Nanooptics and photonics

The influence of deuterium concentration and temperature on the degree of water structuring

S.A. Dolenko[1], M.D. Skilskaya[1], I.Yu. Romaniukina[1], A.I. Marynin[2], V.V. Goncharuk[1]

[1]Department of Physics, Chemistry and Biology of Water, Institute of Colloid and Water Chemistry, Natl. Acad. of Sci. of Ukraine, 42 Vernadsky pr., Kiev-030042, Ukrain.
E-mail: email.of. corresponding_iryna.romaniukina@ukr.net

[2]Problem research laboratory of the National University of Food Technologies Ministry of Education and Science of Ukraine, 68 Volodymyrska str. Kiev-01601, Ukraine.

Thermodynamic, viscometric, conductometric methods, as well as dielectric, IR-, RS- and UV-spectroscopy, NMR, X-ray diffraction analysis, neutron diffraction and computer simulation are widely used to study the structure of liquid water. Despite such variety of research methods, the evidences of the existence of stable structural elements are still a difficult task. It is caused by the fact that the most methods leads to deformation of near water structure, which making difficult to detect inhomogeneous structure of the small sizes. The method of dynamic light scattering (MDS) is successfully used to study the processes of aggregation and dissociation of water molecules, allowing to determinate their dimensions and don't violate the integrity of the sample.

The possibility of using MDS for research of structural changes in water samples with different isotopic composition depending on temperature (in the range of 4 – 80 °C) and deuterium concentration (from 6 ppm to 99.9%) was studied in this work. The dimensions of optical inhomogeneities of investigated water samples are experimentally established. It has been shown that the temperature and concentration dependences of optical inhomogeneitie are stepped with accurately expressed critical points at ~ (4; 36; 45 and 60 – 70) °C and deuterium concentrations (150-200 ppm and 10^5 ppm). The obtained dependences well correlated with the changes in the electrical conductivity, ξ-potential, pH value of water samples, and also with the formation of H_2O_2 as the most stable by-product of photolysis of the investigated water samples.