EXPERIMENTAL INVESTIGATION OF ANOMALOUS DIFFUSION IN HYDROGEL-MEMBRANE SYSTEM

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We study diffusion in a membrane system consisting of two cells separated by a horizontally located polymer membrane. We have filled the upper cuvette of the membrane system with an aqueous solution of glucose (in a gel form) while in the lower one there has been water gel. We follow the diffusion process of glucose in agarose hydrogel for different agarose gel concentrations ranging from 0.5% to 3%. The structure of agarose hydrogels was earlier found by means of the atomic force microscopy method (AFM).

The diffusion can be characterised by a time evolution of the so-called near-membrane layer (NML), where the concentration of diffusing substance drops *k* times [1]. When the thickness of NML, grows in time as t^{γ} with $\gamma=0.5$ we deal with normal or gaussian diffusion. If $\gamma>0.5$ there is a superdiffusion and when $\gamma<0.5$ we have a subdiffusive behaviour [2]. To observe the time evolution of NML we have employed the laser interferometric technique: the interference fringes pattern has provided quantitative measurement of the substance concentration $C(x,t)$ at position x and at time t. Recording the interferograms with a given time step, we have constructed the profile of glucose concentration. A very good test to check whether the diffusion process is subdiffusive, normal, or superdiffusive is to test how various concentrations profiles at different times scale.

Our results show that the thickness of NML grows in time t as t^{γ}, with $\gamma<0.5$, manifesting a subdiffusive character of the transport process in hydrogels with concentration of the agarose larger than 0.5%. Analysis of the AFM images indicate that these one are much more pores in the 1% gel than in the 3% one. We observe that the diffusion exponent γ decreases with increasing agarose concentration. The concentration profiles $C(x,t)$ obtained experimentally obey the scaling, $t^{\beta}(F(x/t^{\gamma}))$, where the exponents β, and γ are fixed.

[1] K. Dworecki, S. Wąsik, Ślęzak, *Physica A*, **326** (2003) 360
[2] T. Kosztołowicz, K. Dworecki, St. Mrówczyński, *Phys. Rev. Lett*., **94** (2005) 170602