

Feasibility of SAXS/WAXS measurements using tunability and its application on supramolecule systems

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The beamline BL40B2 is a monochromatic focused X-ray beamline with tunability ranging in photon energy from 5 to 20keV. A feature of this beamline is that its experimental station has two experimental modes for small-angle scattering (SX) and protein crystallography (PX) which can be exchanged by minor rearrangement in a short time. An imaging plate (IP) area detector having a large detecting area (30cm x 30cm) is installed as a common detector. Therefore, BL40B2, as well as the SAXS station of BL45XU, is expected to be well suited for scattering and diffraction experiments of supramolecule systems in which the data collection over a wide range of angles is required to elucidate their internal structures.

The present study has been proposed to evaluate the current status of the facility of BL40B2 in the SX mode. For this purpose, measurements have been done on solutions of apoferritin and pellets of DPPC-water mixtures, particularly with the intention of examining the possibility of expansion of data collection range using wavelength modulation.

The scattering patterns from about 10 mg/ml solutions of apoferritin (~500,000 Da), prepared from horse spleen ferritin, were recorded on the IP detector (Rigaku R-AXIS IV) at wavelengths of 1.77, 1.55, 1.03 and 0.73Å (corresponding to photon energies of 7, 8, 12, 17 keV) for a camera length of 1 m. Fig.1 shows the scattered intensity curves which were circularly averaged without any correction for detector characteristics. The profiles, except the 1.77Å data, coincide closely with one another in the overlap region of detecting angles, implying that the recording with the change of wavelength is apparently free from the fading effect of IP. The diffraction patterns of slightly hydrated DPPC were recorded for a camera length of 0.4 m at various wavelengths. Fig.2 shows the pattern for 1.03Å. The first order of lamellar reflection and the high-angle reflections originating from the packing of hydrocarbon chains are detected with enough spatial margins. In all experimental conditions, the high-angle resolutions practically accessible for analysis were the same as those calculated from the size of detecting area and the used

wavelength. A small-angle scattering resolution of about 600Å was obtained with a Guinier plot of the scattering data when the measurement was done at a 1.77Å wavelength using a 1-m camera with a beam stop of a size of 4mm x 4mm.

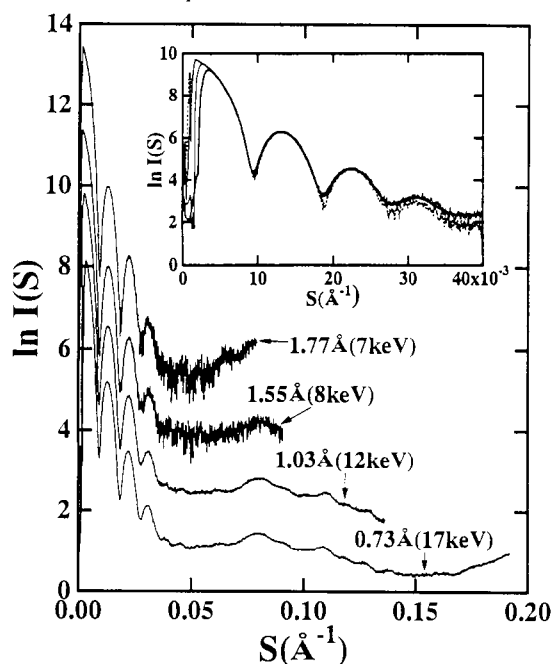


Fig.1 Circularly averaged scattered intensity curves of apoferritin recorded at various wavelengths. In the inset, a comparison is made by superposing the profiles.

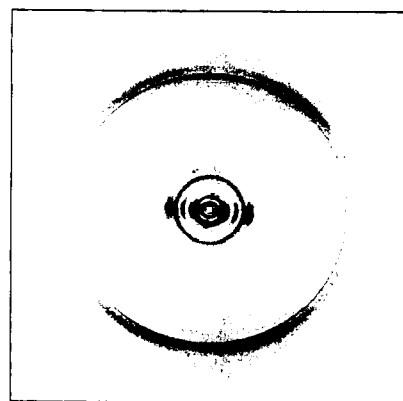


Fig.2 Diffraction pattern from a DPPC lamellar phase with a partial orientation.