SURFACTANT-POLYMER INTERACTIONS IN POLYMER HYDROGELS INVESTIGATED BY SANS

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Nanophase separated structure of epoxy hydrogels containing polyoxyethylene (POE) and polyoxypropylene (POP) has been revealed and investigated by SANS in recent years [1]. The hydrogels respond sensitively to external stimuli such as change of temperature or presence of a surfactant in swelling solution [2]. The main focus of this project is investigation of the effect of interaction of ionic surfactants with POE and POP on swelling behavior and structure of the hydrogels.

Stoichiometric amphiphilic epoxy network containing POE and POP was prepared by reaction of α, ω-diamino terminated POP and POE bis(glycidyl ether) of molar masses ca 4000 and 526 g.mol^{-1}. A series of hydrogels was obtained by swelling of the network in D_2O and excess volume of solutions of two ionic surfactants: myristyltrimethylammonium bromide (C_{14}TAB) and sodium dodecylsulfate (SDS) in D_2O. SANS measurements were carried out at the YuMO small-angle instrument at the IBR-2 pulsed reactor (JINR, Dubna, Russia) in the time-of-flight regime.

A nanophase separated structure consisting of water-rich and water-poor domains with Bragg's distance ca 110 Å is revealed by SANS from the hydrogels obtained by swelling in D_2O, C_{14}TAB solutions and subcritical SDS solutions (see Figures 1 and 2). A significant increase of swelling degree was observed for all hydrogels obtained from supercritical SDS solutions. This is accompanied by change of hydrogel structure from a two-phase morphology of water-rich and water-poor domains to a morphology composed of micelles dispersed in highly swollen polymer network. Details of hydrogels structure were obtained by fitting experimental SANS profiles to models with morphology of polydisperse spheres with interaction described by hard-sphere (HS) potential and rescaled mean spherical approximation (RMSA). Average radius of water-poor domains of ca 40 Å was determined for hydrogels in case of two-phase morphology. In hydrogels containing micelles, average micelle radius of 25 Å (C_{14}TAB) and 17 Å (SDS) was found. Differences in hydrogel behavior and structure are attributed to different degrees of ionization of SDS and C_{14}TAB micelles in the hydrogels.