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Interactions of Hydrated Species in Transport Across Membranes

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The conductance and resistance phenomenological coefficients in the flow equations of non-equilibrium thermodynamics are expressed as a function of hydration numbers of species permeating through a membrane. The significance of hydration on values of friction and coupling coefficients is demonstrated employing experimental data for the system $NaCl_{aq}$/perfluorinated Nafion 120 membrane.

In den Transportgleichungen der irreversiblen Thermodynamik wurden die phänomenologischen Leitfähigkeits- und Widerstandskoeffizienten als Funktion der Hydratationszahlen der durch eine Membrane transportierten Komponenten ausgedrückt. Die Versuchsergebnisse für das System $NaCl_{aq}$/Nafion 120-Membran weisen auf den Einfluß der Hydratation auf die Reibungs- und Kopplungskoeffizienten hin.

Introduction

One of the fundamental treatments of mass transport processes in membranes is Spiegler's frictional model based on the principle of a balance between thermodynamic forces acting on the system and frictional interactions between the components of the system [1].

The main advantage of this model is that it can characterize the interactions between all pairs of components, including a membrane, through so-called resistance coefficients r_{ik} and friction coefficients f_{ik}.

The frictional model has been used by many authors [2–7] to describe the transport of electrolyte solutions through membranes, but as yet they treated the unhydrated ions as one component and the total water present as another. As hydration of ions (or other solutes) can occur, such resistance and friction coefficients may differ from the coefficients describing interactions between hydrated and unhydrated species and water – real components of a system.