Investigation of spin-flop in XMCD near the compensation of a ferrimagnetic garnet

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The rare-earth iron garnets are cubic ferrimagnetic insulators with the general formula $M_3Fe_5O_{12}$, where M is a trivalent metal ion. The temperature at which the magnetization cross zero is called the compensation temperature T_{com}. Here the magnetization of the M sublattice is equal and opposite to the ferric ion sublattices. At $T<T_{com}$, magnetic moments of the rare-earth site dominate. On the other hand, moments of ferric sublattices dominate at $T > T_{com}$. In order to investigate spin-flops of sublatice moments at T_{com}, we measured MCD spectra. Fig.1 shows Ho-L_3 edge MCD of Ho-IG at T=150K($>T_{com}$) and 110K($<T_{com}$). In following experiments, x-ray beam monochromatized at 8.065 keV were selected. At this energy, the $2p$-$4f$ transition is dominant. Fig.2 shows MCD intensity as a function of temperature under a constant magnetic field H=2T. Around T_{com}, the MCD intensity changes a sign from positive negative. If discrete jumps corresponding to spin-flop of individual clusters exist, Barkhausen type signal is observed in a hysteresis loop. In this sample, these jumps above a noise level have not observed. But multi stage changes have been observed as shown in a inset of Fig.2.

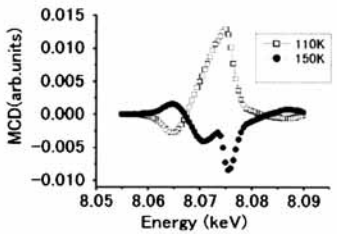

Figure 1. Ho-IG Ho-L_3 edge MCD spectrum at H=2T.

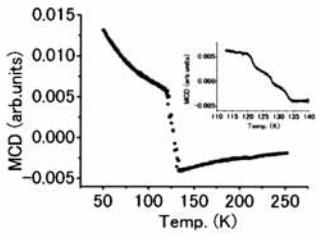

Figure 2. MCD intensity of Ho-IG thin film as a function of temperature.

X-ray Magnetic Circular Dichroism of Pt L-Edge in CoCrPt-SiO_2 Perpendicular Magnetic Recording Films

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Recently developed CoCrPt-SiO_2 granular magnetic layer is hopeful for perpendicular magnetic recording media for HDD with high recording density. In this magnetic layer SiO_2 is important for forming granular microstructure and Pt is also important for increasing magnetic thermal stability of small grain. We measured X-ray magnetic circular dichroism (XMCD) at Pt L-edge and also measured magnetic hysteresis of Pt to clarify the role and behavior of Pt atoms.

The samples were prepared using RF sputtering method. The layered structure of a sample was a glass/underlayer/Ru /CoCrPt-SiO_2/a-C. The thickness of a magnetic layer was 20nm. Substrate temperature was room temperature.

X-ray absorption spectra (XAS) and XMCD spectra of Pt L-edge were measured at the beamline BL39XU in SPring-8. X-ray beam was incident perpendicularly on the specimen surface under magnetic field of 20kOe perpendicular to the surface. The spectra were measured in the fluorescence mode using SDD detector. Magnetic hysteresis of Pt was measured at the energy of MCD peak.

Figure 1 shows the X-ray absorption spectra (XAS) and the XMCD spectra measured at Pt L_3-edge (a) and Pt L_2-edge (b). In the XAS spectra at both Pt L_3-edge and Pt L_2-edge the so-called white line decrease with increasing SiO_2 content. These results suggest that Pt is not oxidized with increasing SiO2 content. The MCD relative intensity to edge gap at Pt L_2-edge decreases with increasing SiO_2 content.

The magnetic hysteresis of Pt varied with SiO_2 content and showed similar curves with magnetic hysteresis measured by a vibrating sample magnetometer (VSM).

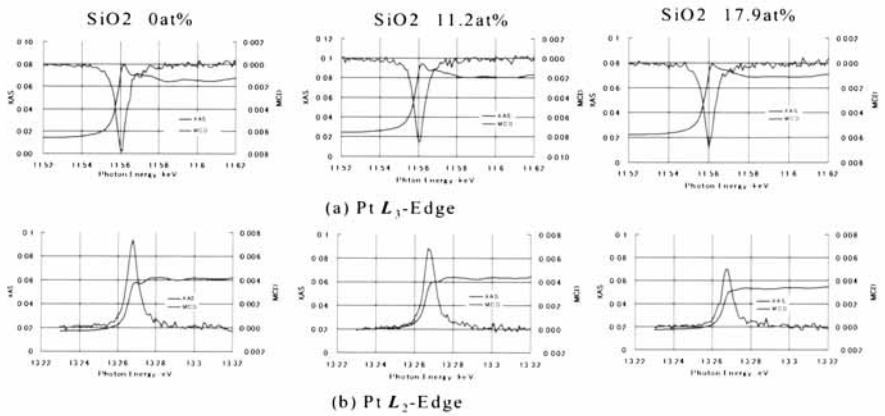

Fig.1. XAS and MCD at Pt L_3-Edge (a) and Pt L_2-Edge (b)