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Hierarchic Super-Molecular Structures in Sugar-Integrated Organogelators Explored with Synchrotron Small-Angle X-ray Scattering

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Introduction

Organogelators are a class of molecules that can undergo self-organization in a particular organic solvent to yield a fine fibrilar structure. This elemental fiber can bundle each other to form a micrometer-scale fiber and this micro-fiber is connected to each other by a so-called "junction point". Therefore, the entire morphology becomes sponge-like, thus it is considered suitable to absorb a large amount of solvent molecules by the capillary effect. This is the reason why this solution behaves as a gel and such compounds are called as organogelators. Organogels constitute an important class of material to their application in template materials, drug delivery systems, and biomimetics.

Results and Discussion

We have studied on a series of sugar-appended organogelators.[1,2] In this work, we found that methyl 4,6-***O***-benzylidene-**D**-mannopyranoside (α-manno and β-manno, see Figure 1 for the structures) can gelatinize ***p***-xylene at considerably low concentrations (less that 1%). One of the peculiar pheromones for these organogelators is that a clear thermal transition from the gel to sol states is observed upon heating. This paper explores how the supramolecular structure of the gel changes in accordance with the thermal transition and discusses the relation between chemical structure and the super-molecular structures.

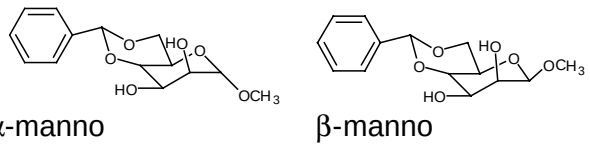

Figure 1. Chemical structures of 4,6-***O***-benzylidene-**D** mannopyranoside derivatives.

Figure 2 shows the scattering profiles from β-manno obtained at 50 – 80 °C. At 50 °C, there is a peak at 0.025 Å^{-1}, which may be described to a particle scattering. If we assume the cylinder, the diameter of the cylinder is estimated to be about 100 Å. This scattering feature is completely different form those of α-manno in ref 2. With increasing temperature, the lower ***q*** peak disappears, whereas the larger ***q*** peak still remains. This feature suggests that even in the sol state, some molecular aggregate is still remained. It is interesting that such a small difference in the molecular structure reflects in the supra-molecular structure in the gel state. We are in the process of analyzing the scattering patterns from β-manno.

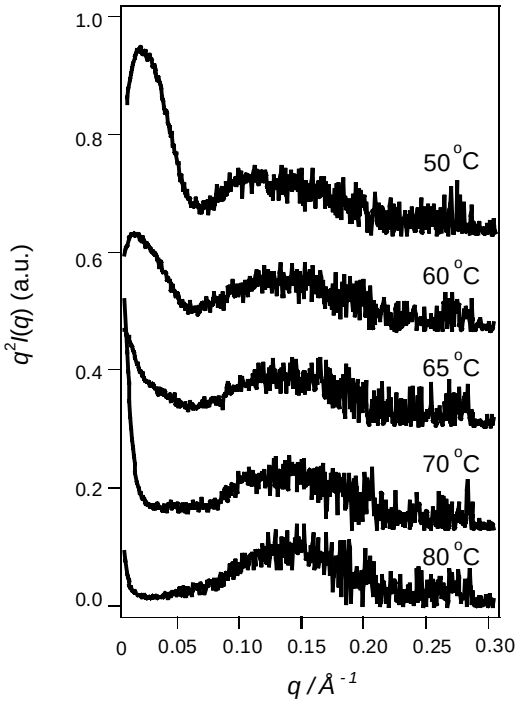

Figure 2. Temperature dependence of β-manno/p-xylene 1.5 % solution. T_{gel} = 68 °C. For convenience, the Lorenz corrected intensity is plotted.

References

[1] K. Sakurai et al., Perkin 2 108, (2001).
[2] K Sakurai et al., Chem. Letter in press (2001)

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