



Experiment title: Hybridization induced changes in the Fe 3d electronic structure of FePd alloys	Experiment number: HE-352	
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Report:

Determination of energy shifts in core-level photoemission is now a routine way to study the chemical environment especially at surfaces. The use of more bulk sensitive techniques such as x-ray absorption spectroscopy (XAS) is much less developed partially due to the screening effect of the additional valence electron in the final state. This makes XAS mainly sensitive to energy changes of the ground state. We studied the influence of hybridization on Fe in ordered FePd alloy films displaying perpendicular magnetic anisotropy (PMA). Energy shifts in the XAS and MCXD excitation energy allow to separate contributions due to a different chemical environment.

Measurements were performed on beamline ID12B with 85% circularly polarized light. The XAS spectra in Fig. 1A were obtained by reversing the light helicity with the sample remanently magnetized along the surface normal (see Fig. 1B). The MCXD difference spectrum shows the usual lineshape expected for Fe. There is, however, a huge shift in excitation energy of 1.1 eV compared to the tabulated L_3 energy position of bulk Fe (marked by the arrow). At the same energy a shoulder is visible in the XAS spectra which indicates the sample contains bulk-like Fe inclusions. We note that x-ray diffraction performed on this sample showed that only 70% are ordered in the FePd structure [1]. Since the shoulder in the XAS spectra shows no dichroism it can either be clue to non-magnetic Fe or to Fe with an in-plane easy magnetization axis (see Fig. 1B). To distinguish between the two possibilities we performed transverse MCXD (TMCXD) measurements where the

photon helicity vector, P , is oriented 90° relative to the magnetic field, H . Saturating the sample with a strong magnetic field along a non-symmetry direction (see Fig. 1C) results in a transverse component of the orbital moment, L , pointing towards the easy magnetization direction [2]. The TMCXD spectrum in Fig. 1A shows clearly that the Fe inclusions in the sample favor an in-plane easy axis whereas the Fe in the FePd regions display PMA. The large excitation energy shift between the two components shows the dramatic influence of Pd hybridization on the Fe 3d electronic structure.

References:

- [1] P. Kamp, M. Belakhovsky, C. Boeglin, H.A. Dürr, G. van der Laan, P. Schillé, A. Rogalev, J. Goulon, V. Gehanno, A. Marty, B. Gilles, *Physica B* 248, 127 (1998).
 [2] H.A. Dürr, G.Y. Guo, G. van der Laan, J. Lee, G. Lauhoff, J.A.C. Bland, *Science* 277, 213 (1997).

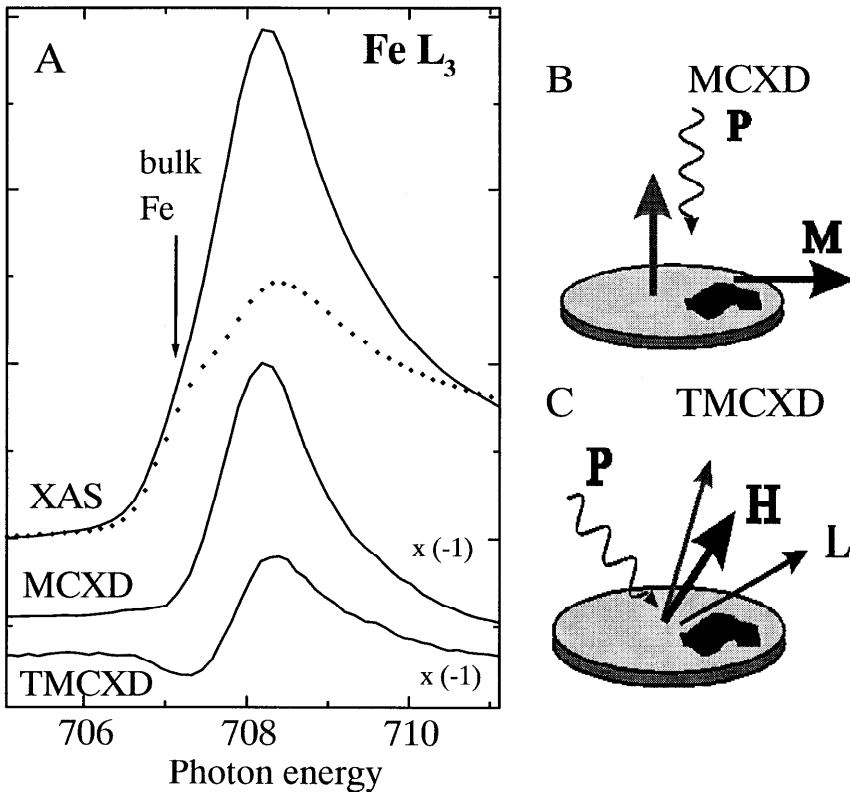


Fig. 1 A) XAS, MCXD and TMCXD spectra obtained in the experimental geometries B) and C), respectively.