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Preliminary Study of X-ray Photon Correlation Spectroscopy at BL-15A2

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1 Introduction

X-ray Photon Correlation Spectroscopy (XPCS) is a coherent X-ray scattering technique with which sample dynamics can be studied. By analyzing the time correlation of speckle X-ray scattering images, one can obtain the time-scale and mode of sample dynamics.

BL-15A2 is a new beamline at which X-rays from undulator is available. At this beamline, low-energy X-rays covering *K*-edges of sulfur and phosphorus can be used; thus, XPCS measurement at this beamline opens up the opportunity of studying the element specific dynamics of soft materials by using resonant X-ray scattering of sulfur and phosphorous. In the present report, we show the result of feasibility study of XPCS at BL-15A2, focusing on the beam stability.

2 Experiment

XPCS measurements were performed at BL-15A2, Photon Factory. We installed a set of pinholes: 20 μmϕ to produce partially coherent X-rays and 50 μmϕ to remove parasitic scattering. X-ray energy used was 7.27 keV. Unfortunately, the ring was not at top-up operation. Scattering from samples was measured using an indirectlly-illuminated X-ray detector with C4880-80 (Hamamatsu Photonics, ltd.) [1]. As a test sample, glassy carbon plate was used. We have confirmed that the glassy carbon plate is static scatterer. X-ray flux at sample position was estimated to be less than 1×10^8 photons/s.

3 Results and Discussion

Figure 1 (upper) shows the time-evolution of azimuthal evolution X-ray scattering intensity at certain scattering angle. The frame rate was 0.091 Hz. Intensity fluctuation over azimuthal angle due to the speckle was observed. In terms of temporal beam stability, a gradual decrease of overall scattering intensity was observed in addition to the temporal fluctuation of scattering intensity and discontinuous intensity fluctuation that is noticeable around 315 and 350 frames. This gradual decrease originates from the decrease of ring current. To remove the influence of inident X-ray flux, we normalized the scattering intensity at each frame by the integrated scattering intensity (Fig. 1 (lower)). Still, temporal fluctuation of scattering intensity is observed. We speculate that it originates from (i) the instability of beam position impinging on the collimator pinhole and/or (ii) that of surface plates, because we have confirmed that the sample and pinhole system is highly static and stable. Temporal intensity correlation functions do show no *q*-dependence (Fig. 2), which support the above speculation.

In summary, we conclude that XPCS can be conducted at this beamline for the system showing the dynamics of slower than several miniutes; however we need to improve the stability of all the beamline component for further study.

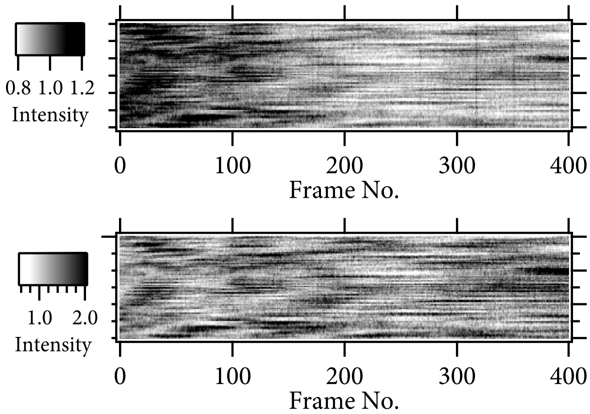

Figure 1: Time-evolution of azimuthal distribution of X-ray scattering before (upper) and after (lower) the nomalization.

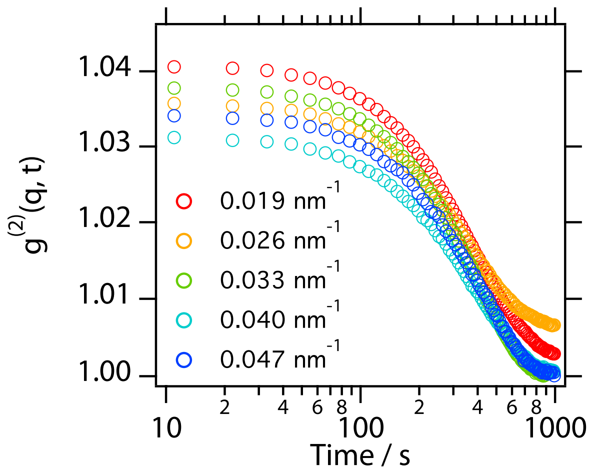

Figure 2: Temporal intensity correlation function. There is no q-dependence (see text.)

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References

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