Evolution of Bubbles in a Ternary Liquid

Wolfgang Dreyer
Weierstrass Institute for Applied Analysis und Stochastics
Mohrenstraße 39, 10117 Berlin
Email: dreyer@wias-berlin.de

We study a liquid mixture consisting of H_2O, CO_2, CH_3OH under conditions so that a vapour phase in form of bubbles may coexist with the liquid.

This problem occurs in direct methanol fuel cells, where the appearance of bubbles might lead to a serious failure of the cell if bubble sizes become possible that prevent a stationary flow of the liquid.

In this lecture we consider a liquid at rest, and we determine the crucial thermodynamic parameters and boundary conditions which control the size of a single bubble. In the literature on this subject, it is often stated that classical thermodynamic laws are not sufficient to determine the equilibria of a two-phase system with more than two constituents, so that a new axiom is needed for uniqueness of the problem. In contrast to this kind of modelling we prefer to remain within classical thermodynamics.

Next we give a summary on the diffusion problem in the vicinity of a bubble, and in particular we discuss a generalized Stefan condition.

Finally we calculate stationary nucleation rates of bubbles for various surroundings.