

Microstructure Analysis of Weakly-charged Gels Having Different Spatial Distribution of Charged Groups ~ pH Dependence ~

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Gel microstructure formation according to spatial configuration of charged groups in gel network has been investigated using a two-dimensional SANS spectrometer (SANS-U) of Institute for Solid State Physics, Univ. of Tokyo, located at JRR3M in Japan Atomic Energy Agency (JAEA), Tokai, Japan. Three types of gel consisting of hydrophobic *N*-isopropylacrylamide (NIPAm) and weakly-charged acrylic acid (AAc) copolymers were prepared with different distributions of AAc monomer units in the network. The first type is NIPAm/AAc copolymer gel in which NIPAm and AAc are randomly copolymerized in monomer unit by redox polymerization (code;redox-mono-AAc). The second type is a UV-crosslinked NIPAm/AAc gel in which AAc is copolymerized in units of polymers (code;UV-poly-AAc).^[1] The third type is a NIPAm/poly-AAc polymer gel prepared using redox method in which poly-AAc was not cross-linked but physically entrapped in the NIPAm polymer network (code;redox-poly-AAc). These three types of gel contain the same amount of charged groups (NIPAm/AAc = 668mM/32mM) but different spatial configurations of charged groups.

Fig.1. shows the T dependence of SANS profiles, $I(q)$ of each NIPAm/AAc copolymer gel at pD=6 or 11. Here, the solid denote theoretical fitting curves. With increasing temperatures, a broad peak appears in $I(q)$ s for redox-mono-AAc and UV-poly-AAc. For a theoretical fitting with this broad peak, we employed Rabin-Panyukov (RP) theory.^[2] RP fittings were quite successful for each experimental result. These results show that UV-poly-AAc undergoes microphase separation with a long-period larger than that of redox-

mono-AAc. Note that these long-period lengths depend on pD for both UV-poly and Redox-mono. The latter results in a higher effective degree of ionization than UV-poly-AAc due to the ion condensation along the poly-AAc chains. On the other hand, in redox-poly-AAc, no pD dependence was observed. In the case of redox-poly-AAc, non-crosslinked poly-AAc does not affect the gel structure at the microscopic levels. These findings demonstrate that the charge configuration in a weakly-charged polymer gel can be tuned and it plays a significant role in microscopic structures.

References

- [1] Ikkai, F.; Adachi, E. *Macromol. Rapid Commun.* **2004**, 25, 1514.
- [2] Rabin, Y.; Panyukov, S. *Macromolecules* **1997**, 30, 301.

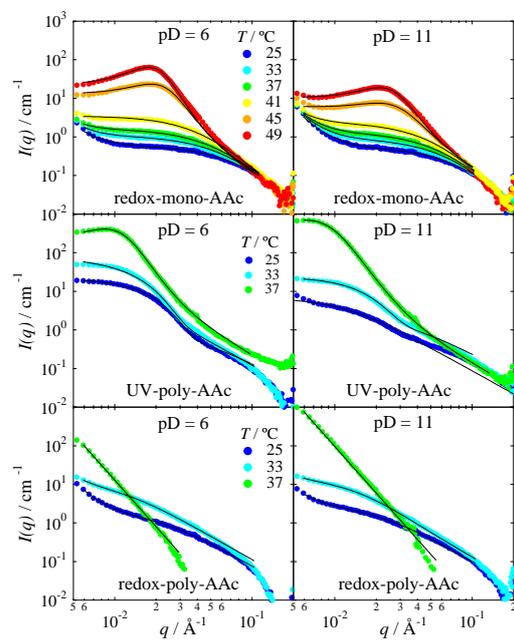


Fig. 1. T dependence of SANS profiles, $I(q)$, at pD=6 and 11 for each type of gel network consisting of NIPAM and AAc. Solid lines show theoretical fitting curves.