Structural Characterization of DNA-module gel by Small-Angle Neutron Scattering

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Physical gels such as gelatin gel or agarose gel, which exist generally like natural materials, are used in various fields, such as food, industrial and medical applications. They are composed of polymer networks crosslinked with physical bonding such as hydrogen bonding, Coulomb 's interaction or hydrophobic interactions. In conventional chemical or physical gels, it is restricted to control the polymer network of physical gels due to the randomness of crosslinking (branching) and the network structure became very heterogeneous. However, by a simple strategy, just mixing two mutual four-arm polyethylene glycols carrying reactive end-groups together, the network will be homogenized because the branching point in each tetra-PEG macromer is uniformly distributed in the network (Figure 1). Our previous SANS study has proved the excellent homogeneity of networks of tetra-PEG gels.

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). Because of the high specificity of hydrogen binding between two complementary DNA, the reproducible sol-gel transition was observed by rheological measurement. We carried out small angle neutron scattering with Quokka at ANSTO to investigate its thermo-dependency of the structure. In the previous study, the data is a bit complicated because it contains both PEG and DNA information. In this proposed experiment, in order to focus PEG polymer and DNA crosslinkers exclusively and obtain more accurate information about PEG and DNA structural change such as association and dissociation of double-helix along with the sol-gel transition. Thus, we investigated this gel with SANS measurement with a contrast matching technique.

The SANS measurement result is shown in Figure 2. With elevating temperature, scattering intensity becomes bigger but SANS profiles do not change clearly at the sol-gel transition point (Tgel ~ 60 ℃) and the melting point of double-stranded DNA. Therefore, this gel has a homogenous structure. Additionally, the SANS profile does not have hysteresis.

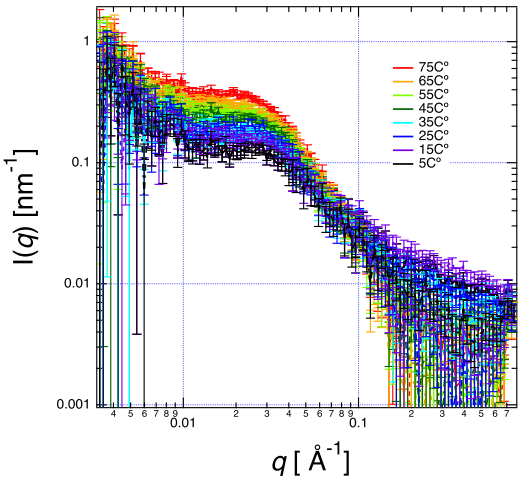

Fig. 1. The SANS profiles of DNA-module gel at various temperature