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Report:

We have performed magnetic circular X-ray dichroism experiments (MCXD) on the Pd L-edges on 7 FePd alloy thin films samples. These samples were Al(2nm) / FePd(30 nm) / MgO(100) grown by MBE on the SP2M setup. The deposition temperatures of the various samples, T_{dep}, were chosen such that the resulting long range order parameter (noted here CO) spans the whole range, from full disorder (CO=0) to the best available order (CO=0.91), c.f. Table 1. We showed [1] that in this series of ferromagnetic samples the magnetic moment goes from the in-plane to the perpendicular directions, due to the progressive change of the magnetocrystalline anisotropy.

The measurement has been done in the so-called Transverse geometry mode (T-MCXD), in which the external magnetic field H is perpendicular to the X-rays, i.e. to the photon helicity [2]. In that case, when putting the sample plane at 45°, a single measurement is enough to obtain directly both the orbital and spin anisotropies. The MCXD signal on the Pd $L_{2,3}$ edges were recorded in the Fluorescence mode. In order to fully align $\vec{S}$ on $\vec{H}$, the amplitude of H had to be increased up to 7 Tesla.

No correction for absorption is necessary in these very thin films. After normalisation for incomplete polarisation rates mainly due to the Si(111) monochromation (12.6 and 20.1 % respectively for the L_3 and L_2 edges) the sum rules, well applicable here, were used.

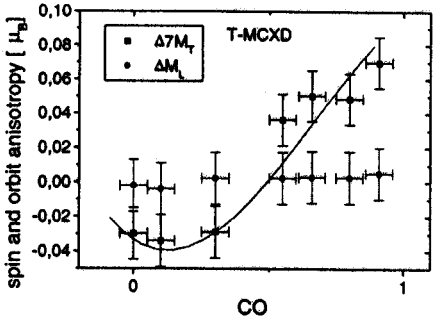
The results for H = 7 T et 45° orientation are given in Table 1.

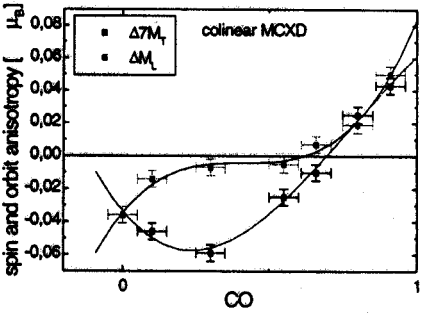
Table 1. The FePd epitaxial films studied are labelled by the T, LRO values. M_L is the orbital moment of the magnetic moment arising from the Pd 4d-band, between the growth direction and the sample plane. M_T represents the spin dipolar contribution to the effective spin moment $M_S^{eff} = M_S - 7M_T$. The "Δ" means the anisotropy of these quantities, between the perpendicular and the in-plane directions.

T_{dep} (°C)	CO	ΔM_L (μ_B)	ΔM_T (μ_B)
20	0.0	0.00	-0.030
130	0.10	-0.004	-0.034
lbl*	0.30	0.002	-0.028
220	0.55	0.0024	0.036
510	0.61	0.003	0.050
420	0.80	0.003	0.049
350	0.91	0.00	0.070

* lbl means "layer-by-layer deposition", all the other samples being prepared by codeposition

These results are also shown on Fig.1. A comparison can be made with our previous results on spin and orbit anisotropies, shown on Fig.2 and deduced from the conventional geometry where H is parallel to the X-rays [1]. Concerning the ΔM_T term, the agreement is remarkably good along the whole series between the 2 independent sets of results, confirming them in absolute values as well as their variation with the CO parameter.
By contrast, the values of the orbital anisotropies are too small by one order of magnitude with respect to the parallel geometry results; this has not been cleared yet.





References

[1] P. Kamp et al. Phys. Rev. B 59 (1999) 1105
[2] H.A. Dürr et al., J. Appl. Phys. 81 (1997) 5355