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# Single-pulse XAFS measurement by XSTRIP detector with DXAFS instrument

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## Introduction

XSTRIP is a silicon miscrostrip X-ray detector system developed in Daresbury Laboratory [1]. It is a powerful tool for the time-resolve DXAFS studies, and it has been installed in NW2A beamline of PF-AR. 1,024 pixels are fabricated on Si (500μ m thick) with the spatial resolution of 25 μm. The output signal from the XSTRIP chip is digitized by 32 of 14-bit ADCs (5 MHz), and the minimum integration time is 0.5 μs for one scan. This minimum integration time of XSTRIP is 4,000 times shorter than that of photodiode array (PDA), whose minimum exposure time is 2 ms. Since the time interval of pulsed X-rays of PF-AR is 1.26 μs, XSTRIP can measure a XAFS spectrum by only one pulse of X-ray. We have carried out some fundamental DXAFS measurements using the XSTRIP detector to evaluate its performance.

## Experiments

The DXAFS measurements of Cu foil were carried out at NW2A beamline of PF-AR using an Si(111) bent crystal (Bragg-type) polychromator with the bending radius of 3,000 mm and XSTRIP. The bunch revolution signal of 794 kHz at PF-AR was used as the trigger for starting the XSTRIP scan to synchronize the scan with the X-ray pulse.

## Results and Discussion

The XAFS spectrum of Cu foil measured at the Cu K-edge using DXAFS with XSTRIP is shown in Figure 1 together with the spectrum measured at the conventional XAFS beamline with an Si(111) double-crystal monochromator. This XAFS spectrum (a) is obtained by one pulse of X-ray. Although the signal-to-noise ratio of spectrum (a) is not so good, the EXAFS oscillation characteristic to Cu can be clearly observed.

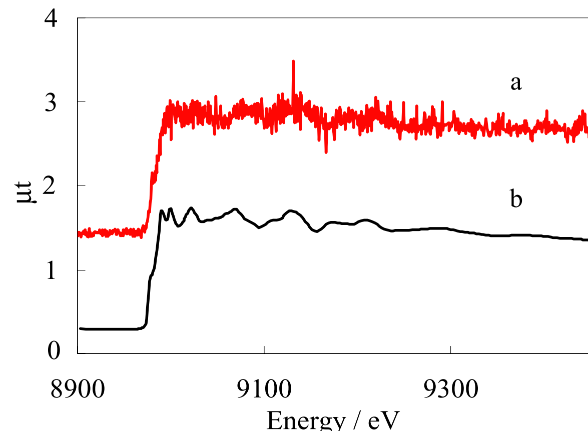


Figure 1. XAFS spectra of Cu foil at the Cu K edge measured using DXAFS with XSTRIP (a) and at the conventional XAFS beamline (b).

In Figure 2, the XANES spectrum of Cu foil measured at the Cu K-edge using DXAFS with XSTRIP is compared with that measured using PDA with $Gd_2O_2S(Tb)$ phosphor and that without phosphor. The integration time and the accumulation number of scans for XSTRIP was 1.5 ms and 10, respectively, and it takes ca. 15 ms to measure one spectrum. On the other hand, those of PDA were 6 ms and 100 for PDA with phosphor (Fig. 2 (c)) and 50 ms and 100 for PDA without phosphor (Fig. 2 (b)), respectively. The total measurement is ca. 2 s for the former and 6 s for the latter. The energy resolution of XANES spectrum obtained with XSTRIP is comparable with that measured using PDA without phosphor and is much better than that measured using PDA with phosphor. XSTRIP enables to obtain a higher-quality XAFS spectrum in much shorter time than using PDA. The single-pulse XAFS measurement using XSTRIP will bring a great breakthrough for the electronic and structural investigations in many chemical fields.

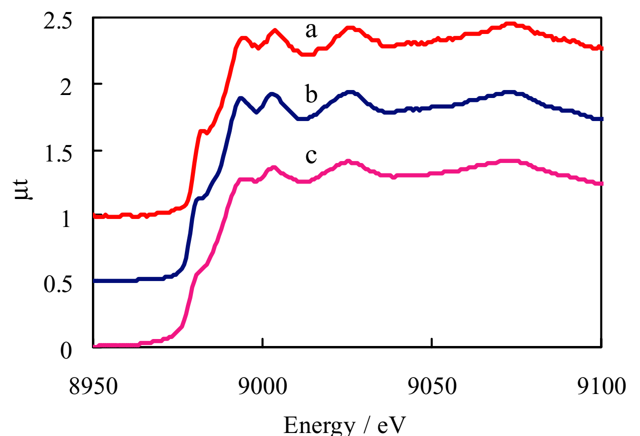


Figure 2. XANES spectra of Cu foil at Cu K edge measured using the DXAFS instrument. The detector was XSTRIP (a), PDA without phosphor (b) and PDA with $Gd_2O_2S(Tb)$ phosphor (c).

## References

[1] J. Headspith et al., Nucl. Instrum. Methods. Phys. Res. A, 512, 239 (2003).

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