

MULTIPLICITY OF THE STEADY STATE SOLUTIONS TO THE BUTLER-VOLMER EQUATION

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We study the mathematical model of the Li⁺ ions' intercalation from the electrolyte into the porous graphite surface of the negatively charged electrode, proposed in [1]-[2]:

$$\frac{d\theta}{\partial t} = \frac{i_{ref}^0}{F \cdot C_{max}} \cdot \left[(1 - \theta) - \theta \cdot \exp\left(\frac{F}{RT}(V - U^0 + S(\theta))\right) \right] \cdot \exp\left(-\frac{1}{2} \frac{F}{RT}(V - U^0 + S(\theta))\right). \quad (1)$$

Here $\theta=\theta(t)$ is the Li⁺ ion concentration at the electrode surface; it is normalized to its theoretically maximal value C_{max} . We replace the 6-th degree polynome $S(\theta)$, which was introduced in [1]-[2] for approximation of the experimental data with the cubic polynome, which approximates better the same set of data and yeilds multiplicity of the steady state solutions to (1) in a certain range of the electrode potential V . This multiplicity may be explained by the simultaneous existence of several phases at the graphite electrode surface [3]-[4]. We prove that for all reasonable initial data the time-dependent solution to (1) is bounded and is attracted to one of the stable steady state solutions. We investigate numerically the time-dependent solutions to (1) with various initial data and demonstrate such experimentally observed phenomena as hysteresis, appearence and disappearance of the stable steady states of the electrode surface depending on the applied electric potential.

Литература.

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