

Development of Scanning Hard X-ray Microprobe for Element-Specific Magnetic Imaging at SPring-8 BL39XU

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A scanning x-ray microprobe has been developed at SPring-8 BL39XU for x-ray magnetic circular dichroism (XMCD) measurement in the hard x-ray region with micron scale spatial resolution. This equipment is based on a micro-focusing method utilizing a Kirkpatrick-Baez (KB) mirror and the x-ray helicity switching technique using a diamond x-ray phase retarder[1] installed in BL39XU. The highly refined KB mirror was fabricated using the plasma chemical vaporization machining and the elastic emission machining[2]. This microprobe allows element-specific magnetometry and XMCD spectroscopy in a particular minute area of a sample. Element-specific magnetization mapping is also available. The intended photon energy is 5-16 keV. These high energy x-rays offer a deep probing depth, which is quite useful for exploring a buried magnetic layer in industrial samples of layered structures, such as magnetic storage media and magnetic random access memories. The following results were obtained through the development process:

1. Focusing property

The focused beam spot size of 1.2(vertical) micron \times 1.0(horizontal) micron was achieved at 8 keV when the source size is minimized. The photon flux in the beam spot was 4.8×10^9 photons/s at that condition. A ten times more intense flux was obtained in a reasonable spot size of 2 micron square for a larger source size.

2. Magnetization mapping

For magnetization mapping, an XMCD image of a hard disk medium CoCrPtB, artificially in-plane magnetized with stripe patterns, was successfully obtained at Pt- L_3 edge (Fig. 1). The XMCD effect was $\sim 5\%$ of the total absorption, and the stripes of 2.4 micron width was clearly resolved.

[1] M. Suzuki et al. Jpn. J. Appl. Phys. **37** (1998) L1488.

[2] K. Yamauchi et al. Jpn. J. Appl. Phys. **42** (2003) 7129.

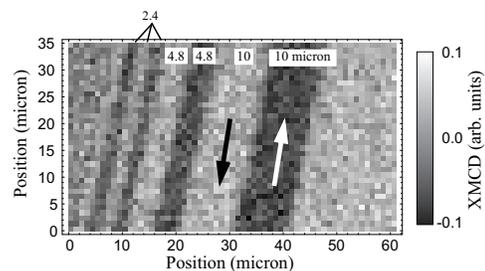


Fig 1: An XMCD image of CoCrPtB taken at Pt- L_3 edge in the fluorescence mode. The incident x-rays make an angle of 45 degrees with respect to the sample surface. In the image, numerals indicate the width of the stripe patterns, and the arrows are the direction of magnetization.