

Effect of additive alcohols on molecular motion in micelles

F. Nemoto^A, H. Akiba^B, Y. Ohmasa^B, O. Yamamuro^B

^A*Natl. Def. Acad.*, ^B*ISSP-NSL, Univ. of Tokyo*

Alcohol acts as a cosurfactant with ionic surfactants in aqueous solutions. For instance, butanol increases the critical micelle concentration (CMC) of cetyltrimethylammonium bromide (CTAB), while hexanol alters CTAB micelle shapes [1]. Alcohols with longer alkyl chains are expected to penetrate surfactant layers due to hydration and dispersive interactions, enhancing their role as cosurfactants. Recent measurements of surface tension and adsorbed structures at the solid-liquid interface for CTAB-hexadecanol mixtures reveal that the CMC remains unchanged between a 1:3 CTAB mixture and pure CTAB. However, a bilayer structure forms in the former, whereas a monolayer forms in the latter. This suggests that surface tension at the liquid-air interface cannot predict the adsorbed structure, which is crucial for designing detergents or cosmetics.

Intermolecular interactions, the driving forces for micelle formation, significantly impact the cleaning performance of surfactants and their efficacy as additives. These interactions are influenced by changes between water and surfactant molecules due to the OH groups of alcohols. Measurement on these dynamics can estimate the intermolecular forces that modify micelle structure. Many studies have focused on micelle motions and the structure of alcohol-doped micelles to optimize cleaning performance [2], comprehensive investigations into the driving forces of micelle formation, incorporating CMC and structural information, are scarce.

This study aims to explore the effect of OH groups in micelles on inter-ionic interactions and elucidate the micelle formation and adsorption process on substrates. Neutron quasi-elastic neutron scattering (QENS) experiments were conducted using the AGNES spectrometer at JRR-3 on micelles formed by ionic surfactants sodiumdodecyl sulfide (SDS) mixed with

alcohols (decanol).

Figure 1 shows the typical QENS patterns of SDS and SDS/decanol (3:1) micelles in D₂O (molar fraction = 5×10^{-3}) at 315 K. The data were simply corrected by subtracting the QENS data of D₂O, considering the molar fractions. These results show that the self-diffusion in SDS and decanol molecules is almost equivalent. It indicates that the alkyl chain of decanol moves according to SDS, and decanol works well as a cosurfactant. It is consistent with the results that decanol stabilizes the SDS micelles as an additive.

[1] T. Schmutzler *et al.*, *Colloids and Surfaces A* **543**, 56, (2018).

[2] V. K. Sharma *et al.*, *J. Appl. Phys.* **128**, 154701 (2020).

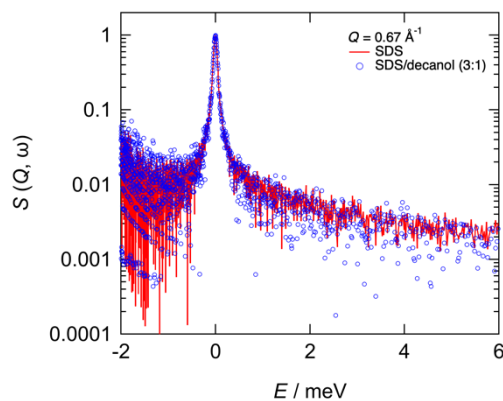


Fig. 1. QENS patterns of SDS (red) and SDS/decanol (blue) micelles in D₂O at 315 K.