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Grazing incidence magnetic compton profile (GIMCP)

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Nano-structured magnetic thin films, such as multilayers, show interesting properties. They come from modifications of wave functions at the interfaces. Magnetic Compton profiles (MCP) have been known as the probe of wave functions. However, it has been not easy to measure magnetic thin films because of strong background from a substrate. Recently, grazing incident X-rays (GIX) have been recognized as a good tool for thin films because the penetration depth is about a several hundred nm. Then, a magnetic Compton profile under the GIX (GIMCP) is expected to give information on the wave functions of the thin films with good signal-noise ratio. In this study we try to develop a system for measuring the GIMCP.

The incident monochromatized X-ray energy was 42.9keV. The scattering angle was 160 degrees. A beam size was 0.05 2mm^2. Cr buffer layer (20nm) and Fe layer (200nm) were sputtered on a polished glass (BK7) substrate (50ϕ×4t). The topmost was capped by C layer with 2nm. The Fe plate (10×30×0.1mm^3) was measured as a reference sample with an incident angle of 10 degrees. The measurement was carried out under the vacuum at R. T. The applied field on the sample was 0.5T. The background scattering from the window of vacuum chamber was about a several tens cps, which was less than 1% of total counts.

Figure 1 shows an experimental reflection curve of the sample. Critical angles of Fe-C interface: $\theta_{\text{Fe-C}}$= 0.065degree (the calculated value is 0.067 degree) is observed in Fig. 1.

Figure 2 shows energy spectra of scattered X-rays from the Fe 200nm on the substrate (a), the substrate (b) and the Fe 0.1mm(standard sample) (c). The spectra were adjusted to have the same Compton peak intensity. Because Ba K fluorescence (32.1keV) comes from the scattering at the substrate, the contribution of the substrate can be subtracted using the spectrum (b). Then the contribution from the Fe layer can be estimated to be 30% in the spectrum (a).

Figure 3 shows the GIMCP of the Fe 200nm. Solid line denotes the MCP of the standard Fe sample. The GIMCP reproduce the MCP of the standard Fe sample.

In conclusion we can succeed to develop a system for measuring the GIMCP. The GIMCP will become a good candidate, such XMCD, for measuring magnetic thin films.

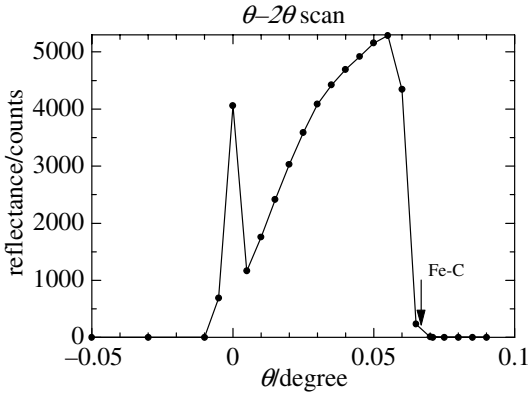

Fig. 1

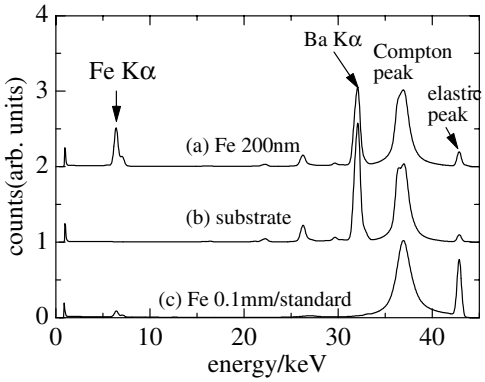

Fig. 2

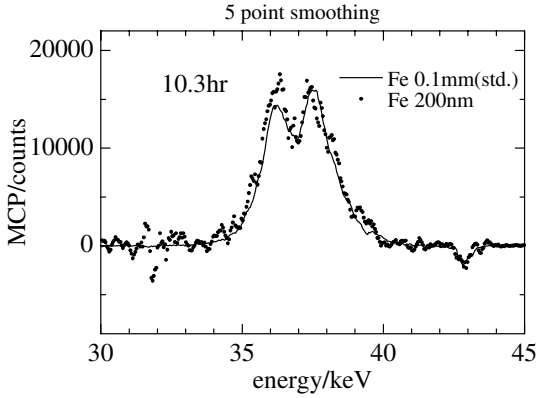

Fig. 3

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