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Micro-structural Analyses of UV-Irradiated AAm/SA Gels

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1 Introduction

Some polymer gels with ionic groups can adsorb harmful heavy-metal ions and can be usable as a kind of purifying materials of the waste-water. The authors have conceived the idea of photolysis of the gel's surface with ultraviolet (UV) irradiation for effective heavy-metal ion swelling. It is because the gel's network gets contracted on adsorbing heavy-metal ions and the follow-on ions cannot easily permeate into the gel's inside. After UV-irradiating process, on the macroscopic observation, the gels turn opaque the by adsorbing copper ion, unlike with the sample not UV-irradiated. The nano-structures of gels were expected to change by the UV-irradiation judging from occurrence of the considerable turbidity, which can be reflected in the adsorbed-Cu distribution. In this study, the authors have investigated the UV-irradiation effect on the microstructure of poly-acrylamide/sodium acrylate (AAm/SA) gel by Small Angle X-ray Scattering (SAXS), using a synchrotron light source.

2 Experiment

The AAm gels were synthesized by a free-radical polymerization. The wet gels were irradiated to UV light with a versatile lamp. The intensity of UV light is 170 mW/cm^2 and exposure times are from 0 to 900 sec. We choose cupper as heavy-metal ions capturing by gels. In the adsorbing process, these gels were soaked in 0.1 M $CuCl_2$ control solution for 96 hours. 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 is the SAXS profiles of the gels adsorbing copper ions after UV-irradiation. As can be seen from this figure, distinct peaks indicating a regular nano-structure are different in the position and the shape. As UV-irradiation time is longer, the peak-positions in transverse shit to lower: for as-prepared gel, the position of peak is around 0.020 Å^{-1} while 0.015 Å^{-1} for UV-irradiated one (900 seconds). This change is corresponding to an increase by 33 % in periodic length of a regular nano-structure. Besides, the breadths of the peaks get narrower by UV-irradiation. From these results, there are possibilities that the gel's network structure changes by UV-irradiation and the distribution of copper ions is influenced.The gyration radii estimated by the Guinier plots are listed on Table I together with the results from Small Angle Neutron Scattering (SANS). It is indicated that the size of gyration radii from SAXS have a negative correlation with those from SANS.

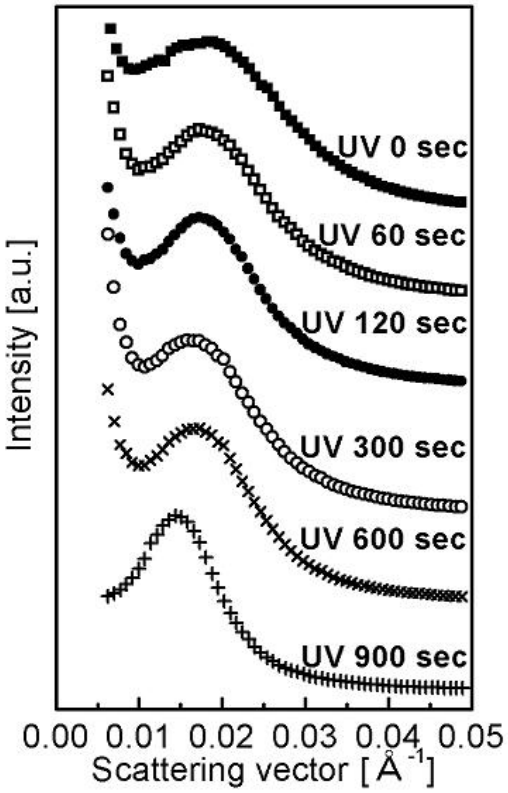

Fig. 1: SAXS profiles of AAm/SA gels with different exposure times of UV light.

Table I: The gyration radii estimated by the Guinier plots.

exposure time [sec.]	Gyration radius [Å]	
	SAXS	SANS
0	330	75
300	370	69

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