SPATIALLY NON-UNIFORMAL STATIONARY SOLUTIONS IN A MODEL OF ELECTROCHEMICAL DIFFUSIVE LAYER

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We study a mathematical model of electrochemical processes that take place at the cathode and in the adjacent electrolyte diffusive layer [1]. The transport of positive ions [2] that discharge at the cathode after adsorption, is considered:

$$\frac{\partial c}{\partial t}(t,x) = D\frac{\partial}{\partial x}\left(\frac{\partial c}{\partial x} + \frac{zF}{RT}c(t,x)\frac{\partial \varphi}{\partial x}\right); \quad \frac{\partial c}{\partial x}(t,\delta) = 0;$$

$$\frac{\partial^2 \varphi}{\partial x^2}(t,x) = -\frac{F}{\varepsilon_0 \varepsilon}c(t,x); \quad \varphi(t,0) = \varphi_0; \quad \frac{\partial \varphi}{\partial x}(t,\delta) = 0;$$

$$\frac{d\theta}{dt}(t) = k_a \cdot c(t,0)\cdot(1-\theta)^2 - k_d\theta - k_e\theta.$$

We prove that this model possesses a family of stationary solutions (c*,φ*,θ*):

$$c^*(x) = c^*(0)\cdot\left(1 + tg^2\left(\sqrt{\frac{\alpha\beta}{2}}\left|c^*(0)\right| x\right)\right); \varphi^*(x) = \varphi_0 - \frac{1}{\alpha}\cdot\ln\left(1 + tg^2\left(\sqrt{\frac{\alpha\beta}{2}}\left|c^*(0)\right| x\right)\right);$$

$$0 = k_a \cdot c^*(0)\cdot(1-\theta^*)^2 - (k_d + k_e)\theta^*; \quad \alpha = \frac{zF}{RT}; \quad \beta = \frac{zF}{\varepsilon_0\varepsilon}.$$

Linearization of the original system in the vicinity of (c*,φ*,θ*) makes it possible to find the stability conditions for these spatially non-uniformal time-invariant solutions.

Литература.

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