15A/2001G278

Transition from Micellar to Lamellar Phases in Nonionic Surfactant / Water System

Minori Kakizawa[1], Youhei Kawabata[1], Tadashi KATO*[1], Hirohisa YOSHIDA[2],
and Masayuki Imai[3]
[1]Department of Chemistry, Tokyo Metropolitan University,
Hachioji, Tokyo 192-0397, Japan
[2]Department of Applied Chemistry, Tokyo Metropolitan University,
Hachioji, Tokyo 192-0397, Japan
[3]Department of Physics, Ochanomizu University, Bunkyo, Tokyo 113-8656, Japan

Introduction

Surfactant systems exhibit a variety of phase behaviours. When phase transition occurs, not only the arrangement but also the shape of building block itself is changed. This makes it difficult but fascinating to clarify the mechanism of the phase transition in surfactant systems. Variation in the shape of building block occurs even far from the transition point. So the equilibrium structure near the phase boundary should be elucidated before investigating the mechanism of the phase transition. In our previous studies on concentrated micellear phase of a $C_{16}H_{33}(OC_2H_4)_7OH$ ($C_{16}E_7$)-water system [1], it has been shown that wormlike micelles are connected each other and make three dimensional network near the lamellar phase. In the lamellar phase, on the other hand, there are water filled defects which disappear above about 68°C [2].

In the present study, we have measured small angle X-ray scattering (SAXS) in the region where micellar and lamellar phases coexist.

Experimental

Measurements were performed using SAXS spectrometer installed at the BL-15A. We used a sample cell made of copper with Kapton windows (sample thickness = 1mm) whose temperature is controlled by using the DTA/SAXS instrument.

Figure 1 shows a phase diagram of $C_{16}E_7$-D_2O system reported before [2]. SAXS patterns were recorded by using the CCD area detector along the paths indicated in the figure by arrows. After the temperature becomes constant, measurements were performed every 2 minutes until the peak position does not change.

Results and Discussion

Figure 2 shows circular averaged SAXS intensities as a function of q ($=4\pi\sin\theta/\lambda$) for 36 and 40 wt% of $C_{16}E_7$. It can be seen from the figure that the two peaks are superimposed in the coexistence region; a sharp and broad peaks corresponding to the lamellar and micellar phases. As the temperature increases, the intensity of the sharp peak increases and its position moves to the lower scattering angles. This may come from the fact that the lower concentration limit of the lamellar phase decreases above about 65°C. However, the repeat distance obtained from the observed peak position is much longer than that at the lower boundary of the lamellar phase. This suggests the existence of intermediates in metastable states.

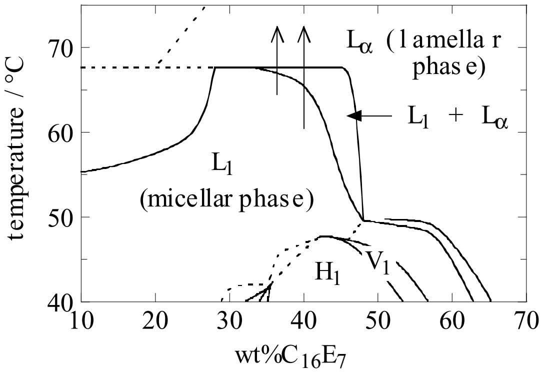

Fig. 1 Phase diagram of $C_{16}E_7$-D_2O system [2].

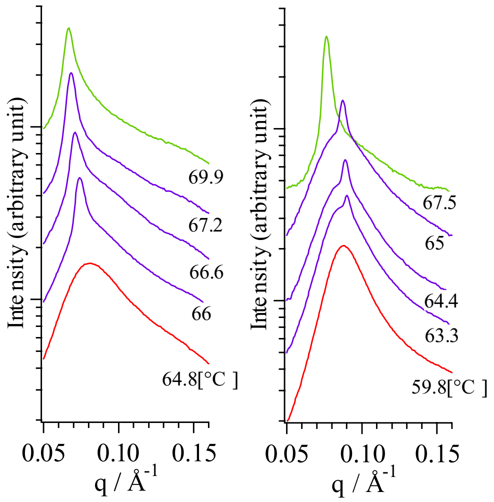

Fig. 2 SAXS intensities at different temperatures at 36 wt% (left) and 40wt% (right) of $C_{16}E_7$.

References

[1] T. Kato et al., *Langmuir*, **11**, 4661 (1995).
[2] K. Minewaki et al., *Langmuir*, **17**, 1864 (2001).

* kato-tadashi@c.metro-u.ac.jp