X-ray Solution Scattering of Biological Supramolecules on an Undulator Radiation Source

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X-ray scattering experiment of apoferritin has been continued at the SAXS station of RIKEN structural beamline I (BL45XU) [1] with the intention of obtaining high quality scattering data over the range of very small to medium angles required to study structures of supramolecules in solution. In the previous study [2], the scattering profile of apoferritin was recorded on an X-ray image intensifier with a cooled CCD camera(XR-II+CCD) and compared with that recorded on a position sensitive proportional counter (PSPC). It was demonstrated that the XR-II+CCD data after circular average has a high statistics enough to distinguish very fine weak scattering in medium angle from the noise level. On the other hand, XR-II+CCD revealed its rather narrow dynamic range(~2). For the past year, the R&D of XRII+CCD as a detector for synchrotron solution X-ray scattering has been done by Fujisawa et al. and the shortage of dynamic range was overcome by introducing various size of mask on detection plane and dividing recording region. Here, An application of this procedure to solution scattering measurement of apoferritin was presented.

The scattering profile of a 10.8mg/ml solution of apoferritin was recorded on XR-II+CCD using copper disks of different diameters. Fig.1 shows the profiles obtained with no mask and with 15 and 30mm masks. In the inset, the profile recorded on PSPC at BL-10C of the Photon Factory is also represented as a reference pattern. It is clear that there is a desmearing effect of masking on the scattering profile. Moreover, the successive weak peaks up to 8-th order in medium angle became more distinctly detectable when the larger central area of detection plane was masked. The radial electron density distribution of apoferritin was calculated from the reconstituted profile, which was made of the no mask data of S< 0.008Å^{-1}, the 30mm mask data of S<0.0165Å^{-1} and 15mm mask data of S> 0.0165Å^{-1}. Fig.2 shows three radial electron density distribution curves obtained from the reconstituted XR-II+CCD profile, PSPC profile and crystallographic data. These curves are closely similar to each other.

The present and previous studies demonstrate that the SAXS facility of BL45XU has the capabilities of permitting X-ray scattering study of biological supramolecules in solution.

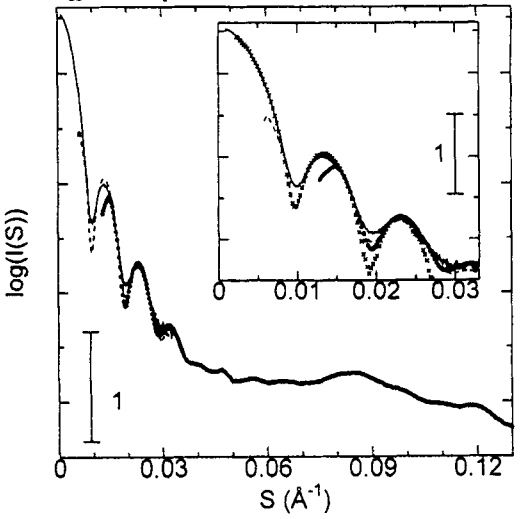

Fig.1 Scattering curves of apoferritin recorded on XR-II+CCD with no mask (——) and 30mm mask (---) at a 2m camera length and with 15mm mask(ooo) at a 0.5m camera length. The inset shows an expansion of the profiles together with the profile on PSPC(×××).

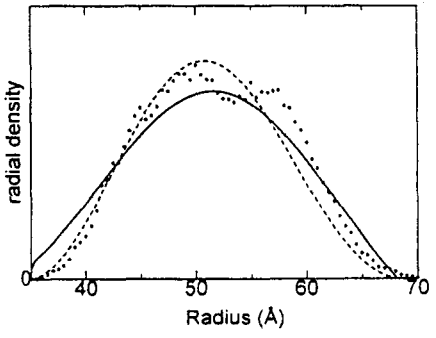

Fig.2 Comparison of radial electron density distribution calculated from XR-II+CCD scattering data(---) with those from PSPC(——) and crystallographic data(•••).

References

[1] T. Fujisawa et al., SPring-8 Annual Report 1997, p238.
[2] Y. Inoko et al., SPring-8 Annual Report 1997, p342.