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Change in the Dehydrated-Gel SAXS-Profile with Additives

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Effect of Trehalose

In both of the industrial technology and fundamental science, nanoscale structures have attracted much attention. In these days, several methods are taken to materialize the nanostructure with the structural-scales needed. Among the self-organizing techniques, there are still many concrete creating methods; the authors have been much interested in one of these methods which make use of constituent compatibilities. The authors have adopted trehalose which is compatible with the solvent(water) in hydrogels and, recently, has attracted much attention with a functionality to protect cells against extreme conditions such as dehydration and freezing..

As shown in Fig.1 of the previous report (shown above), the authors have found an influence by introducing trehalose: In double legalism plot of SAXS profile, the dehydrated agarose gel without trehalose shows a straight line indicating a fractal-like structure in the observed scale range (from 60Å to 1000Å) with the fractal dimension of 2.3. The dehydrated agarose gel *with* trehalose shows a different feature: the straight line in the double legalism plot ends around 0.03Å^{-1} (pointed with an arrow, ~200Å in real space) indicating a structure which can be characterized by some scale of ~200Å.

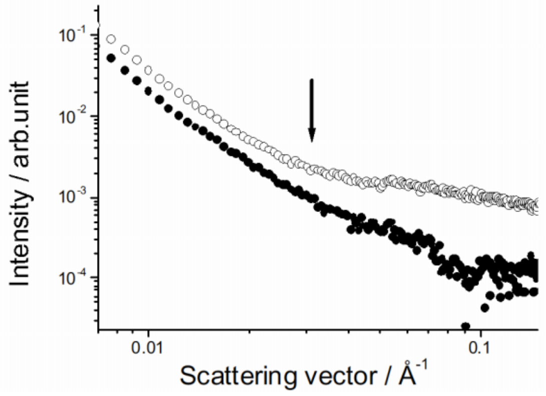

Fig.1. SAXS profiles of dehydrated agarose gel with and without trehalose. Closed circle and open circle indicate the profiles of the dehydrated agarose gel without trehalose and with trehalose, respectively. The inset arrow indicates the lower limit of scale of fractal structure in the agraose gel with trehalose (previous report).

Effect of Additive in Other System

The effect of an additive can be also observed in the other dehydrated gel system. Figure 2 shows SAXS profiles of the dehydrated NIPA/SA gels with and without additive cupper ion. With absorbing cupper ion, the SAXS peak shifts toward the lower-q region demonstrating a correlation length of the hydrophilic domains becomes small. This feature can come from a condition that each cupper ion (Cu^{2+}) in the hydrophilic domains attracts two ionized side chains (negatively charged carboxyl groups) dangling from separated main chains by making a chelate-connection. It has been also found that superfluous Cu^{2+} ions can not interact with the stuffed ionized side chain polymers and, consequently, do not affect the nanoscopic structure. Other characteristic change is a broadening of the SAXS peak indicating an increase in a heterogeneity of the domain structure. This feature can reflect a heterogeneous distribution of the region where the chelation occurs, however because there exists still a clear SAXS peak, the heterogeneity may be small.

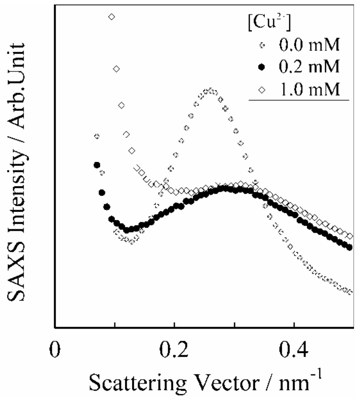

Fig.2. The SAXS profiles of a dehydrated NIPA/SA (500mM/200mM) gel and of those dehydrated after absorbing Cu^{2+} ion. Numerals in a square at the upper-right corner are Cu^{2+} concentrations of aqueous solutions in which NIPA/SA gel lumps were immersed before dehydration.

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