Dynamic properties of reversible clusters in concentrated lysozyme solutions with both a short-range attraction and long-range repulsion

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At low salt condition, the interaction between lysozyme proteins in solution consists of a short-range attraction and long-range repulsion (SALR). This long-range repulsion is mainly due to the screened Columbic interaction between proteins and is not very sensitive to temperature. However, the short-range attraction, which is believed to be mainly due to the hydrophobic patches of the protein surfaces, is very sensitive to temperature. Thus, the attraction strength between lysozyme proteins can be controlled by temperature. Computer simulation has shown that reversible clusters form in lysozyme solutions due to the competition of the attraction and repulsion. The formation of clusters can cause the increased viscosity of concentrated protein solutions. Using neutron spin echo, we have studied the short-time behavior of the protein solutions with cluster formations. It is shown that even though the attraction increases significantly, the short-time diffusion for lysozyme proteins does not vary too much after normalizing the diffusion coefficient with the solvent viscosity. This indicates that the formed clusters are not very strongly bounded clusters in solutions. At very high concentrations in the random percolated region, the normalized diffusion coefficients become sensitive to the temperature. This indicates that there are more strongly bounded small clusters in the random percolated region.