Structural study of NIPA/SA gel with low water content

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Introduction

Recently, it has been observed by a small-angle x-ray scattering (SAXS) that a gel with competing bases, such as hydrophobic and hydrophilic bases, in its polymer network exhibits microphase separation by dehydration[1]. The mechanism of this micrpohase separation is considered as follows: because the network of the gel consists of the hydrophobic and hydrophilic moieties, the solvent (water) can not evaporate homogeneously via the different interaction degrees with the hydrophobic and hydrophilic parts in the gel network, therefore as a result, a heterogeneous structure like the islands in the sea can be generated.

Therefore, it is inevitable to observe the structural evolution on dehydration for proof of this hypothesis. In this study, we measured the structure of an *N*-isopropylacrylamide /sodium acrylate (NIPA:hydrophobic, SA:hydrophilic) gel with various water content by the SAXS experiments.

Experimental

Firstly, we prepared for the dehydrated NIPA gels with NIPA/SA ratio of 4:3. Secondly, we added water to the dehydrated gel to reproduce the intermediate state on the dehydration. The amounts of the added water are 0.0 w, 0.5 w, 1.0 w, 1.5 w and 2.0w: w is weight of the dehydrated gel. SAXS experiments are carried out with SAXS apparatus in BL10C of Photon Factory.

Results and discussion

Figure 1(a) shows SAXS profiles of the re-moistened NIPA gel. As you can see, a peak is observed around 0.020 A^{-1}. This means that the gel makes microphase separation. In addition, the peak position is shifted to lower q-region and its intensity shows the maximum between the amounts of the added water of 0.5 w and 1.0w as shown in Fig. 1 (b). The peak position indicates the size of the cluster. Therefore, the cluster consists of SA-rich network part and water complex domain. With increase of the water, the SA and water complex domain gets bigger and at one critical point the relation between water-rich domain (including a lot of SA parts) and water-poor domain (including a lot of NIPA parts) is inversed. In other words, the water-poor domain (including a lots of NIPA parts) is isolated in matrix of water-rich domain in the gel with a lots of the water. We consider that the critical point locates between 0.5w and 1.0w.

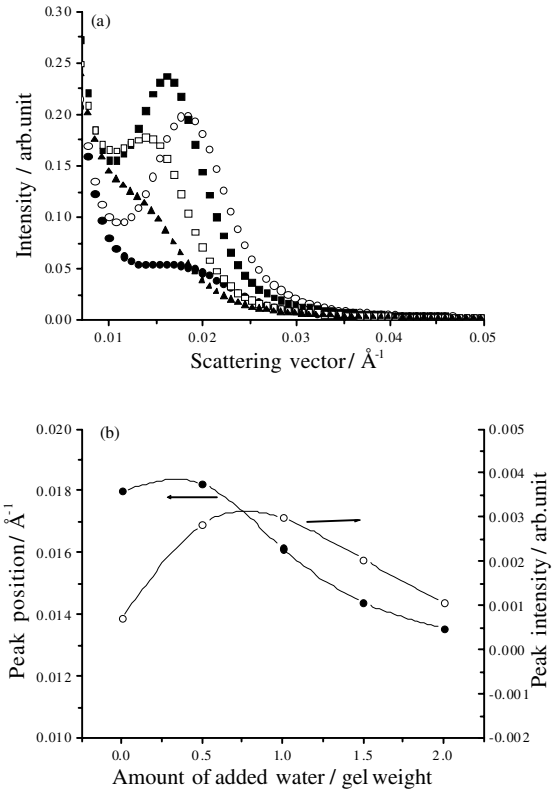

Fig.1. (a) SAXS profiles of the re-moistened dehydrated NIPA gel. Closed circle, open circle, closed square, open square and closed triangle indicate the profiles of the gel added water of 0.0w, 0.5w, 1.0w, 1.5w and 2.0w, respectively. (b) Peak position and intensity distributions of the re-moistened NIPA/SA gel for the amount of added water.

References

[1] M.Sugiyama et al., Jpn. J. Appl. Phys. 38, L1360 (1999).

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