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# Self-assembling Structures of 12-Hydroxystearic Acid Solutions

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## Introduction

Some low molecular weight materials can gelate various kinds of organic solvents. The materials are called low-molecular weight gelators. They usually form a three-dimensional network of crystalline fibers in an organic solvent, so that they cause gelation. The sol-gel transition in the mixture of the gelator and the solvent depends on the melting behavior of the crystallites, and the sol-gel transitions exhibit thermally reversible behavior.

12-hydroxystearic acid (12-HSA) is one of the low-molecular weight gelators and can gelate many kinds of solvents at very low concentrations less than 1%. In this study, we have investigated self-assembling structures of mixtures of 12-HSA and an organic solvent.

## Experimental

### Sample and sample preparation

12-HSA was purchased from Aldrich Co. (purity 99 %) and used without further purification. All the solutions were put into a glass tube by known amounts of sample and solvent. The homogeneous solutions were obtained by heating and afterwards were cooled at room temperature, so that the gels were formed.

### Small-angle and wide-angle X-ray scattering

X-ray scattering measurements were performed at the beam line 15A. The scattering experiments were carried out at two sample-to-detector distances of 2260 mm (small-angle X-ray scattering (SAXS)) and 524 mm (wide-angle X-ray scattering (WAXS)). The scattered intensity was detected with an image intensifier coupled to a CCD camera. 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 $\theta$ is the scattering angle. The background scattering intensity was subtracted from the scattering intensity of the sample. The subtracted data were normalized by the intensity of the incident beam and the exposure time of the measurement.

## Results and Discussion

Figure 1 presents WAXS profiles for 12-HSA powder and 12-HSA gels in organic solvents (dodecane or polybutadiene (PB) oligomer with molecular weight of 3,000). The WAXS profile of the powder sample has peaks at $q$ = 0.13 Å$^{-1}$ and 0.41 Å$^{-1}$, which were attributed to (001) and (003) Bragg reflections, respectively by other researcher [1]. The WAXS profiles of the gels have peaks at the same position, indicating that the gels consists of crystallites. Moreover, SAXS was measured for the gels in toluene (transparent gel) and dodecane (turbid gel) (not shown here).

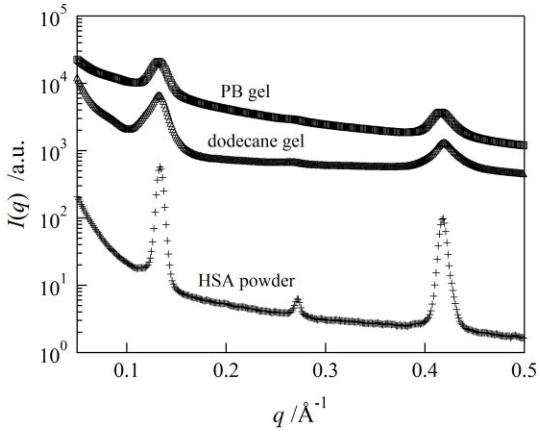


Figure 1 WAXS profiles for 12-HSA powder and 7 wt% 12-HSA gels in organic solvents (dodecane or PB). The scattering profiles were shifted vertically for visual clarity.

The scattering function from randomly oriented rods with the height $2H$ ($2H = L$) and the diameter $2R$ was taken into consideration for the SAXS profiles of the gels.

$$P(q) = 4\int_0^{\pi/2}\left[\frac{\sin^2(qH\cos\beta)}{(qH\cos\beta)^2}\right]\left[\frac{J_1^2(qR\sin\beta)}{(qR\sin\beta)^2}\right]\sin\beta d\beta$$

Here $J_1$(x) is the Bessel function of the first order and $\beta$ is the angle between the preferential axis of the rod and the wave vector $\boldsymbol{q}$. In the fitting procedure, the inhomogeneity of $R$ with Gaussian distribution was considered. Consequently, the average radius of 117 Å and the standard deviation 20 Å were obtained for the toluene gel [2]. Thus, it is shown that the gel consists of the crystalline nanofibers .

## References

[1] T. Tachibana, T. Mori, K. Hori, Bull. Chem. Soc. Jpn, 54, 1714 (1980).
[2] H. Takeno, T. Mochizuki, K. Yoshiba, S. Kondo, T. Dobashi, Prog. Colloid Poly. Sci. 136, 47 (2009).

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