

Reentrant Behavior of Bovine Serum Albumin with Multi-Valent Cation: Effects of Coexistence of Monovalent Cation

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Some hydrophilic proteins are regarded as “charged particles” due to their positive/negative charge(s) on their surfaces. Reentrant phenomenon is an interesting behavior for the solutions of these “charged particles” that the solubility of particles depends on concentration of multi valent ions; (i) the particles are soluble with lower concentration, (ii) insoluble in middle concentration, and (iii) soluble (reentrant) in higher concentration (Zhang et al. 2008)[1]. This phenomenon should be related with the protein’s in vivo behavior such as peptide folding, aggregation/segregation. Toward quantitative discussion of this reentrant phenomenon, we explored aggregation behavior of bovine serum albumin (BSA) solution with multi valent cation Yttrium chloride (YCl_3) using light scattering technique.

Static light scattering (SLS) measurements were carried out with Strutt (our self-making light scattering spectrometer) with a laser of wavelength as 633 nm. Scattering angle was set at 90° . YCl_3 concentrations were varied in the range of 0.05 – 100 mM. Monovalent salt NaCl was added as an additional salt at a concentration of 0 or 50 mM.

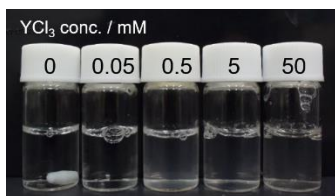


Figure 1: Picture of the sample vials with increase of YCl_3 concentration (BSA concentration was set at 50 mM).

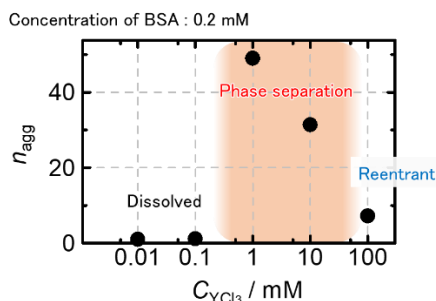


Figure 2: Relative scattering intensity of the solutions of BSA/BSA aggregates against YCl_3 concentration.

Figure 1 shows the visual observation of the solution with five YCl_3 concentrations, and aggregation numbers (n_{agg}), which are calculated from the relative scattering intensities, shown in the Figure 2. With YCl_3 concentration of 1 or 10 mM, the solutions were slightly turbid and the relative scattering intensities were about 50 times higher than the ones of lower YCl_3 concentrations. Above the concentrations of 10 mM, relative intensities were decreased with increase of YCl_3 concentration. It means decrement of aggregation number, and this is the first quantitative report of reentrant phenomenon. In the solution of monovalent salts added, the concentration range of YCl_3 accompanied with aggregation narrowed. However, in this region aggregation occurred, the turbidity became stronger and larger aggregation numbers were observed.

Reference

[1] Zhang, F. et al. Reentrant Condensation of Proteins in Solution Induced by Multivalent Counterions. *Phys. Rev. Lett.* **2008**, 101 (14), 148101.