

# XMCD Measurements at *K*-Edge using Diamond Phase Retarder

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Since a  $\lambda/4$  phase plate can efficiently convert linearly polarized X-ray to circularly polarized one [1], application to X-ray magnetic circular dichroism (XMCD) has been already developed [2]. The phase plate can provide a high-rate of degree of circular polarization  $P_c$ , and amplitude of XMCD is proportional to  $P_c$ , hence the phase plate is favorable to measurement of a weak XMCD signal. In this work, efficiency of the diamond phase retarder installed on the BL39XU is examined for the availability at the *K*-edge in pure Fe and Co metals, where the XMCD of 0.2% to edge-jump in the XANES spectrum has been observed.

XMCD was recorded in transmission mode under the plus helicity fixed. The magnetic field was tilted by  $60^\circ$  away from the incident X-ray and applied parallel to the plane of a foil 5  $\mu\text{m}$  in thickness. Data accumulation was made 40 times at each energy point while the field direction was reversed at intervals of 2 sec.

At the Fe *K*-edge, when offset angle of the diamond phase plate 0.73 mm in thickness was adjusted to about 180 arcsecs, the value of  $P_c > 0.99$  was estimated from the polarization analysis. Helicity can be easily alternated between the offset angles of  $\pm 180$  arcsecs. Figure 1 shows the Fe *K*-edge XMCD and XANES spectra in pure Fe. This XMCD clearly shows a better S/N ratio, a better efficiency, and a better statistical accuracy in comparison with the early data. We can also find several fine structures with a slightly better energy resolution. These benefits result from the high-rate of  $P_c$  and the high-flux beam.

When the offset angle is changed the sign from positive to negative, that is, the helicity is alternated from plus to minus, a reversal of XMCD spectrum will be taken place. Indeed,

figure 2 demonstrates the Co *K*-edge XMCD and XANES spectra in pure Co, and clearly shows the reversal with a good reproducibility.

This test shows that the diamond phase retarder efficiently functions as a device for generating the circularly polarized X-rays and for alternating the helicity. The XMCD spectrum can be improved by the phase plate.

## References

- [1] T. Ishikawa *et al.*, *Rev. Sci. Instrum.*, **63** (1992) 1098.
- [2] C. Giles *et al.*, *J. Appl. Cryst.*, **27** (1994) 232.

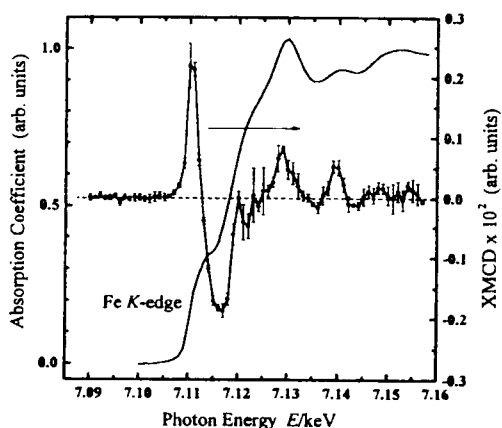


Fig.1. XMCD and XANES at the Fe *K*-edge in pure Fe.

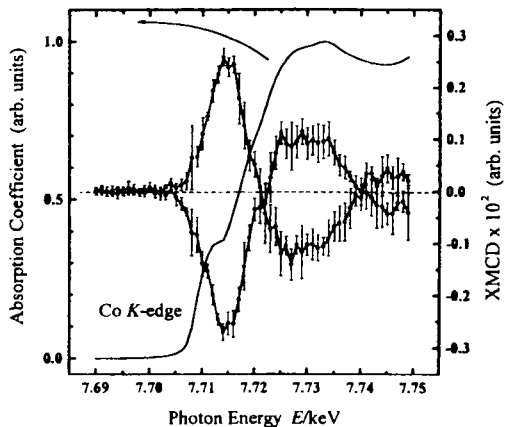


Fig.2. XMCD and XANES at the Co *K*-edge in pure Co. The reversal of XMCD results from the helicity alternation.