Measurement of diffusion of atmospheric gases in a liquid perfluorocompound by means of optical technique

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Diffusion of gas molecules dissolved in the liquid bulk is the problem that is rarely addressed experimentally, mainly due to a difficulty in sensing the presence of dissolved gas and quantifying its concentration. Approaches which are typically used to overcome the problem include either indirect methods (e.g. based on the gas dissolution kinetics [1]), or newly developed complicated sensing techniques [2].

Assessing the diffusion of gases in liquid might be needed for different reasons, for example, it is a limiting factor affecting bubble formation and growth in boiling processes. Our interest to this problem, in particular, was motivated by development of life-support systems aimed at delivery of oxygen within human body. There are at least two types of health-related applications where diffusion of O_2, N_2 and CO_2 in perfluorocarbon compounds (PFC) is important: it is artificial blood design and liquid ventilation [3]. Knowledge of diffusion rates of these gases in the liquid is of utmost importance for both applications.

But complexity of the existing measurement approaches makes them difficult to establish, while rendering the data obtained therein hard to reproduce and verify. To overcome the complication, we have tested an ability of classical diffusion measurement technique, namely, interferometry and diffusion cell, to support such measurements. We found that the high solubility of the gases in PFC together with high sensitivity of the diagnostics make the measurements well accessible.

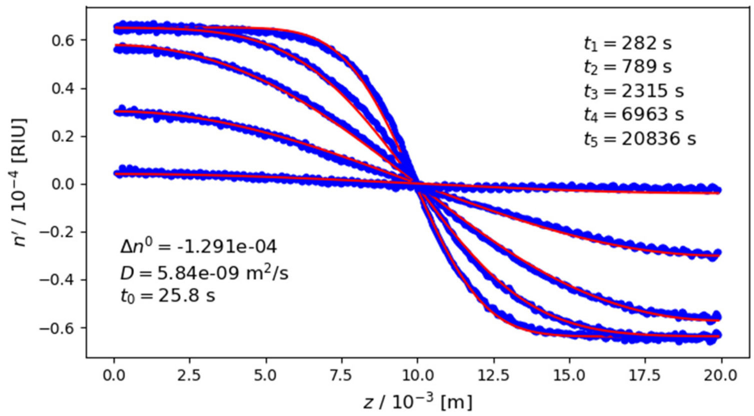

Figure 1: Refractive index profiles acquired in course of an experiment on gas diffusion in methoxy-nonafluorobutane (HFE-7100) at 298 K.

By using the approved approach, we have taken a set of measurements of diffusion of the most important atmospheric gases in a perfluorocarbon within the temperature range 288-313 K. Obtained results are in good agreement with a data for analogous systems available in literature.

References

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