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Localization of Dye Molecules in Surfactant Assemblies via SANS Contrast Variation

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The heteroaggregation between azo dyes and surfactants is an interesting phenomenon. The responsivity of the dye spectrum to changes in their chemical environment is often used to monitor alterations in a solution state by means of UV/vis-spectroscopy. However, little attention was paid to the morphology of dye/surfactant assemblies. Small-angle neutron scattering (SANS) with contrast variation permits the elucidation of assembly-morphology and the unambiguous localization of dye-molecules within surfactant micelles. We studied the interaction between the commercial, anionic azo dye Blue and the cationic surfactant DTAB in an alkaline buffer. Solutions of Blue and DTAB phase-separate above a Blue:DTAB ratio of 1:2.5. Below this ratio, stable solutions form with the absorption spectrum of Blue depending on the concentration of DTAB. To better understand underlying mechanisms, the morphology of assemblies in the 1-phase region was studied with SANS. Moving from the precipitation threshold to the surfactant-rich side leads to a shrinking of assembly size and a reduction in its anisometry. SANS contrast variation was applied by matching DTAB to the solvent and revealing the scattering signal arising from Blue only. For all sample compositions, we unambiguously located Blue on a surface-layer of the dye-surfactant micelle. This work demonstrates the feasibility of SANS contrast variation for dye/surfactant-systems and relates findings to UV/vis spectroscopic investigations.

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