Krajowa Konferencja Zastosowań Matematyki w Biologii i Medycynie

Sandomierz, 5th–9th September 2016

INTERFEROMETRIC ANALYSIS OF DIFFUSION IN THE SYSTEM WITH THE FREE PHASE BOUNDARY

Sławomir Wąsik[1,†], Michał Arabski[2], Marcin Drabik[1], Kazimierz Dworecki[1], Tadeusz Kosztołowicz[1], Katarzyna D. Lewandowska[3], Jacek Semaniak[1], Andrzej Ślęzak[4]

[1]Institutie of Physics, Jan Kochanowski University
ul. Świętokrzyska 15, 25-406 Kielce
[2]Institutie of Biology, Jan Kochanowski University
ul. Świętokrzyska 15, 25-406 Kielce
[3]Department of Radiological Informatics and Statistics, Medical University of Gdańsk
ul. Tuwima 15, 80-210 Gdańsk
[4]Institute of Health and Nutrition Sciences, Technical University of Częstochowa
ul. Armii Krajowej 36B, 42-200 Częstochowa
[†]s.wasik@ujk.edu.pl

ABSTRACT

The transport processes of substances through the membranes separating two solutions play a key role in the functioning of artificial and biological systems. Diffusive transport is the subject of experimental research carried out by numerous methods, and for its description can be applied different theoretical approaches. A major problem in the theoretical description is the formulation of the appropriate boundary conditions. Useful in the testing of theoretical models of the membrane transport is construction a suitable control system without the barrier separating the solutions.

Comparative analysis of the diffusion which occurs in the systems with and without the membrane allows to specify the appropriate boundary conditions imposed by the membrane. It also enables to investigate the effect of the membrane itself on the transport in the system. Such studies are relatively easy to carry out in gel systems, however in systems with different liquid solutions the difficulty is in the elimination of hydrodynamic instabilities related to the filling of the system, which disturb its state.

Presented results concern interferometric analysis of diffusion with the free phase boundary (no membrane) using miscible solutions. For this purpose a modified measurement system which overcomes the hydrodynamic disturbances at the initial instant, and a Mach-Zehnder interferometer coupled to the image processing computer system was used. The diffusion of ethanol released from an aqueous solution of concentration 0.125M to the pure water with the time interval of 120 seconds was tested. Spatio-temporal distributions concentration were obtained on the basis of which were determined the evolution of concentration boundary layers and the evolution of the concentration field at different distances from the phase interface. Such parameters as the amount and the fluxes of transported substances, and the diffusion coefficient of the substance in water were also determined.

ACKNOWLEDGEMENTS

This work was supported by BS UJK grant no. 612414.