

The crystal monochromator beamline KMC-1 at BESSY II

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Abstract: The KMC-1 is a soft x-ray double crystal monochromator beamline for the energy range between 2 and 12 keV. The bending magnet beamline as well as the experiment are under UHV-condition. It incorporates high indexed Si-crystals for high resolution and it is primarily used for HAXPES experiments employing the HIKE (High Kinetic Energy Photoelectron Spectroscopy) chamber.

1 Introduction

The crystal monochromator beamline KMC-1 (Schäfers et al., 2007) at a BESSY II bending magnet covers the energy range from soft (2 keV) to hard x-rays (12 keV) employing the n,-n double crystal arrangement with constant beam offset. The monochromator is equipped with three sets of crystals, Si (111), Si (311) and Si (422) which are exchangeable in-situ. Beamline and monochromator have been optimized for high flux and high resolution. The beamline and experiment are under UHV-condition. The multipurpose beamline is used for techniques such as hard x-ray high kinetic photoelectron spectroscopy (HIKE or HAXPES), (Bio)-EXAFS, NEXAFS, absorption, reflection and fluorescence spectroscopy. Due to the windowless UHV-setup the k-edges of the technologically and biologically important elements such as P, and S are accessible. The photon flux is in the 10^{11} – 10^{12} photons/s range and a resolving powers $E/\Delta E$ of more than 100.000 has been measured at selected energies. Thus, HAXPES with a total instrumental resolution of about 150 meV is possible at selected energies.

The beamline is not permanently equipped with a particular experimental station but rather varying user experiments are connected to it according to the beamtime schedule. Based on the allocated beamtime the HIKE end station is the main user of the KMC-1 beamline (Gorgoi et al., 2009).

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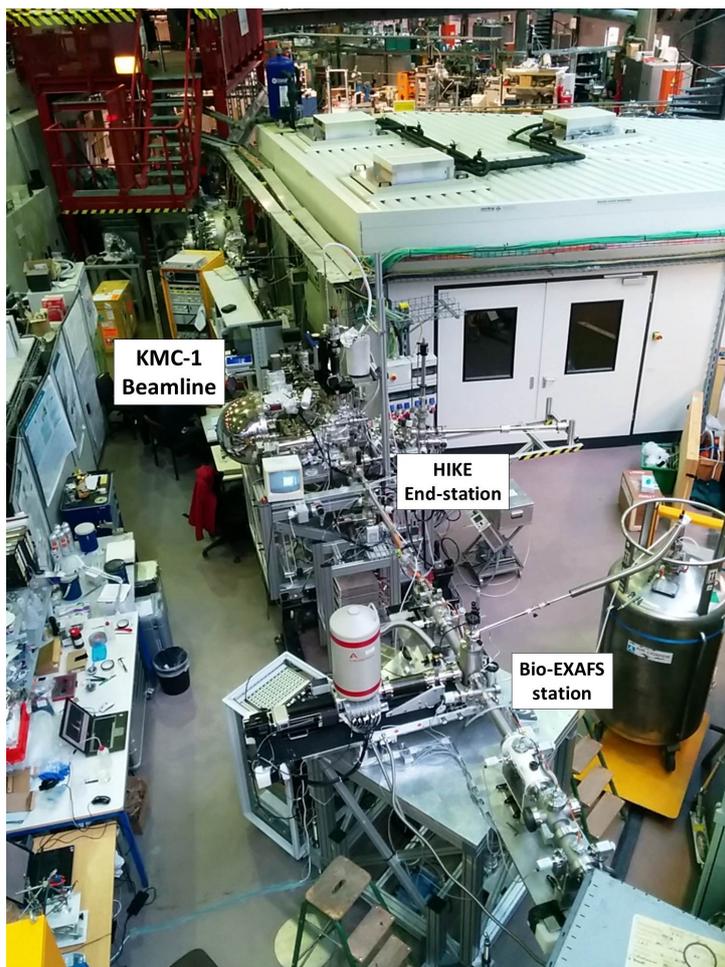


Figure 1: Top-view of beamline KMC-1.

2 Instrument Applications

Typical applications are:

- HAXPES (Hard X-Ray Photoelectron Spectroscopy)
- EXAFS, NEXAFS, XANES
- Diffractometry
- Reflectometry

3 Source

The source is the bending magnet D1.1 with the following parameters:

Electron energy [GeV]	1.7
Magnetic field [T]	1.3
Bending radius [m]	4.35
Power on 1 st optical element (300 mA) [W]	45
Critical energy [keV]	2.5
Source horizontal size (σ_x) [μm]	96
vertical size (σ_y) [μm]	47
Source hor. divergence (σ_x) [μrad]	300
vert. divergence (σ_y) [μrad]	20

Table 1: BESSY II source characteristics of the dipole section DIP 1.1.

4 Optical Design

The beamline and the double crystal monochromator KMC-1 have been optimized for highest possible flux and high resolution (Schaefer et al., 2007). This was achieved by (1) a windowless setup under ultrahigh-vacuum (UHV-) conditions up to the experiment, (2) by the use of only three optical elements to minimize reflection losses, (3) by collecting an unusually large horizontal radiation fan from the bending magnet (6 mrad) with the one and only toroidal mirror, and (4) the optimization of the crystal optics to the soft x-ray range necessitating quasi-backscattering crystal geometry ($\theta_{\text{Bragg,max}}=82^\circ$) delivering crystal limited resolution.

5 Technical data

Location	3.1
Source	D1.1
Monochromator	KMC-1
Energy range	2 – 12 keV
Polarisation	horizontal
Divergence horizontal	3 mrad
Divergence vertical	0.2 mrad
Focus size (hor. x vert.)	0.4 x 0.6 mm
Distance Focus/last valve	670 mm
Height Focus/floor level	1728 mm
Free photon beam available	Yes
Fixed end station	No

Table 2: Technical data of Beamline KMC-1.

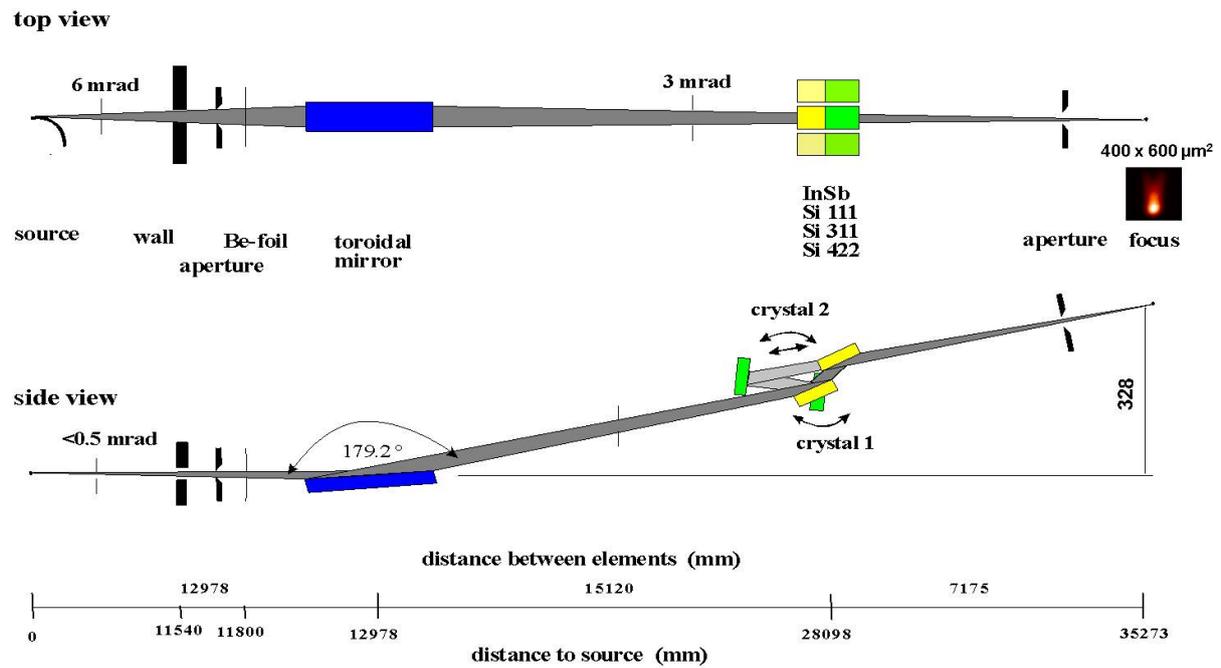


Figure 2: Optical layout of beamline KMC-1.

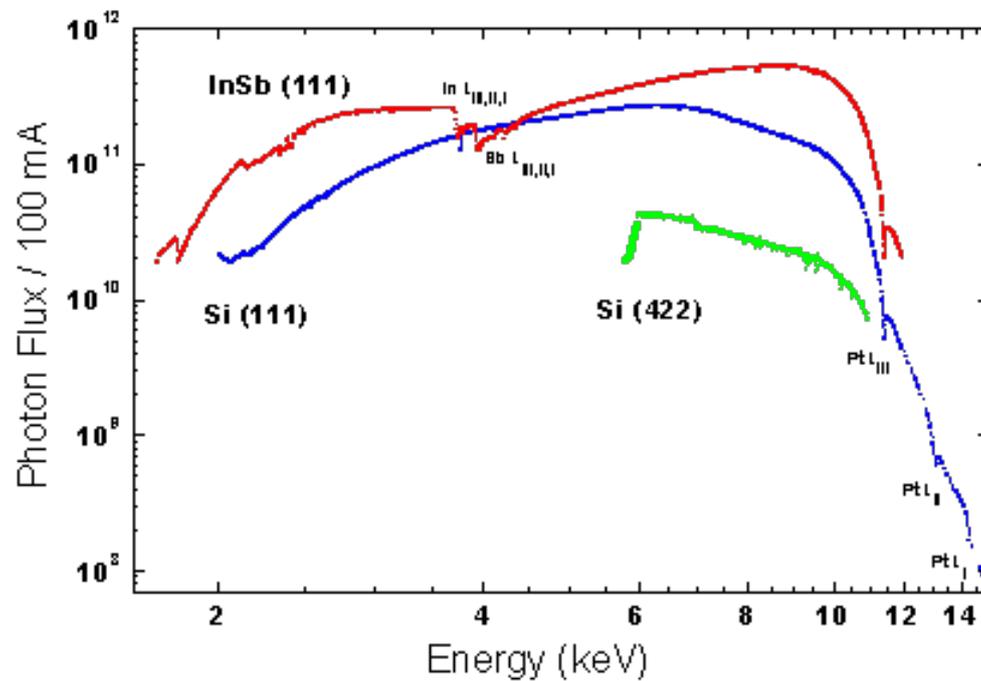


Figure 3: Photon flux at the sample position, normalized to 100 mA ring current. Typically BESSY-II runs with 300 mA.

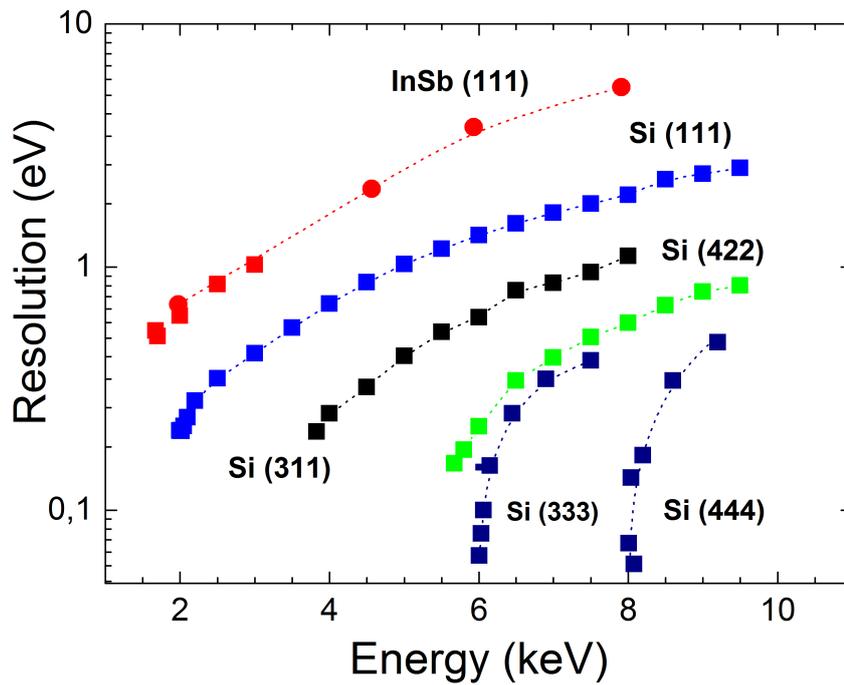


Figure 4: Energy resolution of the KMC-1 beamline for the different crystals.

References

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