

Investigation of Structural Changes of Water Droplets Encapsulated in the AOT Reverse Micelles

Marina Rukhadze

Department of Chemistry, Faculty of Exact and Natural Sciences, Javakhishvili Tbilisi State University, Georgia

e-mail: marina.rukhadze@tsu.ge marina_rukhadze@yahoo.com

Complexity of water structure becomes enormous when it is confined to nanometer-scale cavities. Such environments include biological molecules and membranes, porous rocks and clays, and zeolites. Reverse micelles are isolated, surfactant-coated water droplets, which have arisen as an appropriate model for confined water in biological systems. Therefore investigation of the properties of water core of the reverse micelles is urgent and topical. The additives of nonionic kosmotropes and chaotropes influence the water structure in water pockets of reverse micelles. Non-ionic kosmotropes (trehalose, glucose, etc.) are very soluble well-hydrated molecules, having no net charge and enforcing extensive hydrogen bonding. Conversely, non-ionic chaotropes (e.g. urea) increase the population of broken water decreasing the hydrogen-bonded network of water.

The goal of the proposed work was to study the influence of nonionic additives introduced in the water core of reverse micelles by using infrared, nuclear magnetic resonance and ultraviolet-visible spectroscopic methods, also by water-in-oil microemulsion chromatography.

The important results of the presented work may be summarized so: The microstructure of sodium bis(2-ethylhexyl) sulfosuccinate reverse micelles was investigated using infrared, nuclear magnetic resonance and ultraviolet-visible spectroscopic methods, also by water-in-oil microemulsion chromatography. The influence of structure-making and structure-breaking nonionic additives on the microenvironment in reverse micelles was studied. The values of chemical shift in the presence of chaotropic urea are different than their values in case of kosmotropic glucose additives according to proton magnetic resonance spectroscopic data. Urea promotes an increasing of free water fraction in the water pockets of the reverse microemulsions, but glucose supports formation of the trapped water on the basis of deconvolution of the O-H stretching vibrational absorption spectra in the region of 3000-3800 cm^{-1} into three subpeaks with a Monte Carlo method. The different influence of kosmotropic and chaotropic nonionic additives on both binding constant K_b of o-nitroaniline to the micelles of AOT and retention of the model compounds were also revealed by UV-visible spectroscopic and water-in-oil microemulsion liquid chromatographic methods respectively.