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Diffusion-limited current to an ion-selective membrane: The role of water splitting and an extended space charge region CHRISTOFFER P. NIELSEN, HENRIK BRUUS, Department of Physics, Technical University of Denmark, DENMARK — The study of ion-transport across an ion-selective membrane or to an ion-selective surface has found numerous applications in e.g. dialysis, desalination and electrochemistry. The classical 1D LEN (Local Electroneutrality) modeling of the problem has however proven to fall short in many ways, since neither the effect of a finite space charge or the influence of water ions (hydronium and hydroxide) is accounted for in this model. In this work we use a simple model assuming local equilibrium of the water dissociation reaction to model salt and water-ion transport across an ion-selective membrane. The developed numerical and analytical models include the effect of an extended space charge region, and yield current voltage curves and water-ion current versus salt ion current curves which are in qualitative agreement with experimental results. As a result of the analysis a number of simple scaling laws are derived. These are useful for characterizing systems with concentration polarization and allow for easy experimental testing of the model.

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