Numerical approximations of radially symmetric and selfsimilar solutions of the Nernst-Planck-Debye system

Łukasz Paszkowski

Institute of Mathematics, University of Wrocław

paszkowski.lukasz@wp.pl

We consider the following 2-component Nernst-Planck-Debye system

$$\begin{aligned} u_t &= \Delta u + \nabla \cdot \left(u \nabla \phi_{v-u}\right) \quad \text{na} \quad \Omega \times \mathbb{R}^+, \\ v_t &= \Delta v - \nabla \cdot \left(v \nabla \phi_{v-u}\right) \quad \text{na} \quad \Omega \times \mathbb{R}^+, \\ \phi_{v-u} &= E_n * (v-u) \quad \text{na} \quad \Omega. \end{aligned}$$

This PDEs model describes process of the electrodiffusion, where u, v characterize the density of negatively and positively charged particles, respectively. The function ϕ is an electrical potential generated by particles. Apart from the electrochemistry, a similar model exists in the semiconductors theory, where u, v describe the density of charge carriers, e.g. electrons and holes.

Due to the common occurrence in the nature of particles charged electrically, computer simulations of solutions to Nernst-Planck equations play an important role in chemistry, electrochemistry and biology. We shall present some numerical experiments concerning symmetric and selfsimilar solutions to this model.