

Self-Assembled Structure and Sol-Gel Transition of Crystalline Organogels and Surfactant Organogels

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1 Introduction

There has been an enormous increase of interest in the properties and structures of low-molecular mass organogels because of their potential applications. Self-assembled fibrillar network is formed in the gel.[1, 2] Usually the network is formed at low temperatures, while it melts at high temperatures, i.e., the gels are thermally reversible.

Recently Raghavan reported that there exist two types of low-molecular mass gels, crystalline gels and surfactant gels.[3] In the former gel, it has been ascertained by X-ray measurements that arrangement of the gelator molecules in the gel is similar to that in the crystalline powder. We showed that the composition and temperature did not affect the fiber structure using small-angle neutron scattering and synchrotron small-angle X-ray scattering (SAXS) for the gel of 12-hydroxystearic acid (12-HSA), which is known as one of the crystalline organogelators,, although they affected the fiber density.[4] On the other hand, the surfactant gel is produced by adding an additive into a surfactant micellar solution. In the case of this type of gel, temperature and concentration dependencies on structures of the gels is not fully understood at the present stage. In this study, we investigated structures and the sol-gel transition behavior for both types of gels using synchrotron SAXS measurements in order to clarify their gelation mechanism.

2 Experiment

In this study we used Lauroyl-L-glutamic- α - γ -dibutylamide (LGBA) and an anionic surfactant (AOT) as a gelator for preparation of the crystalline gels and the surfactant gels, respectively. Various kinds of additives were used for production of the latter type of gel. The synchrotron SAXS measurements were performed at the beam line 15A and 10C. The scattered intensity was detected with an image intensifier coupled to a CCD camera in the former, while it was detected using a imaging plate (RIGAKU R-AXIS) in the latter. The two dimensional scattered images were circularly averaged to obtain the scattering profiles as a function of the scattering vector q defined by $q = 4\pi \sin(\theta/2)/\lambda$, where θ and λ are the scattering angle and the wavelength of X-ray, respectively. The scattering data were corrected for the background scattering, the incident beam and the exposure time of the measurement.

3 Results and Discussion

The scattering profiles for LGBA gels in toluene at various concentrations and various temperatures showed almost the same shape in the log-log plot, while the

scattering intensity gradually decreased with increasing temperature in the gel state, indicating that the fibers gradually melted with increase of temperature (not shown here). Further increase in temperature caused drastic decrease of the scattering intensity, which suggests that the sol-gel transition took place. These behaviors are very similar to that of 12-HSA gels.[4] On the other hand, the SAXS behavior for surfactant gels strongly depended upon composition and temperature. Figure 1 shows scattering profiles for a surfactant gel in toluene at various concentrations. The profiles for 5 wt% and 10 wt% surfactant gels monotonously decreased with increase of q . The profile for the gel with a higher concentration (15 wt%) had a sharp peak and a broad peak at $q = 0.32 \text{ \AA}^{-1}$ and $q \cong 0.15 \text{ \AA}^{-1}$, respectively. Appearance of the sharp peak suggests that an ordered structure was formed at the high concentration.

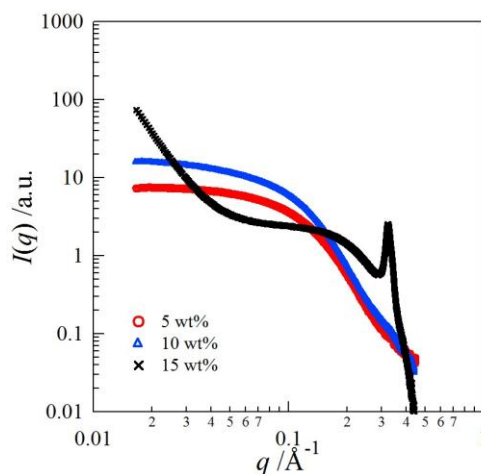


Figure 1 SAXS profiles for a surfactant gel at various concentrations.

References

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