Small-angle Scattering Studies of the Mixed Amyloid Peptide/SDS Aggregates

Jhih-Min Lin (林智敏)[1], Tsang-Lang Lin (林滄浪)[1], and U-Ser Jeng (鄭有舜)[2]

[1]Department of Engineering and System Science, Tsing Hua University, Hsinchu, Taiwan
[2]National Synchrotron Radiation Research Center, Hsinchu, Taiwan

The amyloid peptide is a fragment derived from proteolytic cleavage of the large amyloid precursor protein (APP). The monomer of amyloid is soluble, but at higher concentration amyloid will self-assemble into fibril. The fibrillar aggregates of amyloid are associated to Alzheimer's disease [1]. The studies of amyloid peptide fibril by X-ray diffraction and NMR show that amyloid fibril contain pleated β-sheet [2]. Some researches further show that the pleated β-sheet is twisted and the direction of β-stranded is perpendicular to fibril axis [3]. As the α-helical structure of amyloid transfers to β-sheet structure, amyloid will aggregate to form fibril and deposit. In the presence of SDS micelles, it is found that a peptide fragment comprised of residues 1-28 has α-helix structure and it is located at the micelle surface and does not insert into the hydrophobic interior [4]. Our previous SANS studies on the effect of adding small amounts of SDS to the amyloid peptide 1-40, at below the SDS critical micelle concentration, could suppress the aggregation of amyloid into fibrils and we found there are SDS/amyloid mixed aggregates in coexistence with small amounts of amyloid fibrils [5]. In this study, the effect of adding SDS at higher than the SDS critical micelle concentration was studied using small-angle X-ray scattering. For the peptide of 0.12 mM in an aqueous solution mixed with 20 mM SDS monomers, SAXS profiles measured at 12, 22, and 42 h after the preparation of the sample solution illustrate clearly that SDS monomers together with SDS micelles suppress better the fibril formation of amyloid peptide at an earlier stage, in comparison with the case of solely SDS monomers. Fig. 1 shows the measured SAXS profiles of mixed amyloid/SDS at 12 and 22 h in together the scattering profile of pure 20 mM SDS. The scattering peak around Q=1.7 1/nm indicates the formation of complex aggregates of SDS/amyloid. The scattering intensity becomes lower at 22 h as compared with that at 12 h. This might indicate that either the number of the mixed aggregates decreases or the size of the mixed aggregates becomes smaller. It is possible that amyloid adsorbed to the SDS micelle surface and stabilized by the surface charge of SDS micelle could still depart the micelle surface and aggregate into amyloid fibril. This would reduce either the number or the size of the mixed aggregates.

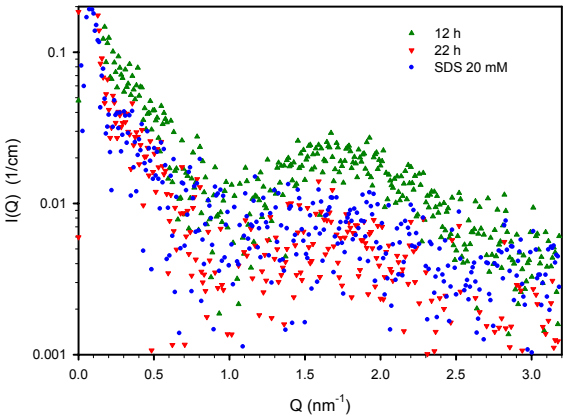

Figure 1. Small-angle X-ray scattering profiles of mixed 0.12 mM amyloid 1-40 and 20 mM SDS at 12 and 22 h after mixing, and the scattering profile of pure 20 mM SDS.

References

[1] C. L. Masters, K. Beyreuther, M. Trillet, Y. Christen, Amyloid protein precursor in Develop, Aging and Alzheimer's Disease, Springer-Verlag, 1994.

[2] L. Li, T. A. Darden, L. Bartolotti, D. Kominos, L. G. Pedersen, Biophysical Journal **76** (1999) 2871.

[3] M. Sunde, L. C. Serpell, M. Bartlam, P. E. Fraser, M. B. Pepys, C. C. F. Blake, J. Mol. Biol. **273** (1997) 729.

[4] K. J. Marcinowski, H. Shao, E. L. Clancy, M. G. Zagorski, J. Ame.Chem. Soc. **120** (1998) 11082.

[5] U-S. Jeng, T.-L. Lin, J. M. Lin, D. L. Ho, Physica B, in press.