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POSTER ABSTRACT PRESENTATIONS

SESSION TITLE: ADVANCES IN EM TECHNOLOGY AND PROCESSING

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Abstract P-3: The Structure of Self-Assembled Surfactant Micellar Networks by *in situ* Cryo-Electron Tomography

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Background: Surfactant molecules can form various self-assembled structures in aqueous solutions, including spherical and cylindrical micelles, lamellae, vesicles, etc. Elongated cylindrical (wormlike) micelles can entangle and form a dense network. The study of the un-perturbed native structure of wormlike micelles in such networks presents a great challenge, since the micelles are formed due to weak non-covalent interactions and may easily break when external conditions are changed. In this work *in situ* cryo-electron tomography (cryo-ET) was applied to reveal the relaxed structure of such entangled systems.

Methods: To prepare samples for the cryo-ET study 1 µl of the aqueous surfactant-containing solution was applied to the glow discharged grid, blotted with filter paper for 10 sec, drained for 60 sec to allow for the relaxation of the system and plunge-frozen with Vitrobot Mark IV. The vitrified sample was transferred to Versa 3D cryo-focused ion beam / scanning electron microscope (cryo-FIB/SEM) to prepare thin (100-150 nm) sections of the sample. Cryo-ET study was conducted using Titan Krios. IMOD and Avizo software packages were used for data processing.

Results: In this work, wormlike micelles formed by a mixture of an anionic and a cationic surfactant were investigated at the excess of the anionic surfactant. Cryo-ET study of the obtained lamellae demonstrated the formation of two different phases, consisting of straight rods oriented along the grid substrate (phase 1) and isotropic network formed by wormlike micelles (phase 2) above it. The topology of the second phase corresponded to the branched saturated network or entangled network depending on cation/anion ratio of the sample. However, the analysis of the thin samples obtained without cryo-FIB

demonstrated only the presence of the metastable phase (phase 1), which could lead to false conclusions regarding the morphology of the micelles.
Conclusion: Here we discuss the influence of different sample preparation approaches on the sample structure and demonstrate that the native un-perturbed conformation of charged cylindrical surfactant micelles in the dense network is that of a slightly bent rod or a wormlike chain with high persistence length.

Key Words: cryo-electron tomography • cryo-FIB • surfactants • wormlike micelles

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