ESRF	**Experiment title:** Hard X-ray magnetic reflectivity	**Experiment number**: HE-973
Beamline: ID12	**Date of experiment**: from: 20 June 2001 to: 25 June 2001	**Date of report**:
Shifts: 18	**Local contact(s)**: Dr. Andrei ROGALEV	*Received at ESRF:*

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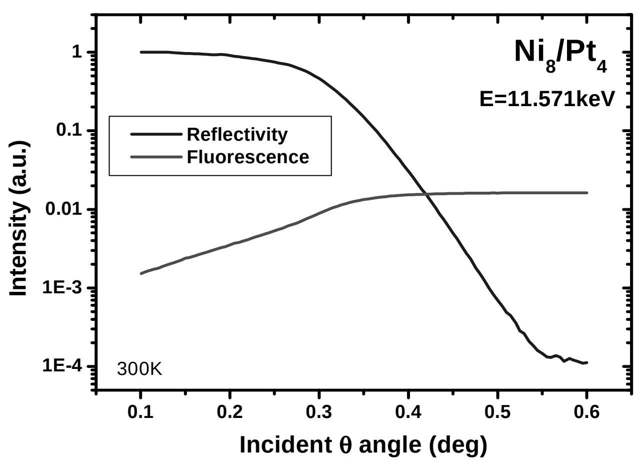
Report:

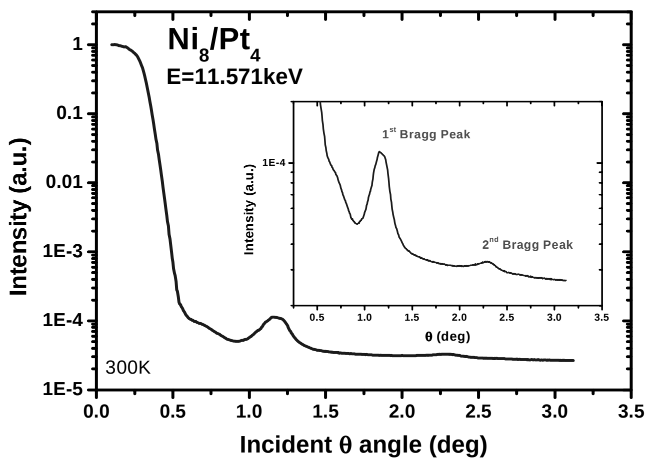
This beamtime was mainly dedicated to the feasibility measurements using a new compact UHV diffractometer/reflectometer developed at the beamline ID12.
The main characteristics of this new equipement which have been confirmed during this run are:

- UHV compatibility (10^{-9} mbar)
- accurate precise θ rotation axis (<3 arcsecond accuracy) from 0 to 15 degree with excellent reproducibility (less than 1 arcsecond)
- vibration free system
- rotable (1Hz) magnetic field up to 0.5 Tesla at the sample
- (magnetic field produced by a modified single period of the Helios-I undulator)
- possibility to use either longitudinal or transverse field geometry
- sample cooling down to 10K
- variable exit slits aperture (1mm to 20μm)
- possibility to record simoultaneously XRMS (x-ray magnetic scattering) and XMCD in total fluorescence yield

These parameters are largely sufficient to study magnetic properties of multilayers in combination with the excellent beam stability offered by the ID12 beamline. This opens new directions in the study of layered magnetic structures. Several test concerning the stability and reproducibility of the θ rotation axis were undertaken. This is of primary importance since in the hard x-ray range, a precision better than 3 arcsecond with an excellent reproducibility is mandatory. The new instrument is equiped with a highly efficient detection system consisting of two Si photodiodes. The first diode is mounted normal to the sample surface plane and is used for total fluorescence yield measurements. The second diode mounted on a motorised translator is located at the bragg condition behind exit slits with variable aperture. This preformant detection system possess an excellent linear dynamical range in excess of 10^7. The sample which is direclty attached to the He-flow cryostat (4K<T<325K) can be mounted either horizontally or vertically allow us to measure samples either with in-plane or out-of-plane easy magnetization axis. Figure 1 shows an example of the simultaneous measurements of the reflectivity and the fluorescence yield in the same angular scan. Figure 2 shows the complete range of the reflectivity and low-angle diffraction patterns obtained from the same Ni_8/Pt_4 multilayer. The excellent linear dynamic range over 10^5 of the detection system is also demonstrated. The *in-situ* magnetic field system was designed with the help of the insertion device group (J. Chavanne). A nearly constant (~5%) magnetic field up to 0.5T at the sample can be applied on the sample over 3cm long and 1cm large. The field is produced by a modified single period magntic array of the Helios-I undulator. The magnetic field was theortically predicted and confirmed by field measurements. The magnetic field can be flipped at a frequency of 1Hz in any in-plane direction using a step motor. This systems offers several enormous advantages compare to other classical magnetic field (no heat load, no angular limitations, nearly constant field...). The mechanism was tested during this beamtime and was reaveled to be highly efficient. Unfortunately, the hard x-ray magnetic scattering measurements on the Co/Pd multilayers could not be performed during this run because the samples were broken during the transport action by post from Greece.



Simultanously recorded reflectivity and total fluorescence yield measurements of a Ni_8/Pt_4 multilayer test sample. The excitation energy corresponds to the Pt L_3-edge (11.571keV). The data were collected in a single scan.



Low-angle diffraction patterns at the Pt L_3-edge (11.571keV) of a Ni_8/Pt_4 multilayer test sample recorded in a single scan. The inset shows clearly two expected diffraction peaks.