Thus, the anion exchange membranes with various anion exchange groups were aminated further with trimethylamine.

The relative transport number of each membrane was measured in the systems : SO_4^{2-} and Cl^- , NO_3^- and Cl^- , Br^- and Cl^- and F^- and Cl^- . The relative transport numbers of nitrate ions and bromide ions against chloride ions increased markedly with increasing chain length of alkyl groups bonded to ammonium groups and the transport numbers of sulfate ions and fluoride ions against chloride ions decreased remarkably with increasing chain length of alkyl groups. After the membranes reacted with trimethylamine further, the remarkable change in the relative transport number weakened. There was strong interrelation between the degree of hydration of anions and the degree of hydrophobicity of the anion exchange groups of the membrane. Namely, the less hydrated anions compared with chloride ions permeated selectively through the membranes with the hydrophobic anion exchange groups, vice versa. This is a new method to control the relative transport number between anions.

Polypyrrole (one of conducting polymers) is doped or dedoped by immersing the polymer into the acid or alkali solution and changes the hydrophobicity. And as reported in the previous year, the anion exchange membrane have strong affinity for pyrrole. The relative transport number between various anions to chloride ions was evaluated using the composite membrane prepared from the anion exchange membrane and polypyrrole. However, the remarkable change in the relative transport number was not observed in doping or dedoping because the anion exchange membrane is basically hydrophilic. Several interesting results were observed in the composite membrane : enhancement of nitrate ion permselectivity against chloride ions, increase in the permeation of fluoride ions and decrease in the permeation of bromide ions.