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POLARIMETER: A Soft X-Ray 8-Axis UHV-Diffractometer at BESSY II

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Abstract: A versatile UHV-polarimeter for the EUV XUV spectral range is described which incorporates two optical elements: a phase retarder and a reflection analyzer. Both optics are azimuthally rotatable around the incident synchrotron radiation beam and the incidence angle is freely selectable. This allows for a variety of reflectometry, polarimetry and ellipsometry applications on magnetic or non-magnetic samples and multilayer optical elements.

1 Introduction

The high precision 8-axis ultra-high vacuum compatible (UHV)-polarimeter (Schäfers et al., 1999) is a multipurpose instrument which can be used as a multilayer-based self-calibrating polarization detector for linearly and circularly polarized UV- and soft X-ray light (Gaupp et al., 2013; MacDonald et al., 2009). It can also be used for the characterization of either reflection or transmission properties (reflectometry) (Eriksson et al., 2006; Schäfers, 2000) as well as to determine polarizing and phase retarding properties (ellipsometry) of any optical element (Uschakow et al., 2013). Magneto-optical experiments are possible in transmission, as the XMCD or XMLD (Magnetic Circular / Linear Dichroism) that are intensity measurements (Mertins et al., 2002).
Additionally a polarization analysis of the transmitted or reflected light is possible which allows for Faraday-, Voigt- or Kerr-effect technique (L-MOKE, T-MOKE) to investigate thin films as well as magnetic multilayers (Mertins et al., 2001; Zaharko et al., 2002). Independent two-dimensional rotation of the detector enables any non-specular magnetic scattering experiment on magnetic dots or grains. A load-lock transfer chamber allows for quick and easy sample exchange.

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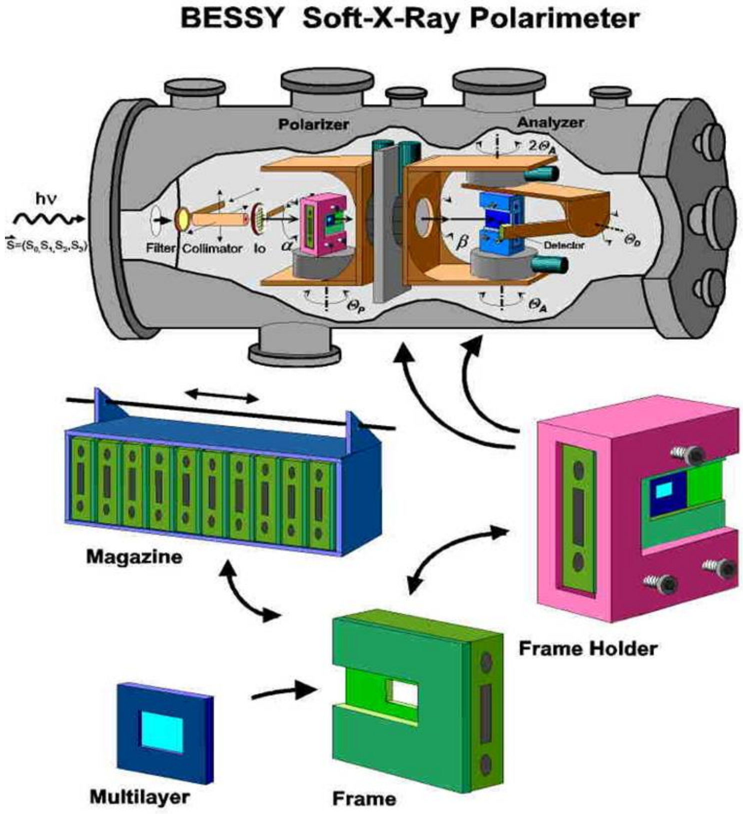

Figure 1: Schematic view of the POLARIMETER station.

2 Instrument application

Typical applications are:

- Characterization of optical elements
- Reflection, transmission properties (s-, p-pol.)
- Polarizing properties (phase retardation)
- Determination of polarization of incident light (Stokes S0,1,2,3)
- Resonant Magnetic Scattering (specular and diffuse)
- Intensity spectroscopy: MCD, LMD, Kerr-effect (L, T-MOKE)
- Polarization spectroscopy: Faraday-, Voigt, Kerr-effect

Methods:

- Elipsometry
- Polarimetry
- Reflectometry

3 Technical Data

Experiment in vacuum	10^{-9} mbar
Temperature range	280 - 480 K
Max. sample size	50 x 50 x 11 mm^3
Min. sample size	10 x 10 x 0.5 mm^3
Incidence angle scan range	$0° \leq \Theta_P$, $\Theta_A \leq 90°$
Azimuthal angle scan range	$0° \leq \alpha$, $\beta \leq 370°$
Detector scan range (in plane)	$0° \leq \Theta_{2A} \leq 180°$
(off-plane)	$-10° \leq \Theta_D \leq 27°$
Min. step size for all motors	0.001°
Sample – Detector Distance	150 mm
Magnetic fields (in-/off-plane) (long./transv.)	-450 < H < 450 Oe
Detector	GaAsP-photodiode with Keithley electrometer 617 (6514)
Detector size	4 x 4 mm^2, 0.2 x 4 mm^2
Load-lock, Magazine	*In-situ* storage of up to 10 samples
Higher order filters	Be, B, C_6H_8, Ti, Cr, Fe
Collimator pinholes	∅ 0.2 – 2.0 mm

Table 1: Technical data of the POLARIMETER station.

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