

Uphill Transport Across a Charged Membrane in Multi-component Ion System

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Summary

Uphill transport of ions across a charged membrane has to be continued to play an important role for the industrial application of membrane such as the recovery of heavy metals from sea and industrial waste water. Ion flux through membrane is functions of the ion concentration, membrane charge density, ion mobility and the valence of ion. These parameters are strongly affected by the ion and water states in the membrane. In this study dielectric constant of water-swollen gel membrane was investigated to understand the state of water and ion.

Membranes which were used in this measurement were commercial porous membranes composed of PTFE, Polycarbonate, Polypropylene, Cellulose acetate and Cellulose nitrate, and Poly(vinyl alcohol) dense membrane. PVA membranes were prepared from casting the 7wt% aqueous solution of PVA(Wako Chemical, D.P.2000) at 25°C. As-cast film was crosslinked and/or annealed to control the absorbed watercontent. Aqueous electrolyte solutions were used with KCl, HCl and KOH. Dielectric measurements were carried out with a couple of measurement cells made of glass having two Pt-C electrodes and impedance analyzer(Yokogawa Hewlett Packard 4192A LF) operating in the range of 5Hz to 13MHz. Relative permittivity and conductivity were determened by the theory on the dielectric relaxation of the interfacial polarization. It was pointed out that this method was more effective to the membranes which were dense or hydrophobic and having small pores than those consisting of comparatively large pores. For PVA membrane the permittivity increases and conductivity decreases abruptly with decrease of degree of hydration(D.H.) below 0.4. Since general theory of two phase mixtures of permittivities such as Bruggeman's one can not be applied for PVA membrane, it is considered that water state is not uniform in PVA membrane from the view point of dielectric properties. If PVA gel membrane is regarded as three phase mixture which consist of polymer, free water and boudary water, permittivity of boudary water can be calculated by estimating the water content.