ESRF

Experiment title: QUARTER WAVE PLATES AND XMCD ON BLP

Experiment number: HE004

Beamline:

Date of Experiment: from: September 17-23 to: December 3-11 1996

Date of Report:

Shifts:

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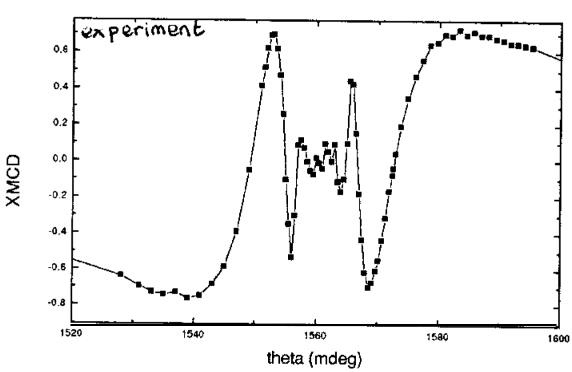
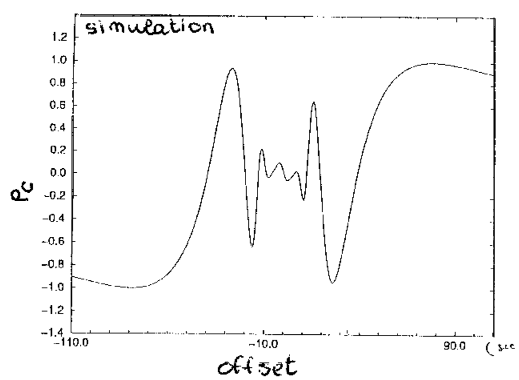
Report:

Evaluation of the diamond (111) QWP in the 7 keV energy range

In the September 1996 run we were able to carry out a complete evaluation of the performances of the diamond (111) QWP coupled to the Si(111) curved monochromator in the energy dispersive beamline. The non-dispersivity conditions between the Si and the diamond crystal was met by adjusting the Ψ angle with a precision of 0.1". An important software-development was necessary in order to achieve such precise optical alignments. The evolution of the XMCD signal as a function of the angular offset (with respect to Bragg condition for the C crystal) (see left figure) allowed us to evaluate the efficiency of the diamond crystal. The (quasi-perfect) simulation (right figure) show that the crystal is 100% efficient in QWP conditions. It is also clear that the quarter wave plate condition can be easily discriminated from half wave plate conditions. The overall divergence of the beamline extracted from the simulation is of 4.5arcsec.





LiF single crystals for QWP in the 11-13 keV range

In the last proposal we speculated about the possibility to use quarter wave plates in the range of the Pt L -edges. Our initial idea was to use diamond crystals of appropriate thickness, which have not been found. CMalgrange suggested to see whether a LiF crystal could work, provided the quality of the crystal is acceptable. Our main concern was to compare the performance of a perfect LiF crystal with that of he diamond (111) crystal used before. The experimental conditions for photons of 7743 eV (Gd L3-edge) are reported in CGiles PhD Thesis (page 43). The offsets needed to phase the two polarisation components by $\pi/2$, are quoted below.

$$\Delta\theta_{\pi/2}(t)=-(re^2/\pi^2)*(F_h/V)^2 *\lambda^3 \sin 2\ \Theta_B\ t\ ,$$

The key-point is the number (30) in parenthesis which represents the best mosaicity expected for LiF. If worst, this can lead to a decrease of the circular polarisation rate.

	c (111)	Si (111)	LiF (200)	
d(Å)	2.059	3.135	2.014	
$(F_h/V)^2$:	0.17	0.14	0.22	
$t=\mu^{-1}$ (µm) :	515	51	508	
Θ_B (°) :	24.6	15.9	25.2	
ϖ_D(arcseconds)	5.6	7.7	6.7	(30)
$\Delta\theta_{\pi/2}(t)$:	50	3.2	74	
$\Delta\theta_{\pi/2}(t)/\ \varpi_D$:	8.9	0;4	11	(2.5)

The following figures report the XMCD signal of $Pt_{28}Fe_{72}$, collected at room temperature for both Pt L3 and L2 edges using a 1.4 mm-thick LiF(200) QWP. The range of offsets is very manageable. In the next run we expect to be able to evaluate the real mosaicity of this crystal (Pt L3 $\Delta\theta_{\pi/2}$= 45 arcsecs and L2 $\Delta\theta_{\pi/2}$=43.2 arcsecs). The beam intensity is reduced by a factor 7 at 11.564 eV (Pt L3 edge). More extended studies are needed to evaluate the real mosaicity of this crystal which shows a limited number of defects by X-ray topography. Dismounting the crystal reveals the X-ray impact due to the irradiation-made coloured centers as it is well known. It remains to evaluate the starting mosaicity and to evaluate whether the irradiation reduces significantly the crystallographic quality of the crystal.