MAGNETO-OPTICAL KERR EFFECT IN BAFEO$_3$

T. Tomoyuki[1,2], T. Someya[1], Sh. Yamamoto[1], S. Chakraverty[3], I. Matsuda[1], H. Wadati[1,2], H. Y. Hwang[3,4] , and Y. Tokura[2,3]

[1]Insutitute of Solid State physics, The University of Tokyo

[2]Department of Applied Physics and Quantum-Phase Electronics Center (QPEC), The University of Tokyo

[3] RIKEN Center for Emergent Matter Science (CEMS)

[4]Department of Applied Physics, Stanford University, Stanford

- Introduction
  - We investigated the magnetism of $BaFeO_3$ thin film (film thickness of ~ 50 nm), a ferromagnetic insulator below 111 K, with resonant magneto-optical Kerr effect by use of soft x-ray in Fe 2*p* absorption edges. The out-of-plane saturation magnetization is ~ 2.8 μ_B/Fe with an external magnetic field of 0.5 T [1].

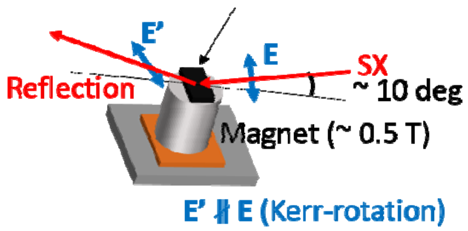

Fig. 1 The geometry of the XMOKE measurement for $BaFeO_3$ thin films on neodymium magnets

  - X-ray magneto-optical Kerr effect (XMOKE) is one of the powerful experimental tool to investigate the magnetism in element-specific way. [2]. The magnitude of Kerr rotation angle in XMOKE is about 50 times larger than that in visible MOKE for typical 3d transition metals [3]. Furthermore, XMOKE is the most suitable method to perform the ultrafast time resolved pump-probe measurements of magnetisms using ultrashort pulsewidth x-ray light sources such as a free electron laser and a high harmonic generation laser. Our final purpose is to perform time resolved XMOKE measurement in ~ 10 fs time resolution.
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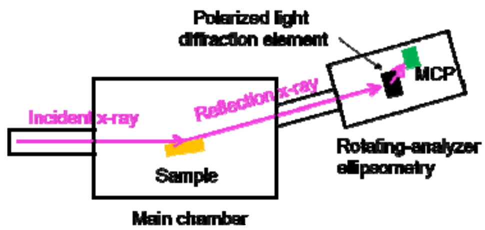

- Geometry and principle of XMOKE
  - The geometry of the XMOKE measurement is schematically shown in Fig. 1.
    The linearly polarized x-ray incidents on the clean surface of a thin film with grazing angle of 10 degrees and the polarization plane of the reflected light is rotated with respect to that of the incident light that reflects the magnetization of the sample. The rotation angle is called Kerr angle. We have utilized polar-geometry in which external magnetic field is applied perpendicular to the film surface (Fig. 1). In order to apply magnetic

Fig. 2 The XMOKE measurement systems (up) and a picture of the main chamber (bottom).

field, we used a permanent magnet. Kerr rotation angle can be measured by using rotating-analyzer ellipsometry (RAE) method and can be extracted from the phase difference between the curves obtained with applying external field up and down direction. The measurement was performed ~ 30 K with the photon energy of ~ 710 eV, corresponding to the peak of Fe *L*-edge XMCD spectra [4].

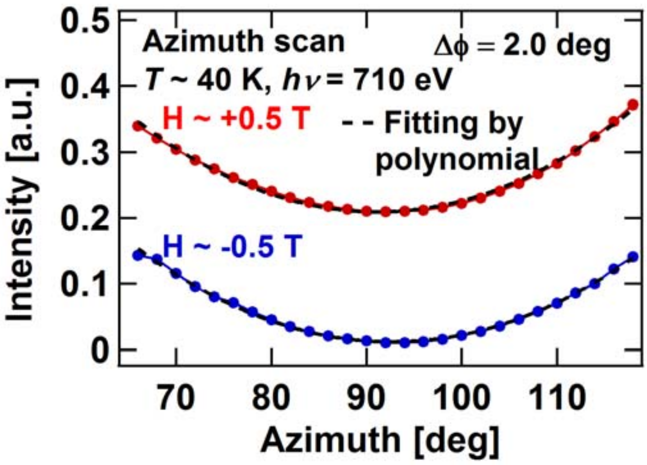

Fig. 3 The results of the XMOKE measurements. We successfully observed 2 degree of the polarization angle.

- Beam line
  - The XMOKE measurements were performed at BL07LSU in SPring-8 in Japan. The chamber shown in fig. 2 was temporary installed for this measurement in a free port area.

- Result
  - Figure 3 shows the results of XMOKE measurements for $BaFeO_3$. The curve obtained by using RAE method, is cosine like curve. By fitting the spectra by quadratic function, respectively, we clarified that the magnitude of twice the Kerr rotation angle is 2 degree.
- Summary
  - We performed Fe *L*-edge XMOKE measurement for $BaFeO_3$ thin films at 30 K. We observed Kerr rotation of 1 degree. We are planning to investigate the effect of Kerr rotations on $BaFeO_3$ thin films by changing the geometry and by improving the precision of the measurement system.

REFERENCES

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