表題：小角中性子散乱 (SANS) 法による高分子ゲル網目均一性の定量的評価

Quantitative evaluation of uniformity of various polymer networks by small angle neutron scattering (SANS) with contrast variation technique

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Polymer gel is a material with flexibility and non-flowability, which has many applications in food industry and biomedical fields. The mechanical properties and swelling behavior of polymer gels depend on the network structure of the polymer gels. Recent studies by our group revealed that the influence of the homogeneity of the network structure plays a very important role on these physical properties. In 2008, our research group succeeded in fabrication of a homogeneous gel " tetra-PEG gel " by a terminal crosslinking reaction of two different types of tetra-branched poly (ethylene glycol) (Sakai et al., Macromolecules, 2008). As a result of small angle neutron scattering (SANS) measurements of tetra-PEG gel, the upturn of intensity in the small angle region, which represents the heterogeneous network structure, was not observed in tetra-PEG gel (Matsunaga et al., Macromolecules, 2009). In addition, tetra-PEG gel exhibits excellent mechanical strength and its elastic properties are well consistent with rubber theory. Although all of the scattering and rheological results support that the tetra-PEG gel is much more homogeneous than conventional polymer gels and we understand the impact of its homogeneous networks, it is still difficult to" quantitatively "evaluate the homogeneity of the structure of the tetra-PEG gels.

A method to visualize the network structure has been attempted by measuring the deuterium-labeled crosslinkers by SANS measurements with contrast variation technique. The average distance between crosslinkers were obtained in a resonable size range for various swollen conditions (Benoit, H. et al. Journal of Polymer Science 1976, 14, 2119). In this study, in order to quantitatively evaluate the polymer networks of tetra-PEG gels, Following the strategy of Benoit, we have synthesized the tetra-PEG gel with deuterium-label near the branching point and conducted SANS experiments with contrast matching method (Figure (a)). However, we failed to observe any peaks (Figure (b)). The reason is likely due to the labeled part was too small to scatter enough neutrons.

In the next study, we plan to measure a newly designed tetra-PEG gel: hydrogenated tetra-PEG polymers are crosslinked with a fully deuterium-labeled linear PEG. By using this study, the scattered intensity enough to observe and we will estimate of quantitative evaluation of uniformity of gel.

使用施設：JRR-3M, 装置：C1-2:SANS-U
分野：Soft Matters

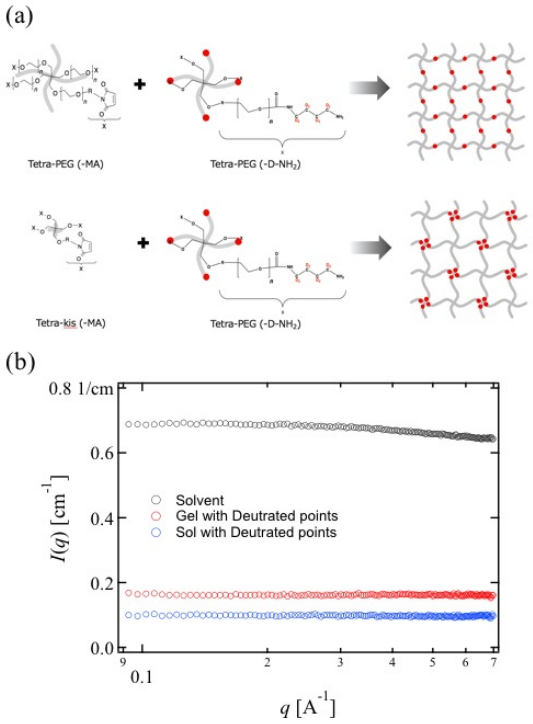

Fig. 1. (a) An illustration of tetra-PEG gels, in which deuterium atoms were introduced in the vicinity of the branching point and in the center of the branching point. (b) The result of SANS by matching contrast methods.