

Study of the influence of ionic additives on the water structure confined in AOT and Brij-30 reverse micelles

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Reverse micelles are small aqueous droplets surrounded and stabilized by a monolayer of surfactant molecules and dispersed in a water immiscible organic solvent. The properties of water molecules localized in the interior of reversed micelles are physicochemically different from those of bulk water, i.e. water droplets in microemulsions provide an environment that is different from the bulk solvent. Study of influence of nonionic and ionic kosmotropic and chaotropic additives on the water pockets structure of the reverse micelles is very informative, since reverse micelles are used as a membrane-mimetic systems [1]. Structural changes of water pools of reverse micelles in the presence or absence of structure-making and structure-breaking ionic additives have been investigated by IR and NMR spectroscopy since IR and NMR spectroscopy are powerful methods to characterize microstructure of confined water in reversed micelles [2-4].

IR absorption spectra were recorded on a Varian 660 –IR – FTIR Spectrometer. All ¹H spectra were recorded on Agilent Mercury 300 high resolution NMR spectrometer operating at 300 MHz. Microemulsions were prepared on the basis of a non-ionic surfactant, tetraethylene glycol monododecyl ether (Brij-30) and an anionic surfactant, sodium bis(2-ethylhexyl) sulfosuccinate (AOT), hexane, water, water solutions of potassium iodide and sodium fluoride. To study the microstructure of the solubilized water, the O-H stretching vibrational absorption spectra in the region of 3000-3800 cm⁻¹ were fitted into three subpeaks. Gauss function was chosen to fit the overlapped peaks. Gaussian curve fitting was achieved with a Monte Carlo method.

Changes in bound, trapped and free water fractions under the influence of kosmotropic and chaotropic ionic additives were revealed in case of AOT and Brij-30 reverse micelles. The percentage of free water fraction in case of kosmotropic fluoride ions increases 3 times than in the presence of chaotropic potassium iodide. Opposite influence of above mentioned additives is revealed in case of Brij-30 reverse micelles. Formation of free water fraction is reinforced by the addition of chaotropic potassium iodide. Also fraction of trapped water is 3 times more in the presence of potassium iodide in case of AOT reverse micelles than in case of Brij-30 reverse micelles.

NMR results showed that the chemical shift of the water proton in AOT reverse micelles varies downfield with an increase of the water-surfactant molar ratio. At the same time, the values of chemical shift in the presence of fluoride ions are higher than their values in case of iodide ions. In contrast to this the chemical shifts of the water proton in Brij-30 reverse micelles under the influence of iodide ions are more than in the presence of fluoride ions.

Results may be useful in the area of biomimicing investigations, where unique properties of the confined water are still a matter of debate.

References

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