



Experiment title: X-ray linear polarization analysis using a dichroic filter

Experiment number: 28-01-51

Beamline:
BM 28

Date of experiment:
from: 07/12/99 to: 12/12/99

Date of report:
6/4/00

Shifts:
15

Local contact(s):
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Received at XMaS:

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Report:

We report the first use of a simple, fixed-wavelength X-ray polarizer, based on linear dichroism at the Br K-edge (13.474 keV) of dibromoalkane molecules, oriented in a urea host lattice [1]. The polarizer has been tested by performing a polarization analysis on magnetic diffraction from antiferromagnetic holmium.

While X-ray linear dichroism as a polarizing mechanism is considerably less effective than Brewster-angle ($2\theta \sim 90^\circ$) diffraction, and is limited essentially to a fixed wavelength, it does have important advantages in some applications [2].

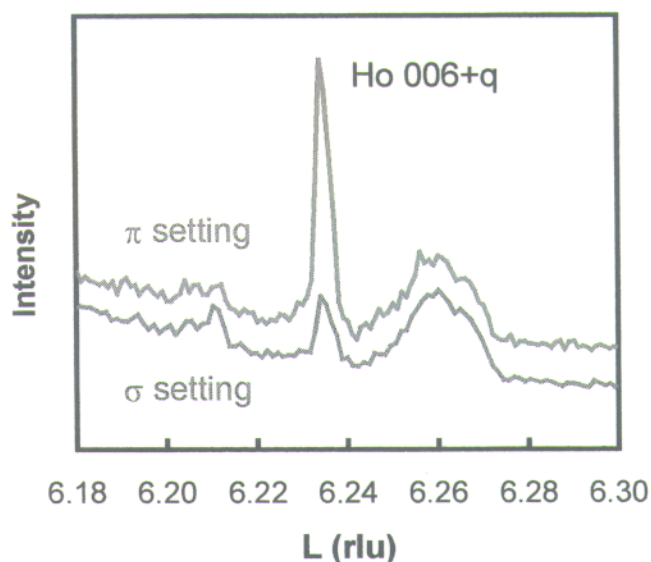


Figure 1. The Ho 006+q magnetic satellite reflection, surrounded by two weak charge peaks. Upper: π -setting; Lower: σ -setting. Data are normalized to the background and offset for clarity.

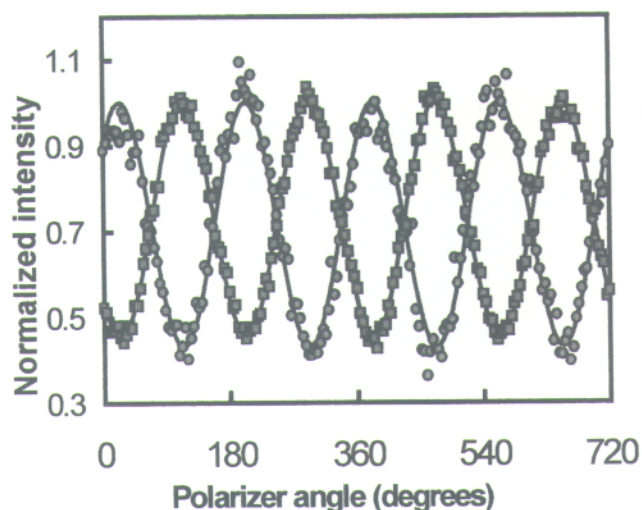


Figure 2. Intensity variation with polarizer angle, for the magnetic reflection (red) and background (blue). The polarization states are almost opposite, with the magnetic intensity mostly π , and the charge-scattering background predominantly σ . Both curves have been fitted to a cosine function.

One such area is non-resonant X-ray magnetic diffraction, where diffraction intensities tend to be very low but the polarization changes of interest are large. Here, a device with a high transmission but modest polarization can be very useful.

A number of anisotropic bromine-containing crystals have been shown to exhibit very strong linear dichroism [3]. In this work, we have employed dibromoalkane/urea inclusion compounds [1] in the form of long, thin crystals, grown at the University of Birmingham by C.L. Bauer.

In order to produce large (~ 4 mm \times 4 mm), fairly uniform platelet-shaped polarizers, piles of aligned crystals were crushed in a binding matrix.

Surprisingly, the resulting material remained almost completely polarized at a molecular level. Polarization extinction ratios of ~ 0.4 - 0.5 can thus be obtained with transmissions of around 25-50%. As an example of use, seven non-resonant magnetic X-ray diffraction peaks from the spiral phase of holmium were measured at the XMaS beamline. A preliminary analysis suggests that this approach is competitive with conventional techniques for both quantitative and qualitative analysis.

References

- [1] K.D.M. Harris *et al*, *J.Chem.Soc.Faraday Trans.* **87** (1991) 3423.
- [2] S.P. Collins, *Nucl.Instrum.Methods B* **129** (1997) 289.
- [3] L.K. Templeton and D.H. Templeton, *J.Synchrotron.Rad.* **2** (1995) 31