Fast XPS end station at P04 (PETRA III): perspective for synthesis and investigation of advanced materials based on low-dimensional systems.

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Introduction

Generally the synthesis and consequently many properties of advanced materials involve fast reaction processes, which should be precisely controlled and characterized. We propose fast electron spectroscopy for this task. The end-station for such investigations was designed, built up and installed into the soft X-ray beamline P04 at PETRA III (DESY Hamburg). The system is based on a hemispherical electron spectrometer ARGUS (Omicron NanoTechnology) with parallel detection, which in combination with the high brilliance of PETRA III at XUV beamline P04 provides the possibility of taking extremely fast (below 1 sec/spectrum) soft x-ray photoelectron spectra of high quality.

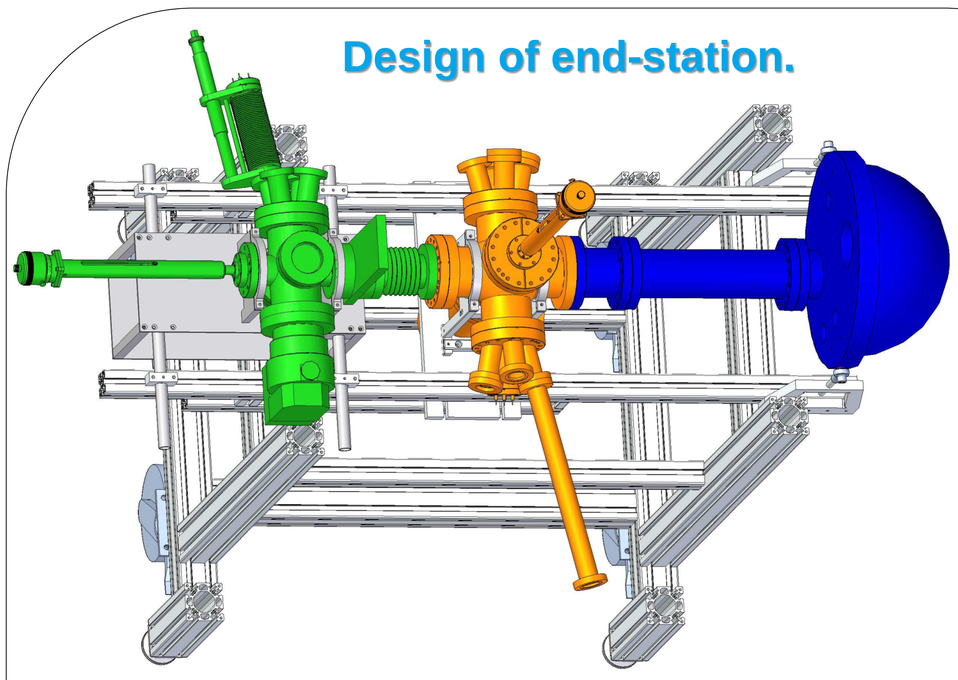
XUV Beamline P04 – Performance

- Photon energy range: (<100) 250 - 3000 eV
- Resolving power: >104 (up to >3 x 104 @1 keV)
- Photon flux: >1012 photons/s (up to 5 x 1012)
- Spot size at sample (h x v): 10 x 10 μm2 / 50 x 50 μm2
- Polarization (switching rate): circular, linear hor./vert. (<0.1 Hz)

ARGUS spectrometer - Performance

- Excellent sensitivity
- Snapshot & Dynamic XPS
- Imaging and small area XPS
- XPD, AES, ISS and UPS
- CASCADE automation system

Design of end-station.



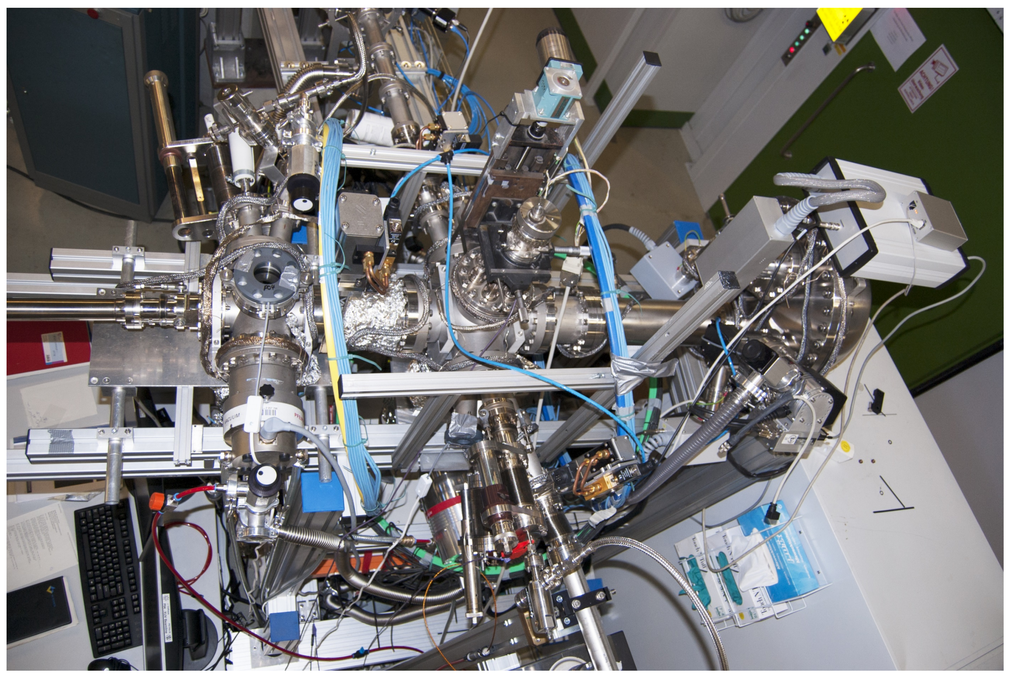
✓ Sample preparation chamber

- Fast entry lock
- Ar-ions sputtering
- Sample garage
- Evaporators of organic, metals, semiconductors etc
- Quarts Thickness Monitor

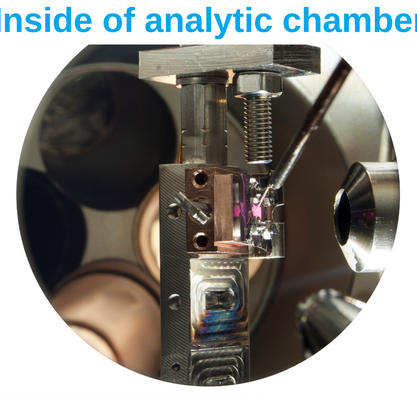
✓ Analytic chamber

- Spectrometer ARGUS
- Manipulator (4 degree of freedom)
- Special sample holder with sample heating options till 1400 ^{0}C during spectra acquisition
- Micro pipe gas-source
- Evaporators of organic, metals, semiconductors etc
- Web camera for adjustments
- Leak valve

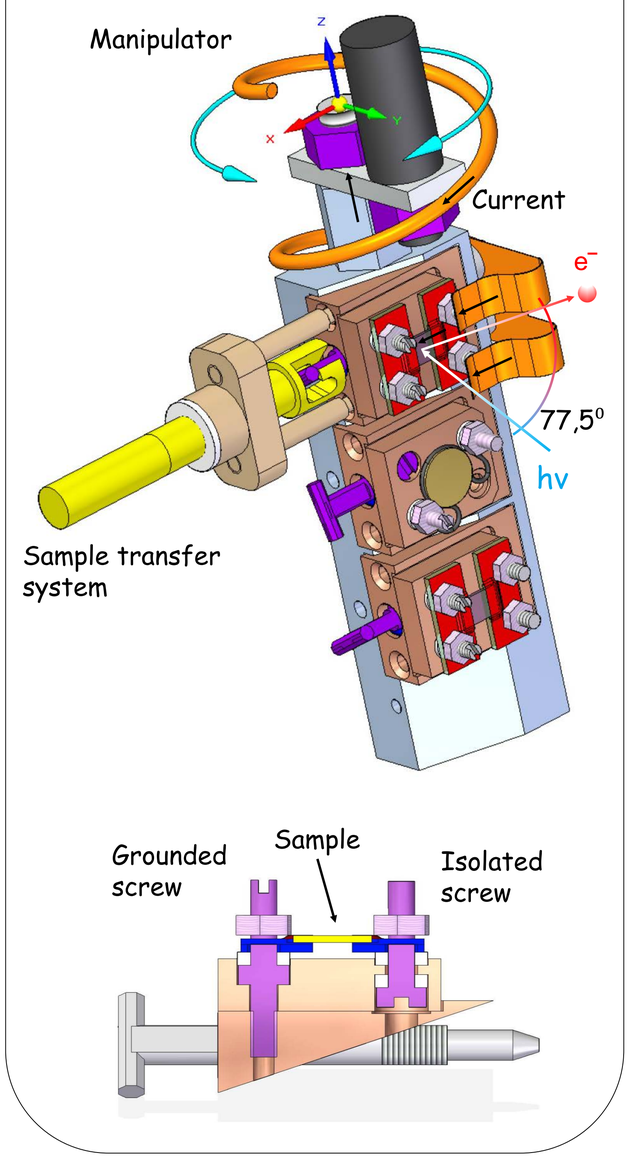
ARGUS Setup



Inside of analytic chamber

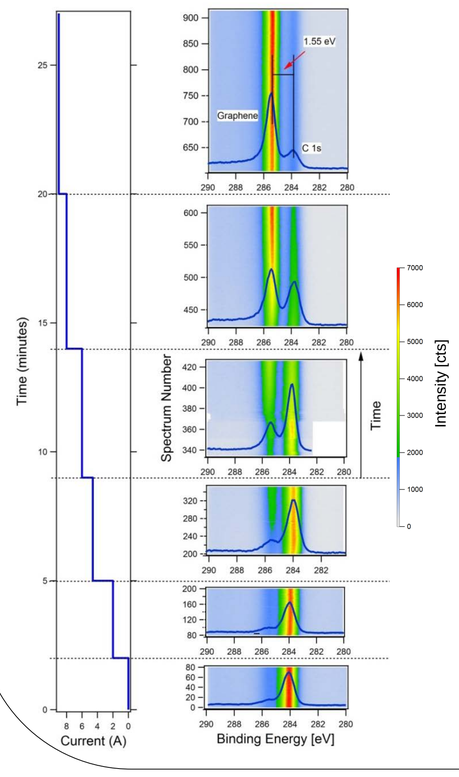


Scheme of sample holders and garage



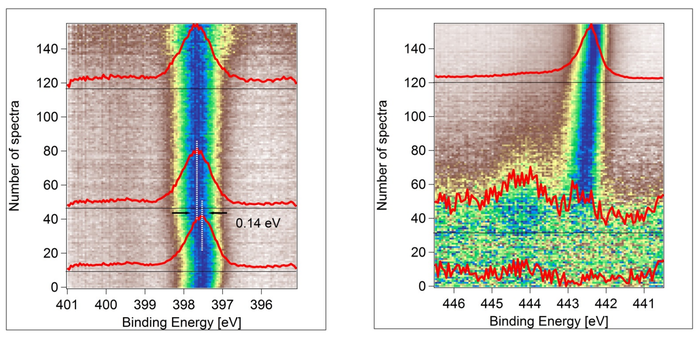
First experiments

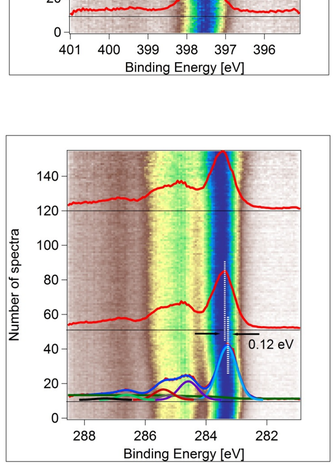
Example of graphene preparation



- C 1s photoemission spectra evolution
- sample: cubic β-SiC(001)
- photon energy: *hn* = 750 eV
- pass energy: Ep = 70 eV
- Temperature range: 0 - 1350 C
- 900 snapshot spectra
- acquisition time of 1 second per spectrum
- following the evolution of the graphene growth on surface during the heating process of the β-SiC.

Example of metal-organic interface formation: In on $CuPcF_4$





- Strong diffusion of In atoms into the organic film
- In atoms occupy sites close to the pyrolle N
- In strongly interacts and transfers negative charge to $CuPcF_4$

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