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Inhomogeneity Effect on Nano-Structure in Dehydrated NIPA/SA Gel

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Introduction

States and properties of the gels are considerably influenced by interaction changes between solvent and polymer-network with environmental conditions. For example, there is a small and continuous change in volume in the NIPA gel at 36°C with the hydrophilic-to-hydrophobic change of its isopropyl group, while, in the case that the network-polymer has additional ionized groups inside such as the NIPA/AAc copolymer gel, the volume change becomes more drastic with the effect of the Donan potential [1]. Such a drastic volume change is referred as a volume phase transition [1,2]. In addition to this macroscopic feature, there also occurs a nano-structural change by introducing the ionized group in the gel: an emergence of a prominent peak in a SANS profile indicating realization of the micro-phase transition [3].

Emergence of A Distinct SAXS Peak by Dehydration

Such a competition of the internal forces will occur in a condition other than the volume phase transition. As such a phenomenon, the authors have been investigating property change of the hydro-gels by dehydration, which is still interesting because the dehydration is one of the most general phenomena by which the gels show a drastic volume change. Besides, by dehydration, there occur property changes indicating that some gels becomes glass-like substances [4], which have been confirmed by viscoelastic measurements [5,6], Raman scattering [7] and inelastic neutron scattering experiments [8]. Moreover, by our SAXS study, a distinct nanostructure has been also found in a dehydrated *N*-isopropyl-acrylamide/sodium acrylate (NIPA/SA) gel, which is a congeneric hydrogel of the NIPA/AAc gel, indicating occurrence of the micro-phase separation by the dehydration [9]. By our succeeding nano-structural observations of the dehydrated NIPA/SA gel, it was found that the distinct SAXS and SANS peaks can be only observed in a restricted parameter region [10]. This feature indicates that the characteristic structure in the dehydrated NIPA/SA gel can be realized on a delicate balance of related interactions [11].

Effect of Inhomogeneity on the SAXS Profile

It is well-known that there is another nano-scale anomaly in hydro-gels: they become opaque above a certain cross-linker concentration, which indicates that an inhomogeneity of the light-wavelength scale occurs. Therefore, in the present study we have observed the cross-link concentration dependence of SAXS profile of dehydrated NIPA/SA gel with changing the cross-linker concentration. By the observation, we have found a considerable change in the SAXS profile as shown in Fig.1: considerable change occurs in peak-position and intensity around a certain cross-linker concentration where the gel becomes opaque.

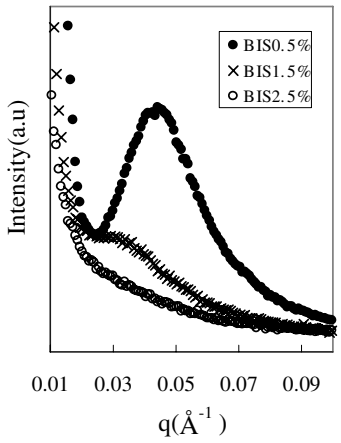

Fig.1 Change in the SAXS profile of dehydrated NIPA/SA gel with cross-linker (BIS) concentration. This gel (before dehydration) becomes opaque with the cross-linker concentration of 1.5%.

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