

Magnetic hysteresis of XMCD effect in Gd/Fe sputtered multilayer

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XMCD measurements have been made on a Gd(20Å)/Fe(20Å) multilayer with transmission mode on BL39XU, and a magnetic hysteresis of XMCD effect was obtained. The experimental method we used was the helicity modulation technique with a phase retarder[1], instead of a usual field reversal method. The sample was prepared by a magnetron sputtering technique, and deposited on a polyimide film.

Figures 1 and 2 show the hysteresis of XMCD at the Gd L_3 - and the Fe K -edges, respectively. A magnetization curve is also plotted for comparison in Fig.1. Peculiar sharp peaks appear at coercive fields $H_c \approx \pm 50\text{G}$ soon after the magnetic field is reversed. It is worth while noting that no indication associated with the peaks are observed on the magnetization curve. In Fig.2 the hysteresis at the Fe K -edge also shows similar behavior but with an opposite sign. This means that the Fe moments are anti-ferromagnetically coupled with the Gd moments.

Both at the Gd L_3 - and the Fe K -edges, the amount of XMCD effect slowly decreases as the magnetic field increases higher than 400G, while the magnetization monotonously increases for all applied fields. This behavior probably arises from that the Fe moments, which are anti-parallel to the field direction, cant from the field direction faster than the Gd moments, which are parallel, as the increase of an applied field. This observation is consistent with a theoretical prediction so called bulk-twisted state[2].

In conclusion we found for the first time a

characteristic magnetic hysteresis of XMCD signal of individual elements Gd and Fe, which cannot be observed on the magnetization curve. This result shows the availability of XMCD measurement with a helicity modulation technique for the investigation of magnetism of complex materials.

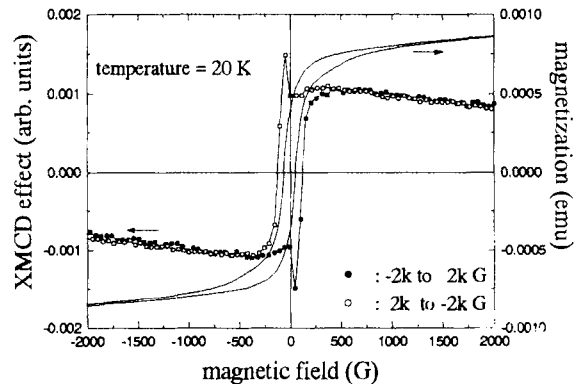


Fig 1 : Magnetic hysteresis of XMCD at the Gd L_2 -edge and of magnetization in Gd(20Å)/Fe(20Å) multilayer.

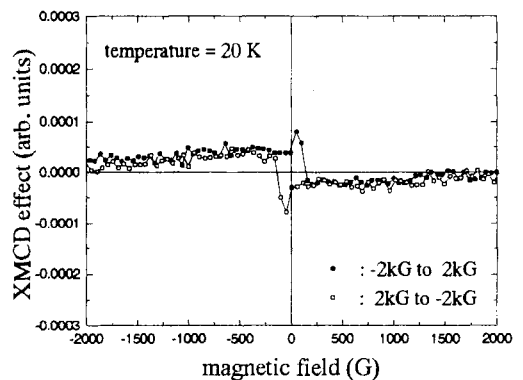


Fig 2 : Magnetic hysteresis of XMCD at the Fe K -edge in Gd(20Å)/Fe(20Å) multilayer.

[1] M.Suzuki, to be published in SPring-8 Annual Report 1997.

[2] J.G.LePage and R.E.Camly, Phys.Rev.Lett. 65 (1990) 1152.