Transport in Proton Exchange Membranes for Fuel Cell Applications – A Systematic Non-Equilibrium Approach

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We hypothesize that the properties of proton-exchange membranes for fuel cell applications cannot be described unambiguously unless interface effects are taken into account. In order to prove this, we first develop a thermodynamically consistent description of the transport properties in membranes, both for a homogeneous membrane and for a homogeneous membrane with two surface layers in contact with electrodes or holder material. For each subsystem, homogeneous membrane and the two surface layers, we limit ourselves to 4 parameters as the system as a whole is considered isothermal here. We subsequently analyze the experimental results on some standard membranes as have appeared in the literature and analyze these using the two different descriptions. This analysis yields relatively well-defined values for the homogeneous membrane parameters and estimates for those of the surface layers and hence supports our hypothesis. As demonstrated, the method as used here allows for a critical evaluation of literature values. Moreover, it allows for a description of stacked transport systems such as proton-exchange membrane fuel cell units where interfacial layers, such as between catalyst and membrane, are taken into account.

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