Moving boundary problems describing osmosis: Modelling, well-posedness, stability

Georg Prokert

TU Eindhoven, Faculty of Mathematics and Computer Science, The Netherlands
g.prokert@tue.nl

The talk is based on joint work with F. Lippoth, Leibniz Universität Hannover, and M.A. Peletier, TU Eindhoven.

Session: 23. Nonlinear Evolution Equations and their Applications

We discuss a moving boundary problem describing the motion of a closed, semi-permeable membrane separating two phases of a salt solution. The motion is driven by osmotic pressure and surface tension. By transformation to a fixed reference domain, the problem takes the form of a fully nonlinear, coupled system of evolution equations inside the domain and on its boundary. Its linearization is a parabolic system with boundary conditions of relaxation type in the sense of Denk, Prüss, and Zacher. By application of corresponding maximal regularity results, we show the existence of classical solutions for short time and, using spectral analysis, global existence and normal stability of the manifold of stationary solutions.

The problem has a variational structure as generalized gradient flow with the sum of entropy and surface area playing the role of free energy. We use this idea to generalize our model to include slow viscous flow of the solvent.