Structural characterization of DNA-module gel by SANS

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Physical gels (e.g. gelatin gel, agarose gel) are familiar materials in our daily life (e.g. foods, diapers). However, it is difficult to control the polymer network of them because the physical crosslinking (branching) occurs randomly and the network structure becomes very heterogeneous. In chemical gels, our group succeeded in fabrication of tetra-PEG gel, which is synthesized just by mixing two mutual reactive four-arm polyethylene glycols together (Sakai, T. et al. Macromolecules, 2008). Because the branching point in each tetra-PEG is uniformly distributed in the network, the homogeneous network will be formed. Previous our SANS study has confirmed the excellent homogeneity of networks of tetra-PEG gels (Matsunaga, T. et al., Macromolecules, 2009).

Recently, we have applied the strategy of tetra-PEG gel into physical gels by modifying the chemically reactive end-group on each arm of tetra-PEG to a physically reactive end-group: sense and anti-sense single-stranded DNA (Figure 1(a)). Because of the highly selective hydrogen binding between sense and anti-sense DNA, reproducible sol-gel transition is observed.

In this study, we carried out SANS study to investigate the temperature dependency of the structure and sol-gel transition. As the result is shown in figure 1(b), there are several interesting features. (1) No significant upturn at low-q region is observed, which suggests that this gel has homogeneous structure as conventional Tetra-PEG gel. (2) Elevating temperature, scattering intensity becomes bigger, however, no significant change was observed at sol-gel transition point (Tgel ~ 60 ℃) and the melting point of double-stranded DNA (Tm ~ 65 ℃). (3) Unpredicted peak around q = 0.02 Å-1 was observed at T > 85 ℃. The correlation distance is estimated to be ~ 30 nm, which is much larger than size of tetra-PEG polymer and that of single-stranded DNA.

In the next experiment, we plan to focus exclusively Tetra-PEG or DNA structure by using contrast matching technique. In addition, by DSC measurement along with SANS, we plan to obtain more accurate thermodynamic information of association and dissociation of double-stranded DNA.

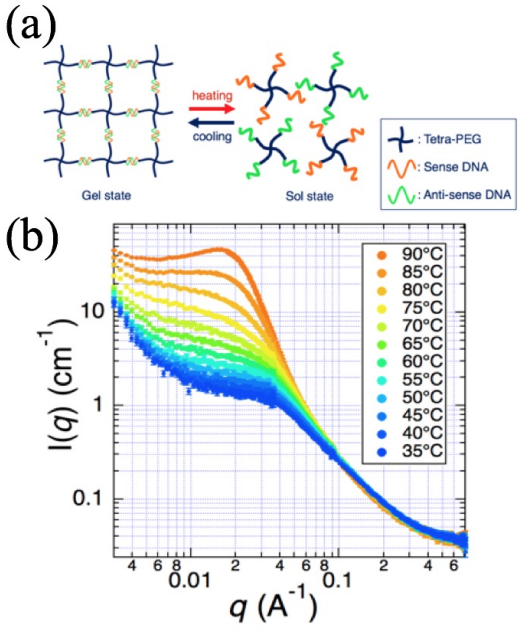

Fig. 1. (a) An illustration of DNA-module gel (b) The SANS profiles of DNA-module gel at various temperature