

Micro-structure Analysis of Heavy-metal ion Adsorbed PAAm Gels

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1 Introduction

Some polymer gels with ionic groups can capture harmful heavy-metal ions; therefore they have a possibility of being utilized for the purification of waste water contaminated with hazardous heavy metals. Properties of the gels are considerably influenced with environmental conditions due to the interaction between solvent and polymer network. By adsorbing heavy-metal ion, gels shrink dramatically. In addition to this macroscopic feature, there also occur micro-structural changes by introducing the ionized group in the gel. The adsorbing ability is naturally considered to be higher if more carboxyl groups are introduced in the polymer network; and, in this sense, introduced sodium malate or sodium fumarate containing plural carboxyl groups as the complexing agent instead of sodium acrylate. However, the change of polymer network before/after heavy-metal adsorbed is not understood clearly. It is important to get the sufficient information on the nano-structures of the heavy-metal-adsorbed polymer gels and on the local structures around the captured heavy metals for the improvement of their heavy-metal-capturing efficiency. In the present study, the authors have investigated these structural properties of Poly Acryl Amide (PAAm) gels by Small Angle X-ray Scattering (SAXS).

2 Experiment

PAAm gels were synthesized by a free-radical polymerization. Sodium acrylate (SA), sodium fumarate (SF) and sodium malate (SM) were selected as the complexing agent. We choose copper as heavy-metal ions capturing by gels. In the adsorbing process, these gels were soaked in 0.1 M CuCl₂ control solution for 2 days.

SAXS measurements were carried out at the BL10C in KEK-PF. Scattering Patterns were measured at room temperature by using Position Sensitive Proportional Counter. The camera length was settled about 2 m with the X-ray wavelength λ of 1.5 Å.

3 Results and Discussion

Figure 1 shows the SAXS patterns of PAAm gels before and after adsorbed copper ions. The SAXS profiles before adsorbed copper ions have no peak and the intensities are decrease sharply in the low scattering-vector region. On the other hands, after copper ions adsorbing process, the SAXS profile of AAm/SA gel shows a distinct peak around 0.018 Å⁻¹ indicating a regular nano-structure. Other samples show no sharply

peak in the measured range. Besides, demonstrating the different nanostructures with the respective ionic groups, the gyration radii estimated by the Guinier plots are 75 Å in the AAm/SA gel, 114 Å in the AAm/SF gel and 194 Å in the AAm/SM gel, which are consistent with them derived from the pair-distance distribution functions calculated by an indirect Fourier transform GNOM software¹⁾.

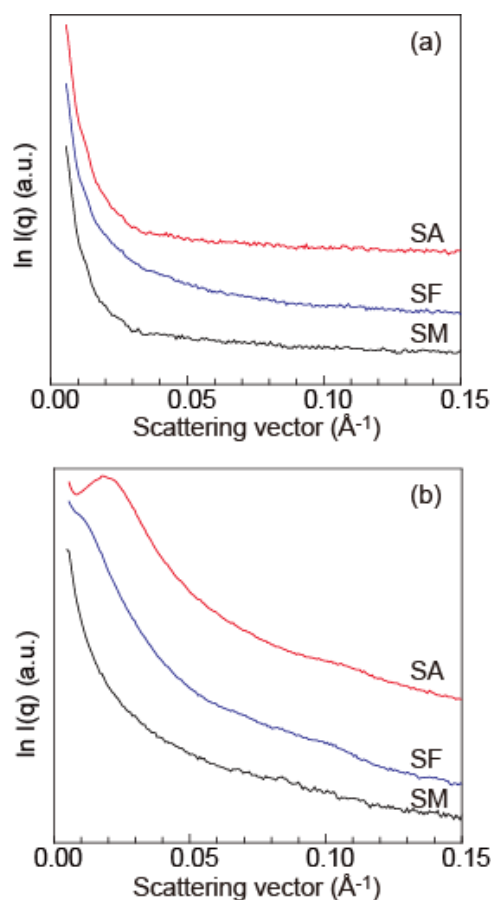


Fig. 1: SAXS profiles of PAAm gels synthesized with the the complexing agent SA, SF and SM respectively. (a) as synthesized and (b) after adsorbed copper ions.

Reference

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