Magnetic field angle-dependent XMCD study of $L1_0$-ordered FePt thin films with perpendicular magnetic anisotropy

K. Ikeda[1], T. Seki[2], G. Shibata[1], S. Sakamoto[1], Y. Nonaka[1], Z. Chi[1], Y.-X. Wan[1], M. Suzuki[1], M. Sakamaki[3], K. Amemiya[3], K. Takanashi[2], A. Fujimori[1]

[1] *Department of Physics, University of Tokyo, Tokyo, Japan*
[2] *Institute for Materials Research, Tohoku University, Sendai, Japan*
[3] *Institute of Materials Structure Science, KEK, Tsukuba, Japan*

In order to increase the storage density of magnetic recording media, magnetic thin films with large perpendicular magnetic anisotropy (PMA) have been extensively studied. $L1_0$-ordered FePt is one of the most promising materials due to its large PMA. However, the precise origin of the PMA remains controversial [1]. According to the perturbation-calculation study by van der Laan [2], the magnetic anisotropy energy (MAE) can be expressed by two terms, one is the spin-conservation term and the other is the spin-flip term. Ueda *et al.* [3] have shown a large contribution of the spin-flip term to the MAE of $L1_0$-ordered FePt by first-principles calculation. However, no experimental proof has been obtained so far. In this study, we have performed Fe L-edge magnetic field angle-dependent x-ray magnetic circular dichroism (XMCD) [4] in order to deduce the MAE and the magnetic dipole moment which contributes to the spin-flip term. Figure 1 shows the results of the measurements of $L1_0$-orderd FePt thin films with different long-range chemical order degree S. One can see that the electric quadrupole moment Q_{zz} which represents the magnetic dipole moment decreases with increasing S.

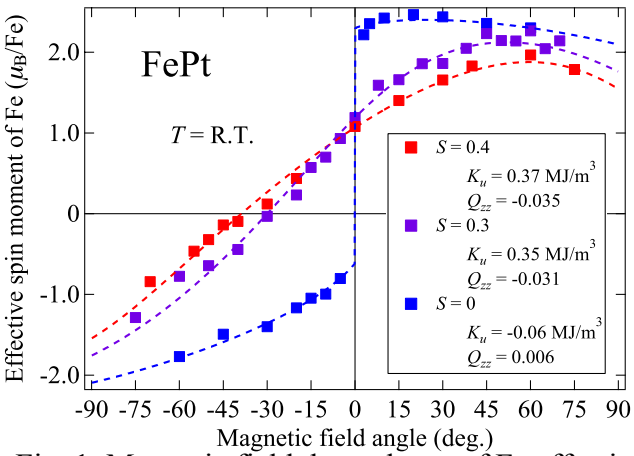

Fig. 1. Magnetic field dependence of Fe effective spin moments measured by Fe L-edge XMCD.

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