STRUCTURE OF THE STABLE NANOBUBBLES OF DISSOLVED AIR IN WATER AS STUDIED BY MEASUREMENTS OF LIGHT SCATTERING MATRIX

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In experiment combining both laser modulation-interference microscopy and scattering matrix measurements (the results of this study have been recently published in [1]) it was established that in the water samples saturated with dissolved air and containing an ionic component, there exist stable (long-living) gas particles at the micron scale having a negative electrical charge. Moreover, it was proved that these micron-sized particles are not monolithic ones but are composed of separate stable nanobubbles containing dissolved air. The solution of inverse scattering problem based on numeric simulation of the angular dependences of the scattering matrix elements has allowed us to estimate the gyration radii of the nanobubble clusters and their fractal dimension. The calibration scatterometry experiments, performed with aqueous monodisperse suspensions of latex particles with various known concentrations have made it possible to define the concentration of the nanobubble clusters. The additives of various salts in the water samples give rise to an increase in the concentration of the nanobubble clusters, while their fractal dimension deceases, and the clusters become "more friable". It is shown that certain peculiarities in the behavior of aqueous solutions of different salts (here we mean the dependences of the mass density and the dielectric permittivity as functions of the salt concentration) can be explained within the framework of model of electrically charged clusters of the nanobubbles, whose parameters critically depend on the salt concentration as well. The nanobubble clusters as charged particles naturally should distort the hydrogen-bond network in aqueous media and also can affect chemical, in particular, auto-catalityc and biochemical reactions. Additionally, the model of the nanobubble clusters can be applied for an explanation of the mechanism for breath of oceanic animals (for example, fishes). And finally, according to our experimental results, these particles are the centers of natural heterogeneity in liquids being the nuclei for the acoustic and optical (laser) cavitation, as well as for boiling. The proposed model allows us to interpret at a qualitatively new level our earlier experimental results [2] on inducing the hypersonic cavitation in a field of broadband optical pump.

1. Nanoscale structure of dissolved air bubbles in water as studied by measuring the elements of the scattering matrix, N. F. Bunkin, N. V. Suyazov, A. V. Shkirin, P. S. Ignatiev, and K. V. Indukaev, THE JOURNAL OF CHEMICAL PHYSICS, **130**, 134308 (2009)

2. Mechanism of low-threshold hypersonic cavitation stimulated by broadband laser pump, N. F. Bunkin, A. V. Lobeyev, G. A. Lyakhov, and B. W. Ninham, PHYSICAL REVIEW E **60**, 1681 (1999)

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