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COMPUTATION OF MASS TRANSPORT IN STAGNANT ELECTROLYTIC SYSTEMS

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Abstract. Mass transport in convection-free electrolytic systems occurs via diffusion and electromigration. Primary electromigration is driven by an encompassing electrical potential gradient often produced by separation of half-cell electrodes. However, variations in the mobility and charge of dissolved ionic species induce the formation of a net solution charge density that drives diffusion potential electromigration. An electrolyte mass transport model has been developed which accounts for transport via inter-coupled electromigration-diffusion and charge density. When solved numerically, the model closely predicts the experimental observations of Fu and Chan [9]. The validated model is then used to determine the effect of diffusion potential electromigration on mass transport in stagnant electrolytic systems.
Keywords. Electromigration, diffusion potential, current density, diffusion, potential gradient.
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1. Introduction

Mass transport in electrolytic systems is a widely applicable science, the importance of which is recognized in the fundamental modelling of macroscopic and microscopic corrosion processes, power generation via fuel cells, ion exchange technology, and industrial electrochemical processes. Continuous mathematical theory can be derived from fundamental transport laws to describe electrochemical mass transport phenomena, which is driven by gradients of electrochemical potential and pressure. In this work, the fundamental laws of electrochemical mass transport are used to construct a mass conservation statement describing the one-dimensional transport of anions and cations in a small diameter tube filled with a stagnant aqueous electrolyte under the influence of an applied electrical current. Validation of the model is achieved through comparison with the experimental work of Fu and Chan [9].

In the absence of activity gradients, electromigration is driven solely by a potential differential between anode and cathode. The movement of ions via an electrical potential gradient induces activity and conductivity gradients in the