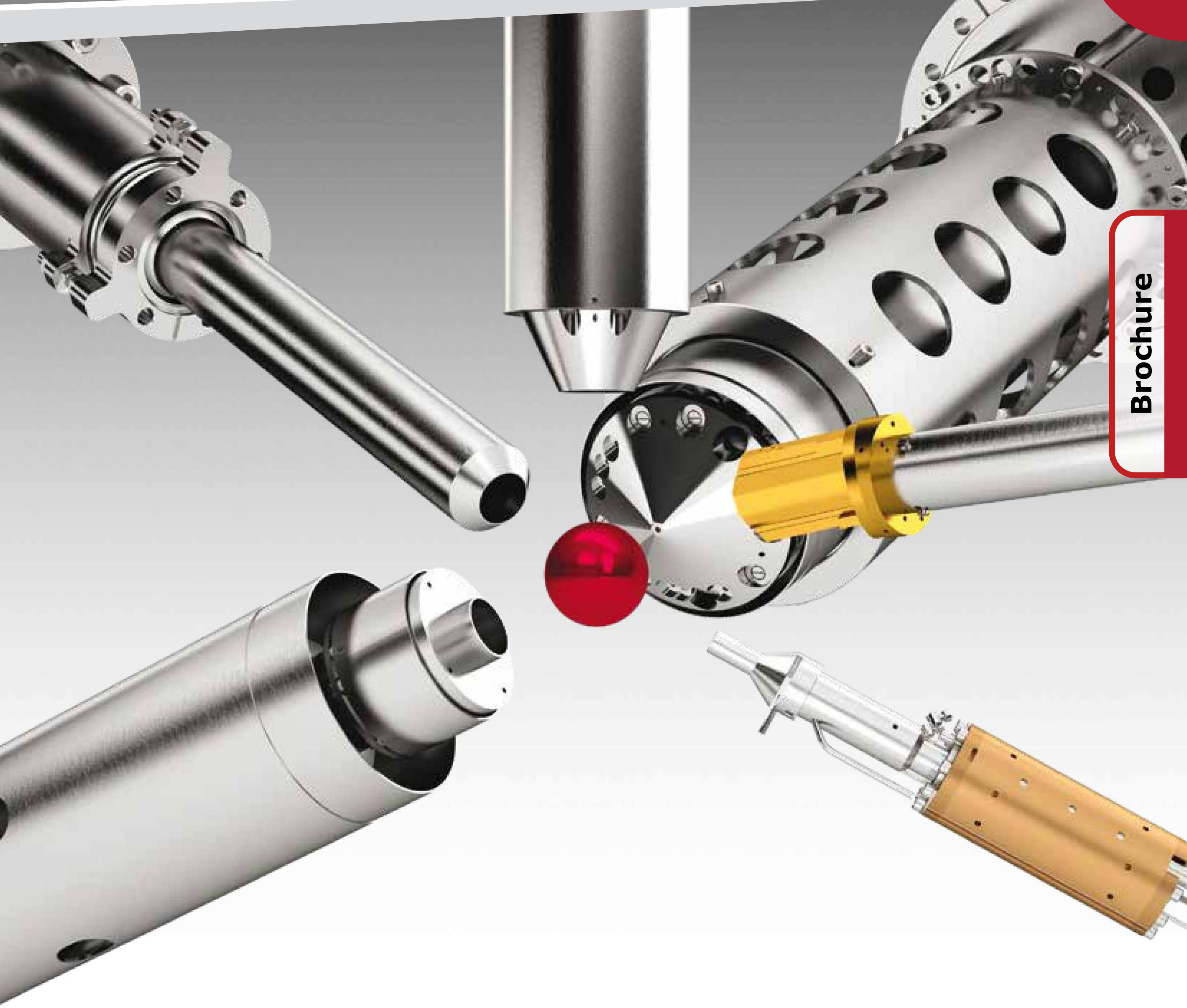
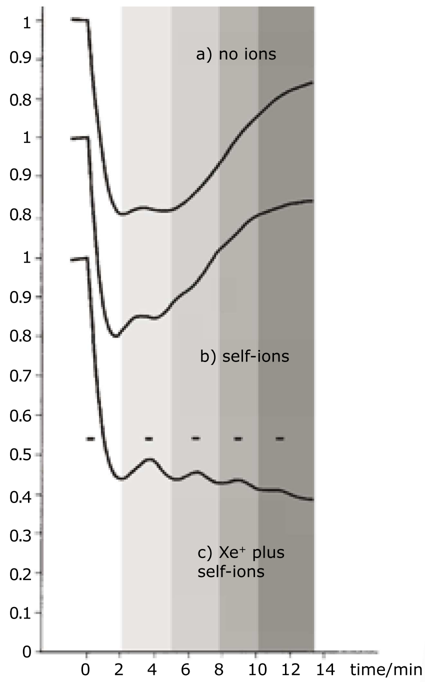


Brochure

PRODUCT CATALOGUE 2019

All about electrons...

THE EFM SERIES
UHV E-BEAM EVAPORATION



EFM 3i: Ion Beam Assisted Deposition (IBAD)

The EFM 3i is specifically designed to facilitate layer-by layer growth in cases where it does not occur naturally. RHEED oscillations monitor the growth of Co on Cu(111) starting with a) a neutral Co-beam to a strongly improved layer by layer growth in c) using self-ions and Xe^+ ions.

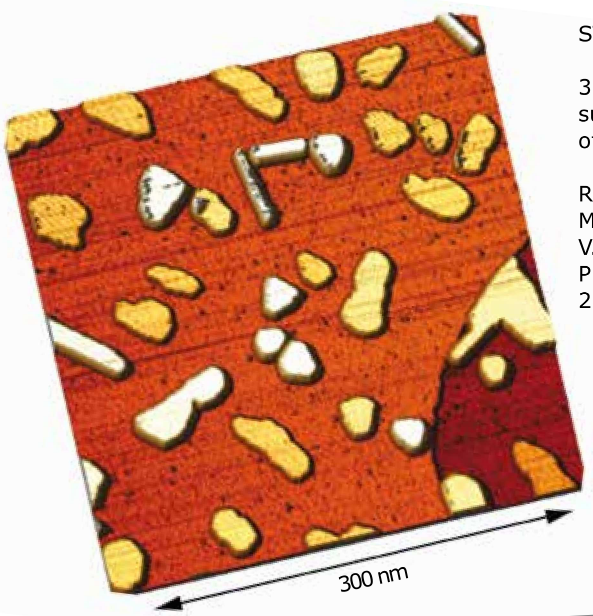
Ref.: J.Kirschner, H.Engelhard and D. Hartung , Rev. Sci. Instrum., Vol. **73**, 11 (2002)

FOCUS is the manufacturer of the widespread and well known EFM evaporators since 1990 (EFM = Evaporation with Flux Monitor). With today more than 2000 sold devices world wide we occupy clearly the leader position on the market.

These UHV e-beam evaporators are dedicated to ultra-pure sub-monolayer to multilayer thin film growth under ultra high vacuum (UHV) conditions.

There is a grown family from the legendary EFM 3 to much more sophisticated solutions like e-g. the EFM 3i for ion-beam-assisted deposition of the EFM 4 for larger samples.

Meanwhile our evaporators are successfully used also for the deposition of organic molecules (see seperate application note).



STM image:

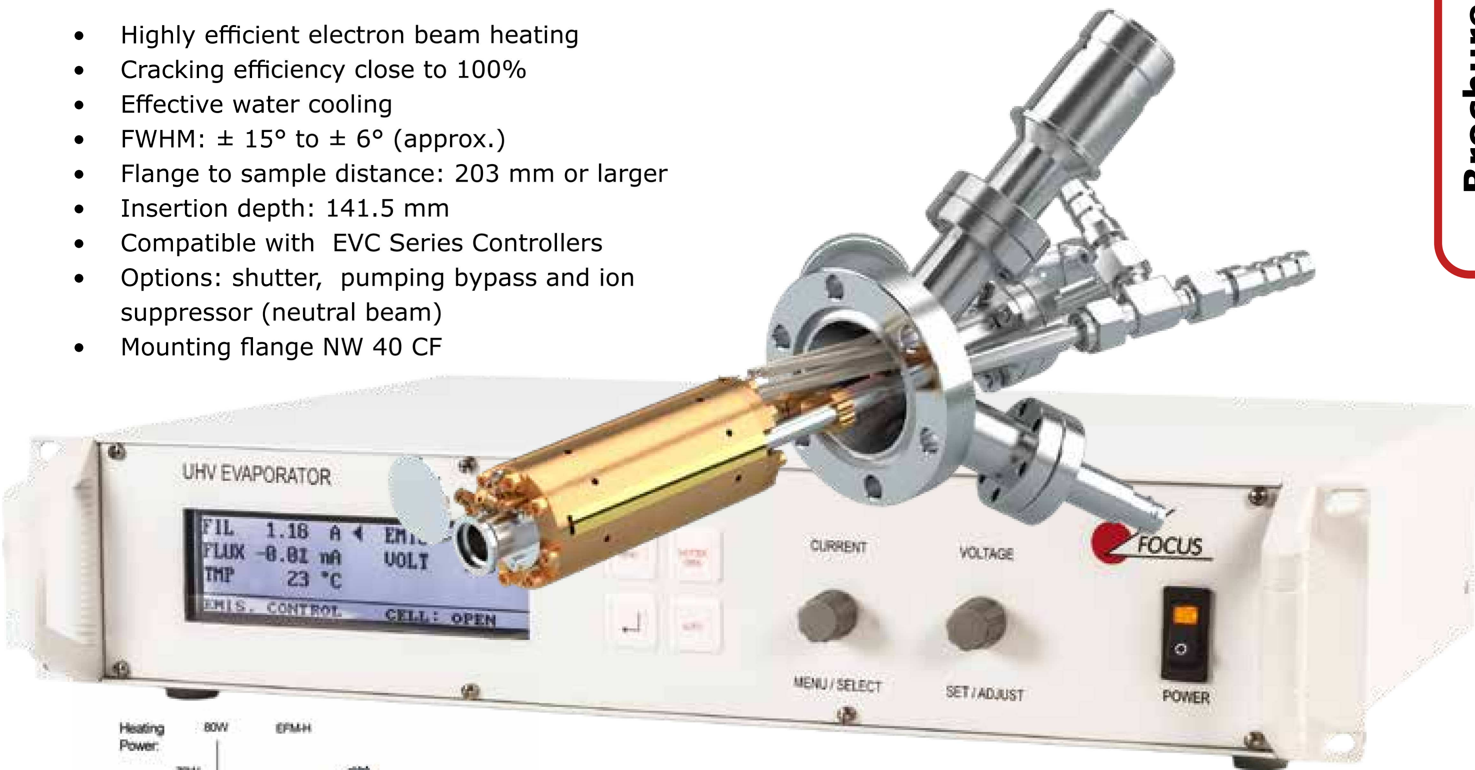
3D view of the $Al_{13}Co_4$(100) surface dosed with 2.6 ML of Bi (300 × 300 nm^2).

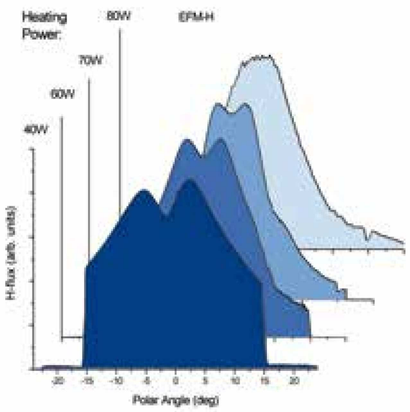
Ref.: S. Bobaru, É. Gaudry, M.-C. de Weerd, J. Ledieu, V. Fourneé, PHYSICAL REVIEW B **86**, 214201 (2012)

EFM-H
HYDROGEN ATOM BEAM SOURCE

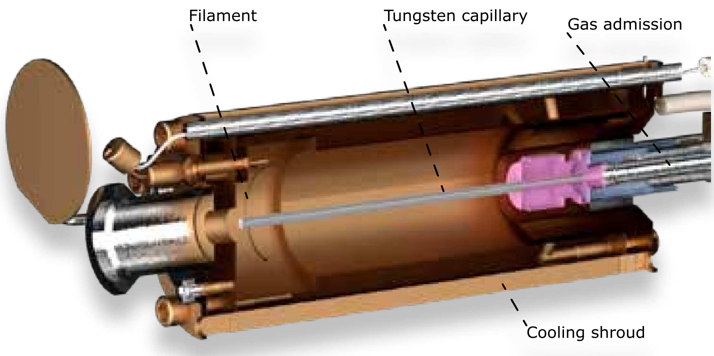
Brochure

- Highly efficient electron beam heating
- Cracking efficiency close to 100%
- Effective water cooling
- FWHM: ± 15° to ± 6° (approx.)
- Flange to sample distance: 203 mm or larger
- Insertion depth: 141.5 mm
- Compatible with EVC Series Controllers
- Options: shutter, pumping bypass and ion suppressor (neutral beam)
- Mounting flange NW 40 CF





The EFM-3H is carefully designed to deliver a sharply defined beam profile. By adjusting the heating power, different spot profiles can be selected.



Schematic cross section of EFM-H

The EFM-H (as thermal gas cracker) is a source to provide atomic hydrogen based on the design of the EFM 3. A flange NW 16 CF on the rear side is used for hydrogen inlet including a pumping by-pass to clean the piping prior to H_2 disposal.

It is ideal for cleaning and etching of semiconductor surfaces (such as Si, GaAs, Ge or InP), for surface passivation, for improvement of thin film growth and other similar applications using atomic hydrogen.

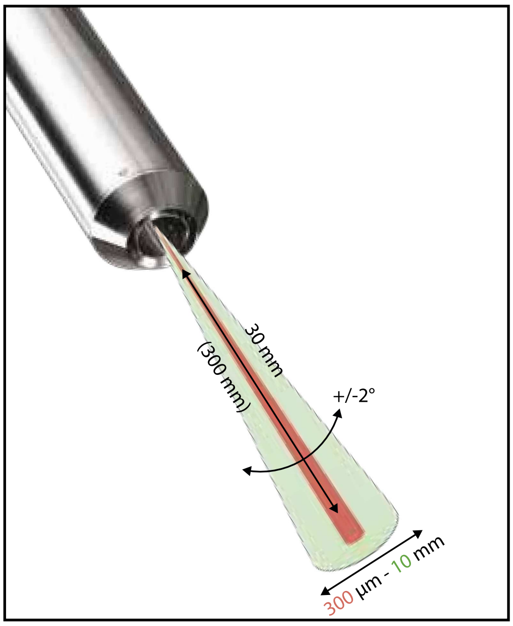
The EFM-H features a cracking efficiency close to 100%, a smooth, flat and sharply defined spot profile, a low background pressure because of its efficient watercooling and a surprisingly low power consumption demonstrating the outstanding performance of the EFM-H.

The EFM-H is compatible with all EVC power supplies and cable sets.

Brochure

FDG 15
HOT FILAMENT ION SOURCE

- The FDG 15 is a hot filament ion source for ultra clean sputtering or depth profiling between 10 eV -5 keV (optional)
- Effective differential pumping (10^{-8} mbar in operation)
- Ion focusing optics with spot size < 300 µm – 10 mm (@ 50 mm working distance)
- Integrated port aligner for spot adjustment
- Controlled by the the power supply front panel or via a TCP/IP interface
- An ease of use LabVIEW™* – based PC software
- Optional high current @ low energies e.g. for sputtering of semiconductors (< 100 eV) or charge neutralization in ESCA (< 10 eV) optional
- Optional regulated gas inlet

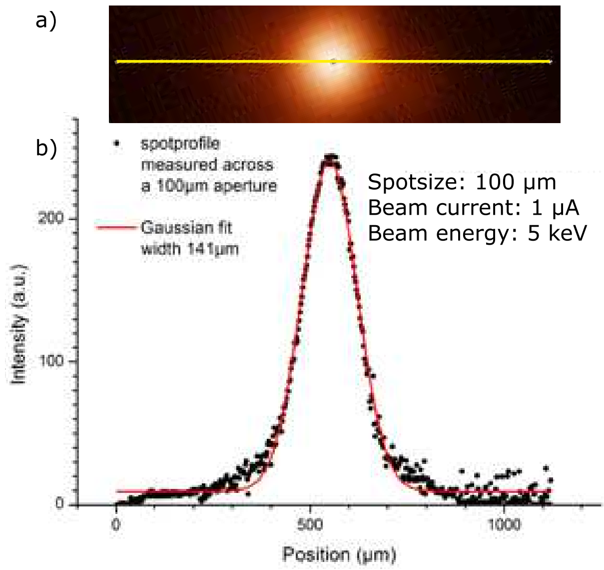


* LabVIEW™ is a trade mark of National Instruments

FDG 150
FOCUSED ION SOURCE

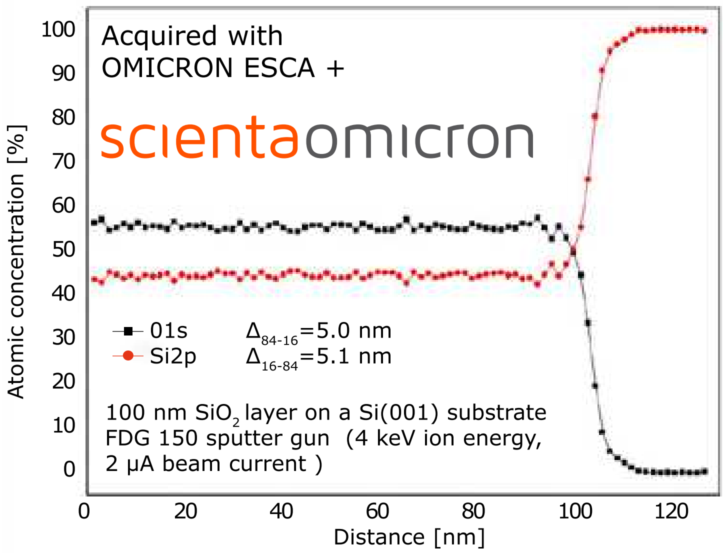
Brochure

The FDG 150 harnesses all features of the FDG 15 and is a high performance UHV Ion source for depth profile analysis with XPS and Auger Spectroscopy, for sample cleaning, for sensor cleaning in scanning probe microscopy, for charge neutralisation (ESCA) as well as for excitation in ISS/LEIS instruments.
The source is additionally equipped with a regulated leak valve, to allow for long term stabilization of the ion current, it can be operated at energies as low as 15 eV to be used for charge neutralization with ESCA applications and its beam can be focused down to less than 150 µm.



a) Image of the argon ion spot scanned across a 100 µm aperture.

b) Cross section along the yellow line of a) showing a spot profile corrected by aperture width which results in a 100 µm spot diameter @ 1µA beam current.



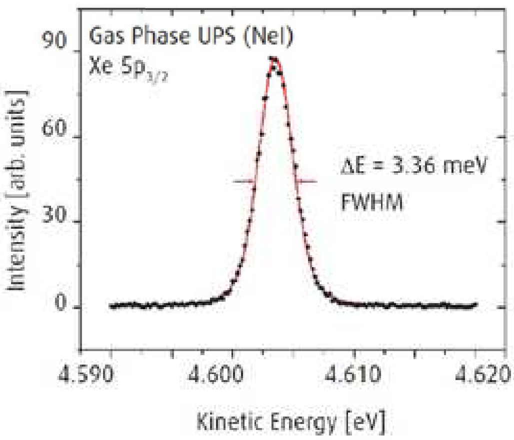
XPS depth profiling through a 100 nm SiO_2 layer on Si (001): The cross-over position of the Oxygen peak (O1s) and Silicon peak (Si2p) intensities indicates the thickness of the oxide layer.

Brochure

HIS 13
HIGH INTENSITY VUV-SOURCE

Ease of operation, robust design and a high intensity make the HIS 13 a preferred excitation source for UPS. The source is available with multiple options such as a linear polarizer, 3rd differential pumping Stage or an attenuator to tune light intensity. More than 350 installed units stand for reliable quality. The VUV source power supply with up to 300 mA discharge current, integrated pressure gauge display and fast electronic ignition supports ease of operation and optimized source brightness.

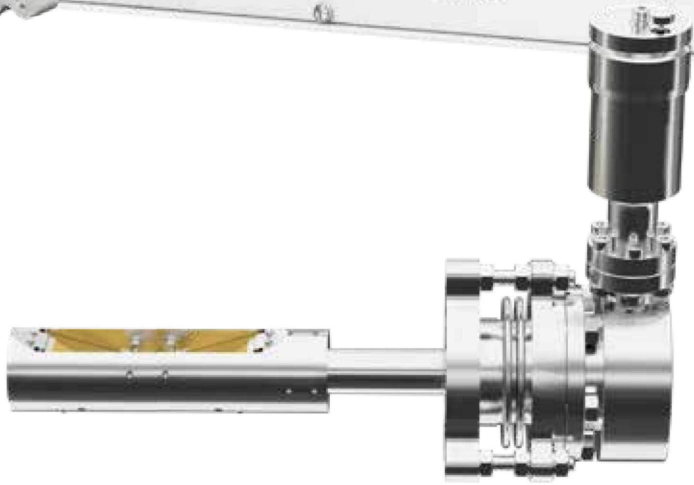
The VUV source power supply with up to 300 mA discharge current, integrated pressure gauge display and fast electronic ignition supports ease of operation and optimized source brightness.



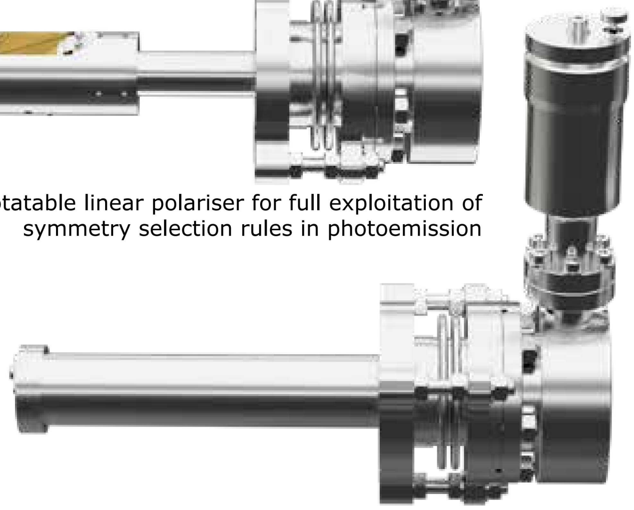
The line width of the gas phase spectrum is dominated by the Xe Doppler broadening and the analyser resolution. It proves a line width less than 2 meV of the HIS 13.

Measured with OMICRON EA 125

scientaomicron



Continously rotatable linear polariser for full exploitation of symmetry selection rules in photoemission

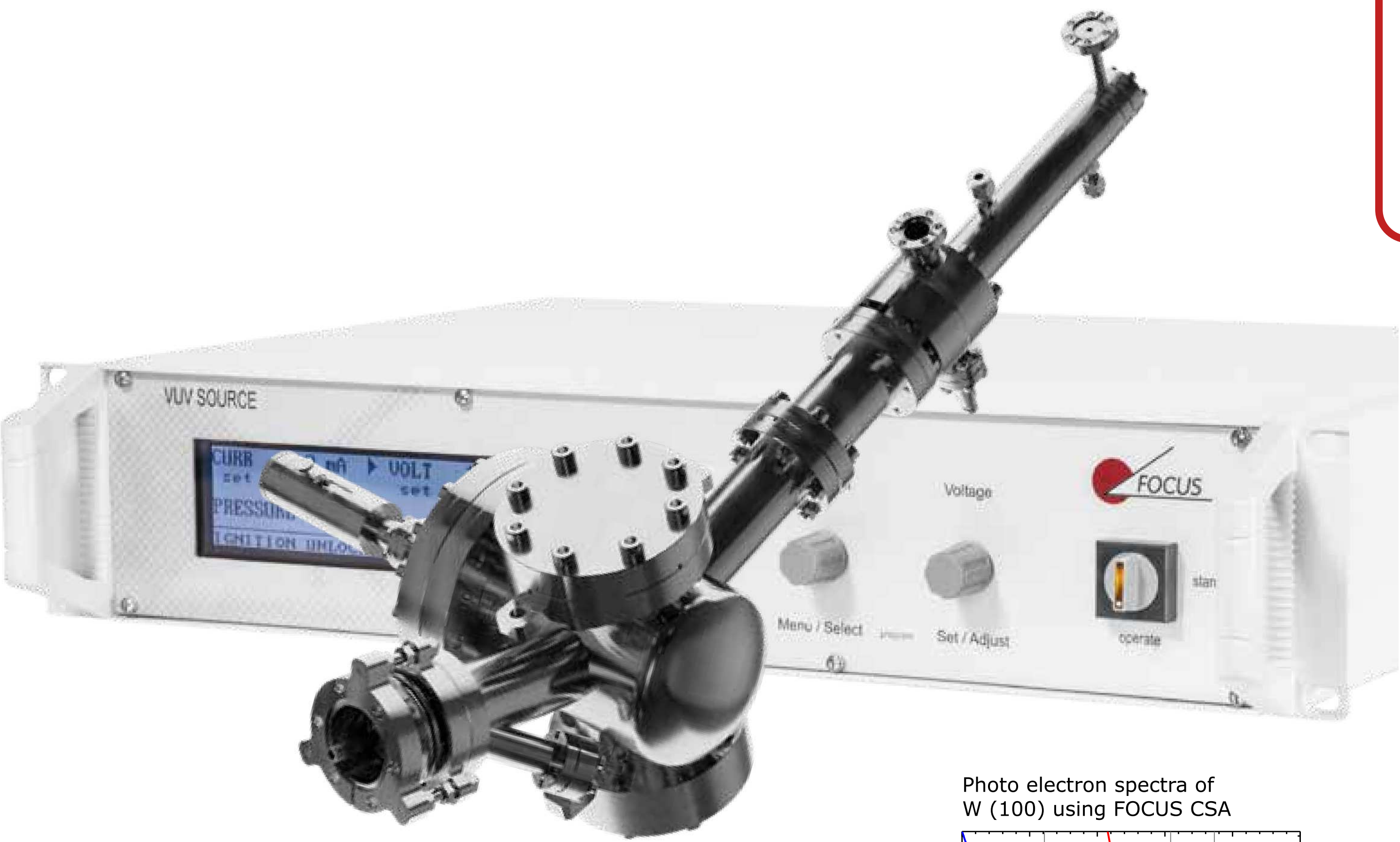


Attenuator for HIS 13/14 for VUV-sensitive samples. Variable reduction of photon flux by a factor 10 or 100.

Brochure

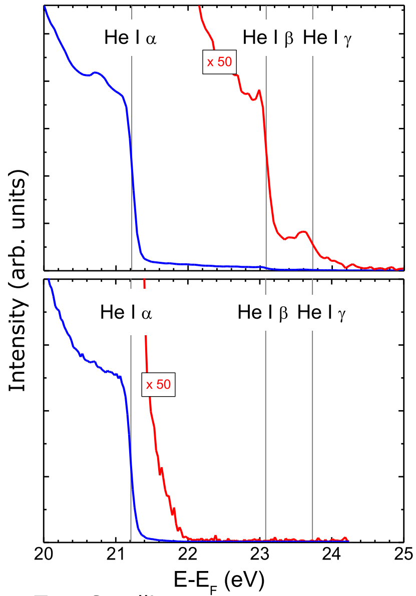
HIS 13 MONO

MONOCHROMATIZED VUV SOURCE



- Dispersive element with >10 % transmission for He I and II
- CF 40 ID mounting flange
- Ease of operation
- Cost effective removal of either HeI or HeII incl. satelites

Photo electron spectra of W (100) using FOCUS CSA



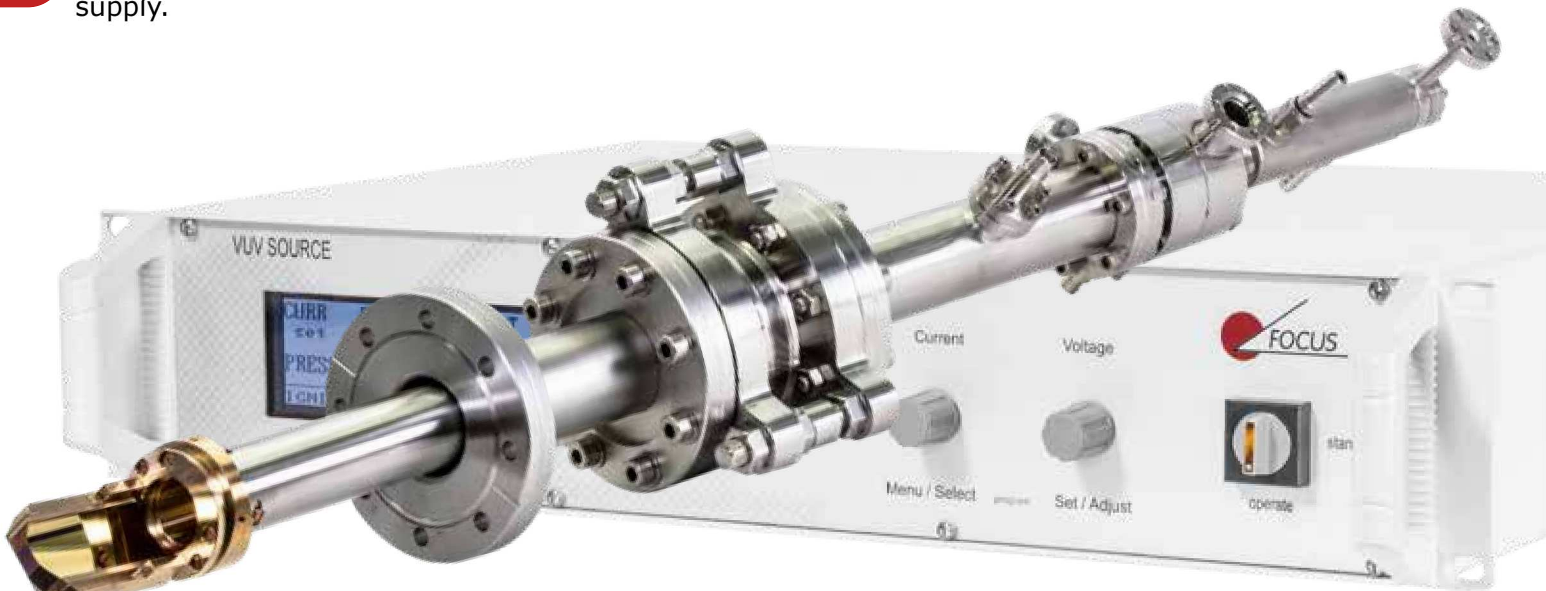
Top: Satellites
He I-ß and y present
Bottom: No satellites

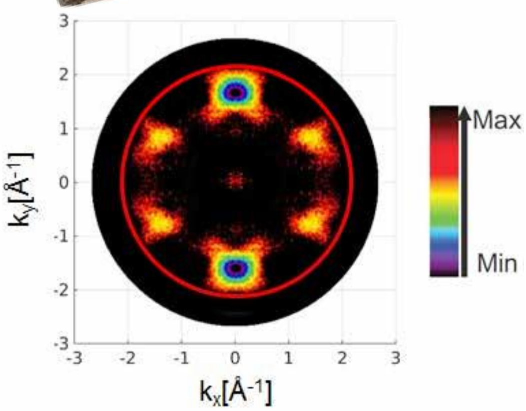
Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

HIS 14 HD
FOCUSED VUV-SOURCE

The HIS 14 HD fine focused high photon density VUV-source is the ideal photon laboratory source for ARPES and PEEM with 300 µm spot size, ca. 70 mm working distance and a 50 times higher flux density compared to a non-focused source.

Operation with chamber pressure in the 10^{-10} mbar range is possible when using the optional 3rd pumping stage. The source is mounted on a CF 63 ID flange and comes with the VUV-source power supply.

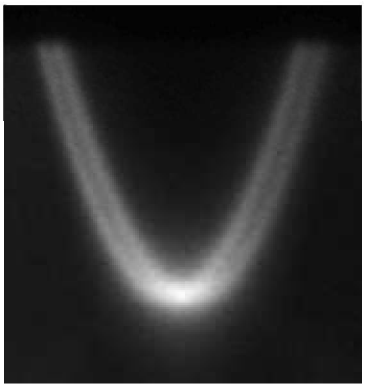




k_x-k_y map of the HOMO of NTCDA on Cu(111)

Dwell time 45 min, recorded with Elmitec SPE-LEEM/PEEM III

Courtesy:
Prof. Christian Kumpf,
FZ Jülich GmbH, PGI-3



Au (111) surface state with Rashba Splitting HeI excitation (21.2 eV)

Dwell time 50 s measured with PHOIBOS 100 (SPECS GmbH)

Courtesy:
Dr. L. Dudy, M. Scholz, Universität Würzburg

Fermi surface (k_x-k_y-map at 21.2 eV) of Au(111)

Dwell time 100 s, recorded with FOCUS NanoESCA
(FOCUS / Scienta Omicron)

Courtesy:
Konrad Winkler, Scienta Omicron

FOCUS HIS 14 HD MONO

MONOCHROMATIZED VUV SOURCE

ULTIMATE UPS, ARPES, PEEM AND M-ARPES

Brochure

Gefördert durch:

Bundesministerium für Wirtschaft und Energie

aufgrund eines Beschlusses des Deutschen Bundestages

- Dispersive element with 20 % transmission for He I and II

- Photon flux
  He I: > 1x 10^{12} Photons/s/mm²
  He II:> 2x 10^{11} Photons/s/mm²

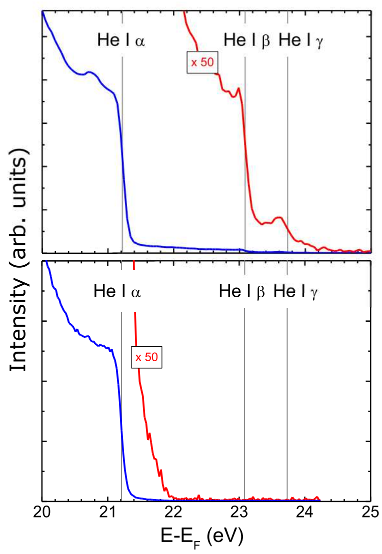
- Spot size < 300 µm
  (ø 1.7mm light capillary)

- Working distance 65 cm

- Ease of operation

- Operating pressure down to 10^{-10} mbar range
  (with 3rd pumping stage)

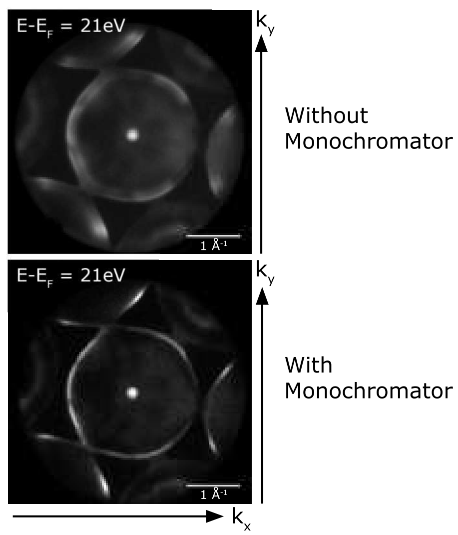
Photo electron spectra of W (100) using FOCUS CSA



Top: Satellites
He I-β and γ present

Bottom: No satellites

Momentum microscopy of Ag (111) using FOCUS IEF-PEEM



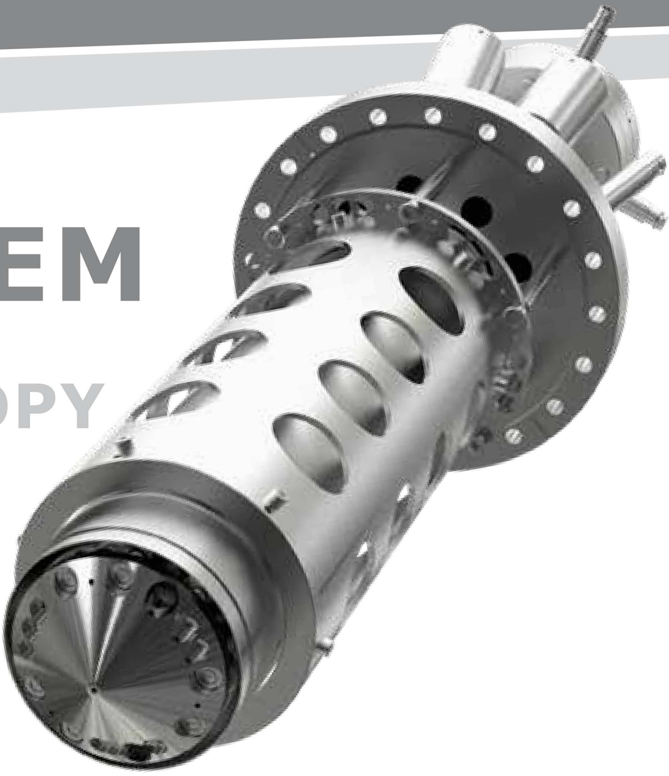
Top: Shadow-structure visible due to He I-β

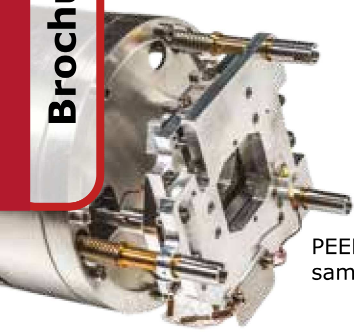
Bottom: Band-structure due to He I-α solely

The HIS 14 HD Mono combines the high photon density of the VUV source HIS 14 HD with a highly efficient dedicated monochromator. By this it comprises an excellent excitation source for ARPES and Momentum Microscopy applications.

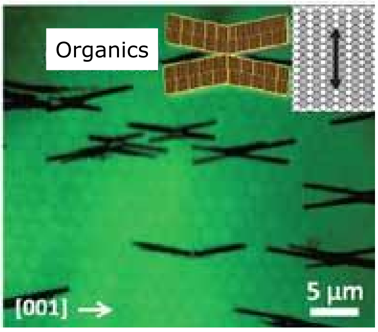
FOCUS IS-PEEM

PHOTO EMISSION ELECTRON MICROSCOPY





PEEM front-end with integrated sample stage (IS-PEEM)

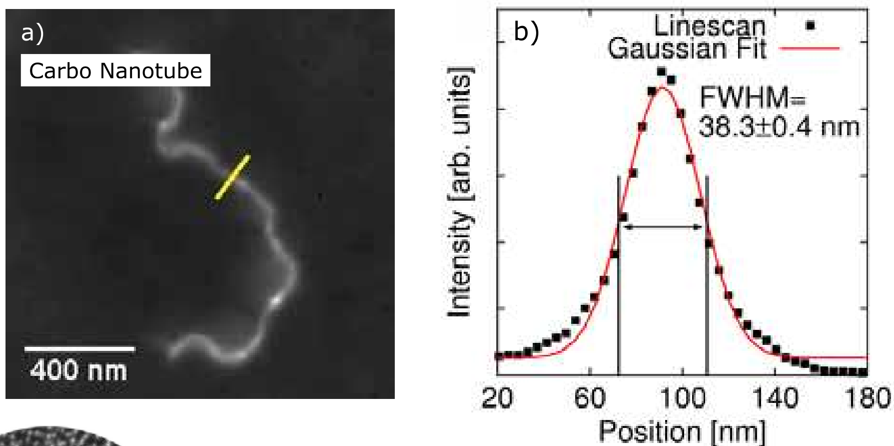


PEEM image of self-assembled p-sexiphenyl (P6) Nanostructures that form when P6 is deposited on Cu (111). Typical height of the nanostructures are in the range of 50-500 nm.
Ref.: A.J. Fleming, M. Ramsey, Phys. Chem. Chem. Phys. **13**, 10, (2011)

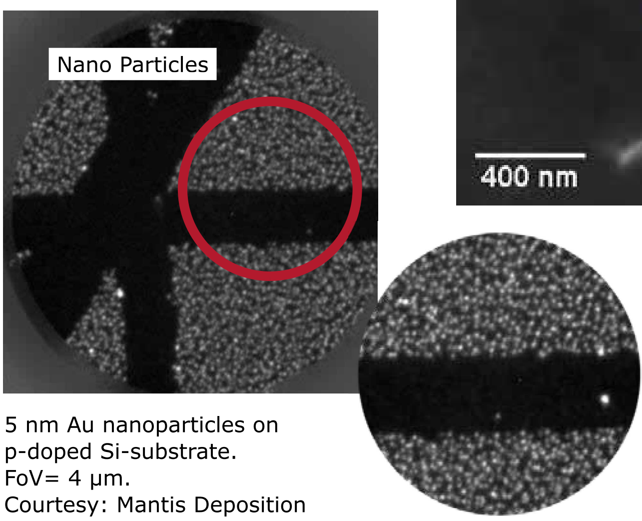
Photoemission Electron Microscope with integral sample stage (IS) for unsurpassed stability and precise sample positioning via remote controlled piezo drives. The in-situ variable contrast aperture and the stigmator/deflector allow the power of PEEM to be fully exploited in laboratory and synchrotron applications.

Topography contrast, work function contrast, chemical contrast and magnetic contrast can be used for surface sensitive real-time imaging of any reasonably flat and conducting surface ranging from molecules, nanotubes, graphene to cluster and magnetic samples.

Ease of use with an operator friendly software makes sure the user operates the PEEM at its full performance level with excellent scientific results.



a) PEEM measurement showing the image of an isolated Carbon Nano Tube (CNT) at highest magnification.
b) Line profile of the intensity along the yellow line in a) together with a Gaussian fit.
Ref.: Andreas Neff, Olga Naumov, Timna-Josua Kühn, Nils Weber, Michael Merkel, Bernd Abel, Aron Varga, Katrin R. Siefermann, American Journal of Nano Research and Application.
Special Issue:Advanced Functional Materials. **2**, 6-1, (2014)



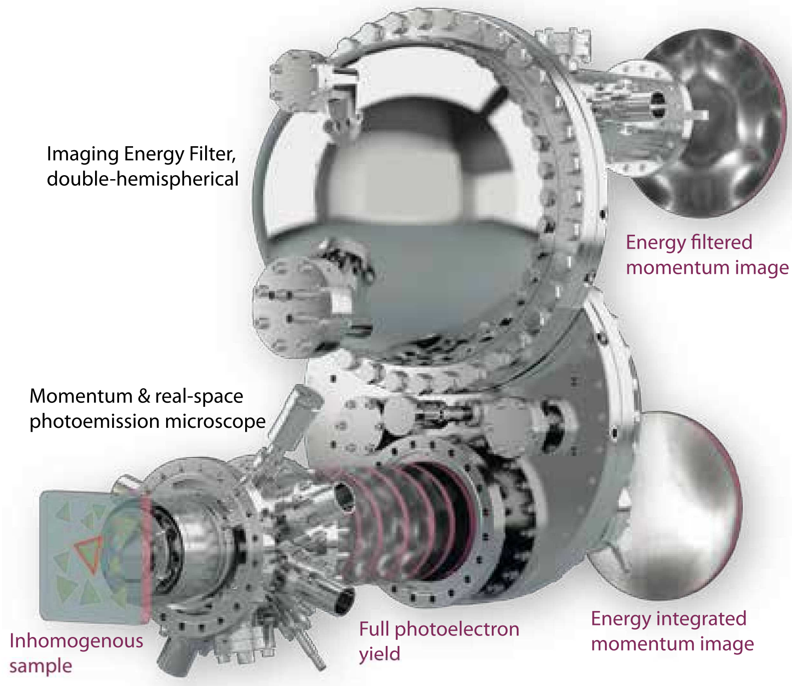
5 nm Au nanoparticles on p-doped Si-substrate.
FoV= 4 µm.
Courtesy: Mantis Deposition

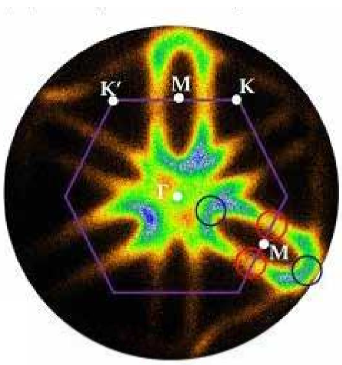
NanoESCA III

NEXT-GENERATION PHOTOEMISSION TOOL FOR REAL- AND MOMENTUM-SPACE MICROSCOPY

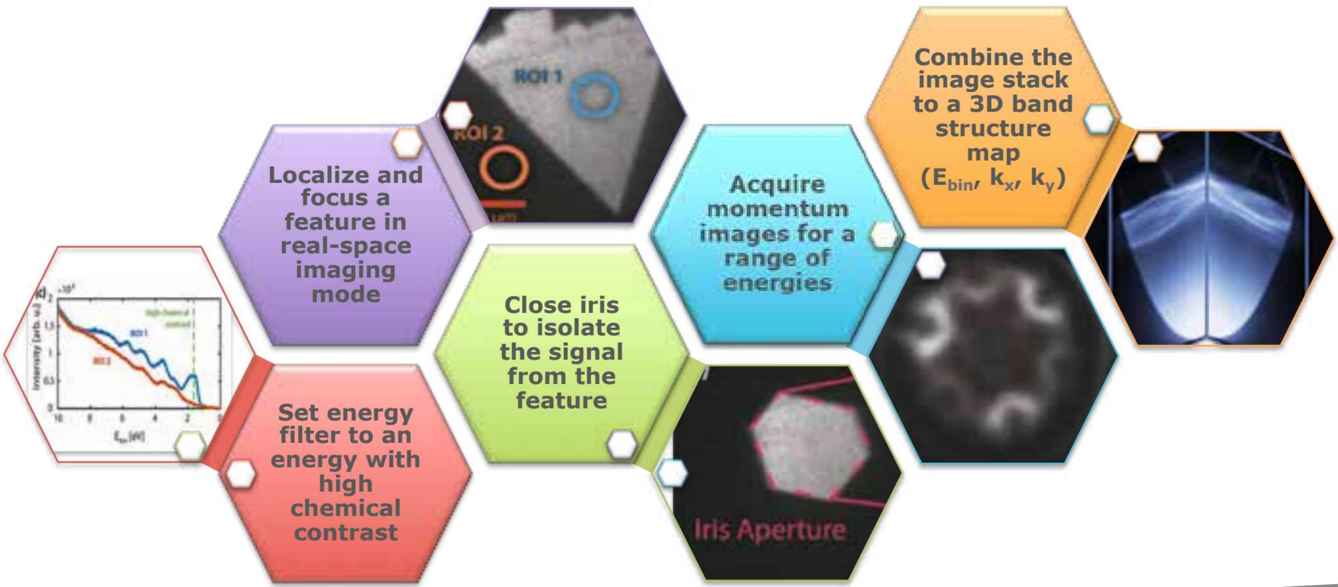
Brochure

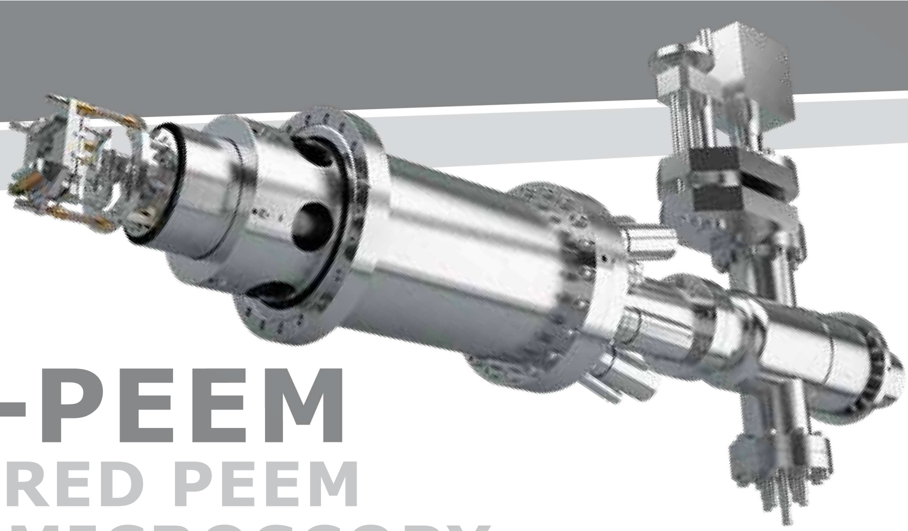
- Live View energy-filtered real & Momentum space imaging
- Precise sample spot definition for small area ARPES
- One-shot 180° ARPES overview without sample movement
- Compatible with an imaging 2D spin filter





Momentum microscopy Fermi surface snapshot of the CDW phase of VSe2 at 40K. Data courtesy of Mattia Cattelan and Neil A. Fox, Univ. of Bristol, UK



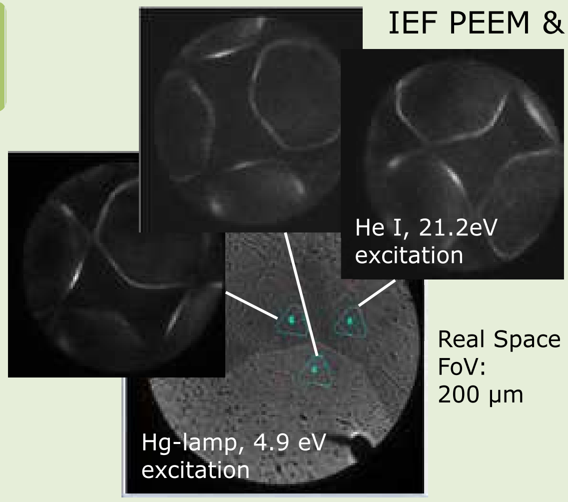


IEF/TOF-PEEM

ENERGY FILTERED PEEM & MOMENTUM MICROSCOPY

The Imaging Energy Filter (IEF) makes the FOCUS PEEM a powerful tool to measure work function maps (with lab sources) as well as element specific maps (with synchrotron, X-ray microspectroscopy) of conductive samples.
For time/energy resolved measurements paired with a pulsed excitation source the FOCUS PEEM can be equipped with a Time-of-Flight (TOF) energy filter. All these options can be combined in one instrument for maximum versatility.
The PEEM with IEF and/or TOF combined with the optional angular imaging optics delivers laterally resolved k-space images (momentum microscopy).

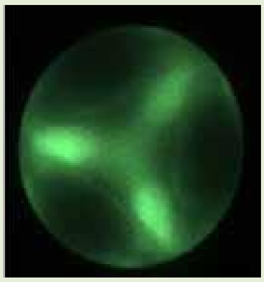
IEF PEEM & VUV lab source HIS 14 HD



Real Space FoV: 200 µm

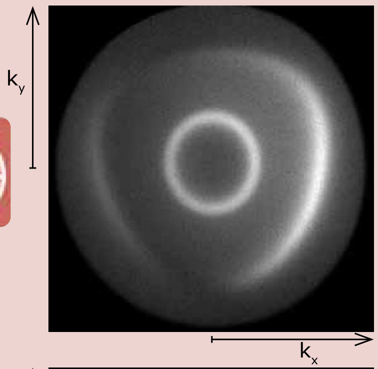
Left: µ-ARPES of polycrystalline silver. The navigation in the real space is accomplished by use of the iris micro aperture defining the region of interest before switching to k-space imaging.

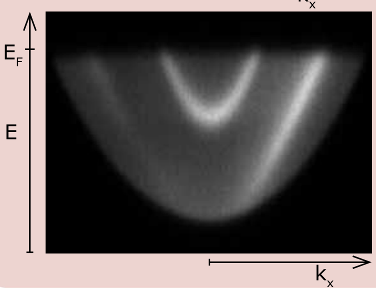
Because of their different crystallographic orientation the single grains deliver different momentum patterns.



Top: Imaging of the d-band region of Ag(111), He I excitation (HIS 14 HD, 21.2 eV), $E-E_F$ = 15.5 eV, dwell time 5 s, FoV = 20 µm

TOF PEEM & Pulsed Laser





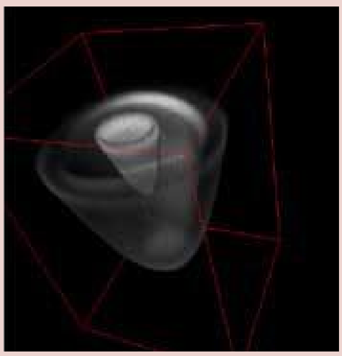
The complete k-space of the photoemission from a Au (111) surface (@room temperature), has been excited with a pulsed 210 nm laser (80 MHz rep. rate, 200 x 200 µm^2, 17 µW); Surface state and direct sp-sp transitions.

Top left:

k_x-k_y image near to the Fermi energy E_F.

Bottom left:

E–k_x image with a sharp parabolic emission horizon.



Right:

3D representation of a complete E-k_x-k_y data cube.

Real space FoV: about 25 µm

k-space FoV: ±0.575 Å^{-1}

drift energy: 20 eV

energy range: 4.3 eV to 5.9 eV (E_F)

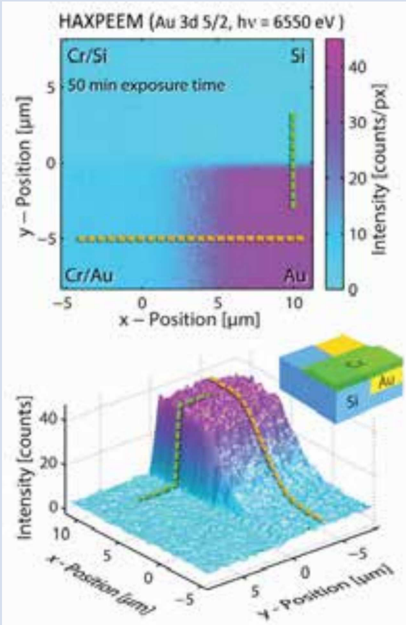
HAXPEEM

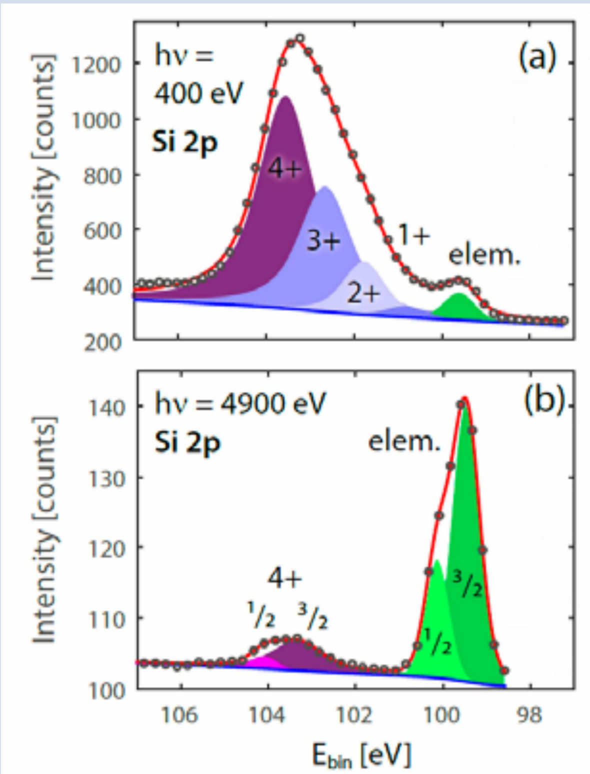
NANOESCA III @ HARD X-RAYS

Brochure

Hard x-ray photoelectron spectroscopy (HAXPES) has now matured into a well-established technique as a bulk sensitive probe of the electronic structure due to the larger escape depth of the highly energetic electrons. In order to enable HAXPES studies with high lateral resolution, we have set up a dedicated energy-filtered hard x-ray photoemission electron microscope (HAXPEEM) working with electron kinetic energies up to 10 keV. It is based on the NanoESCA design and also preserves the performance of the instrument in the low and medium energy range. In this way, spectromicroscopy can be performed from threshold to hard x-ray photoemission.

The HAXPEEM approach is of high interest for the study of new material systems and complex device structures like nonvolatile memory cells, spin-transistors, photovoltaic elements or batteries, because it allows a spatial resolved chemical analysis of the used materials (and their electronic intermediate states) even if they are covered by electrodes which are compulsive for the functionality of these devices.



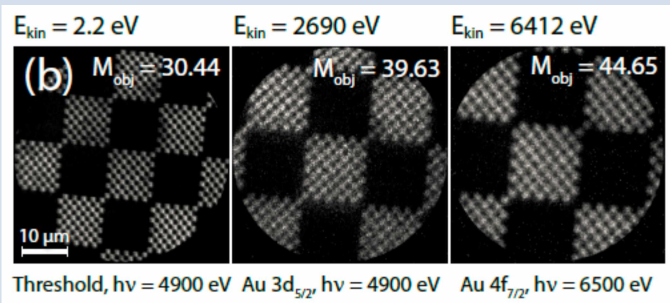


Top:

The energy-filtered PEEM image demonstrates, how the Au 3d signal is still detectable under a cover layer with increasing thickness.

Left: Image spectra were acquired from the same Si sample with soft- and hard-x-ray synchrotron light. The measurements show, how bulk sensitivity is increased with the hard-x-ray approach.

Bottom: Energy-filtered PEEM images were acquired with different excitation energies and different energy-filter settings. The HAXPEEM provides a stable image quality over a wide range of kinetic electron energies.



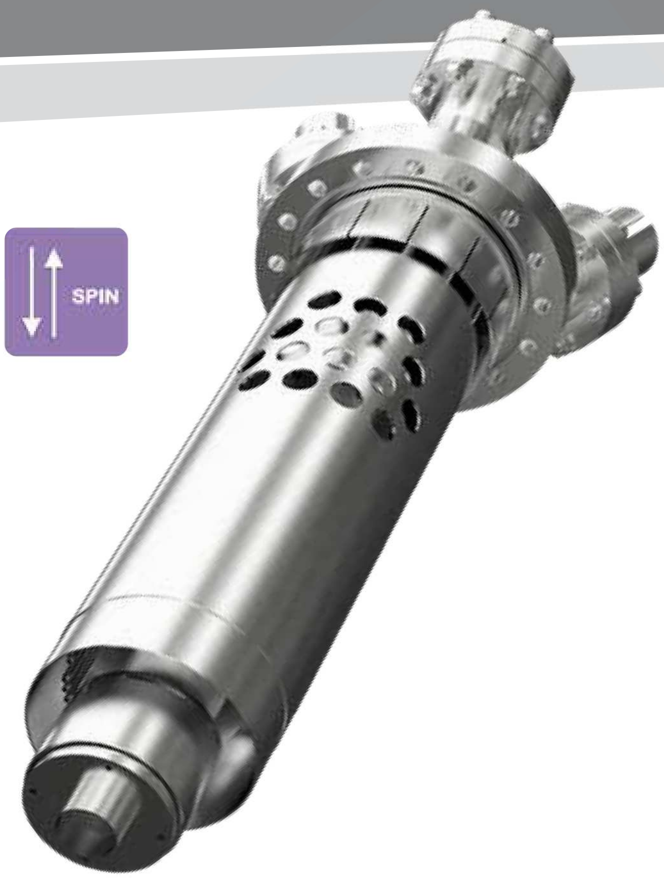
All data on this page courtesy of M.Patt, Scienta Omicron GmbH,
D - 65232 Taunusstein, Germany

Ref.: Patt et al., Rev. Sci. Instrum. 85, 113704 (2014)

Brochure

FERRUM

HIGH EFFICIENT SPIN DETECTION



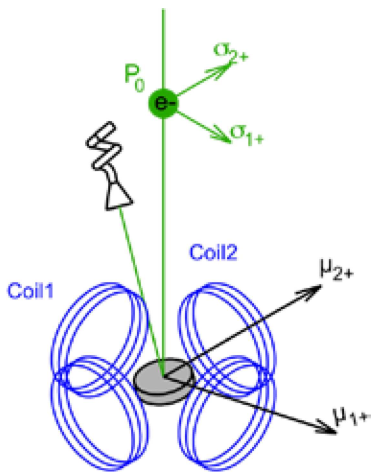
Spin and angle resolved photoelectron spectroscopy (SARPES), with its unique simultaneous sensitivity to electronic spin, momentum and energy, is a powerful method for directly probing the spin polarization of surfaces and electronic structures of current research interest.

While ARPES is an established technique SARPES still suffers from long integration times due to small signals of not user-friendly spin detectors.

The spin polarization detector FERRUM with its ultimate figure of merit (FoM: 8.8 x 10^{-3}) has demonstrated to overcome these restrictions to a large extent.

The integration time for a given signal to noise can be reduced by more than one order of magnitude compared to conventional Mott– or SPLEED detectors. In addition the operation of the FERRUM is straight forward and does not require expert knowledge.

The FERRUM can be used with all kinds of electron analysers. Together with an optional spin rotator it allows for measuring of all three spin components without sample rotation.

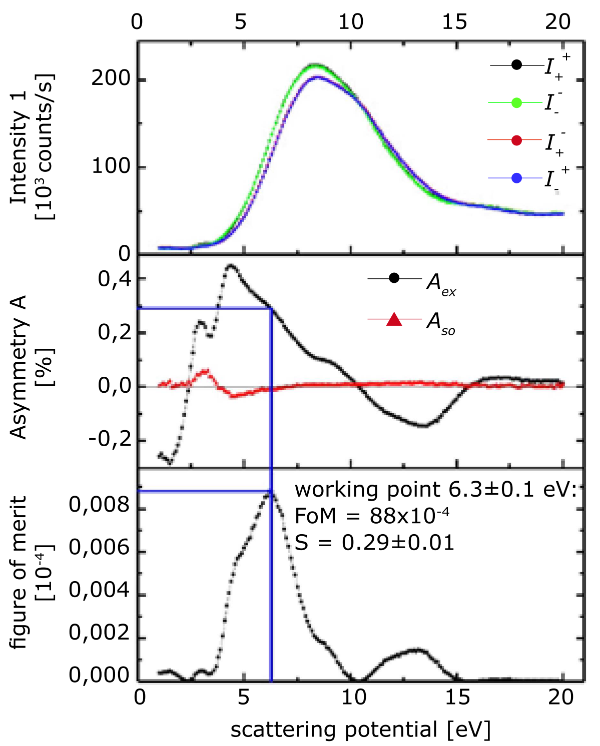


Working principle of the FERRUM

Incoming electrons are scattered spin-dependent at a magnetized thin iron film on W(100).

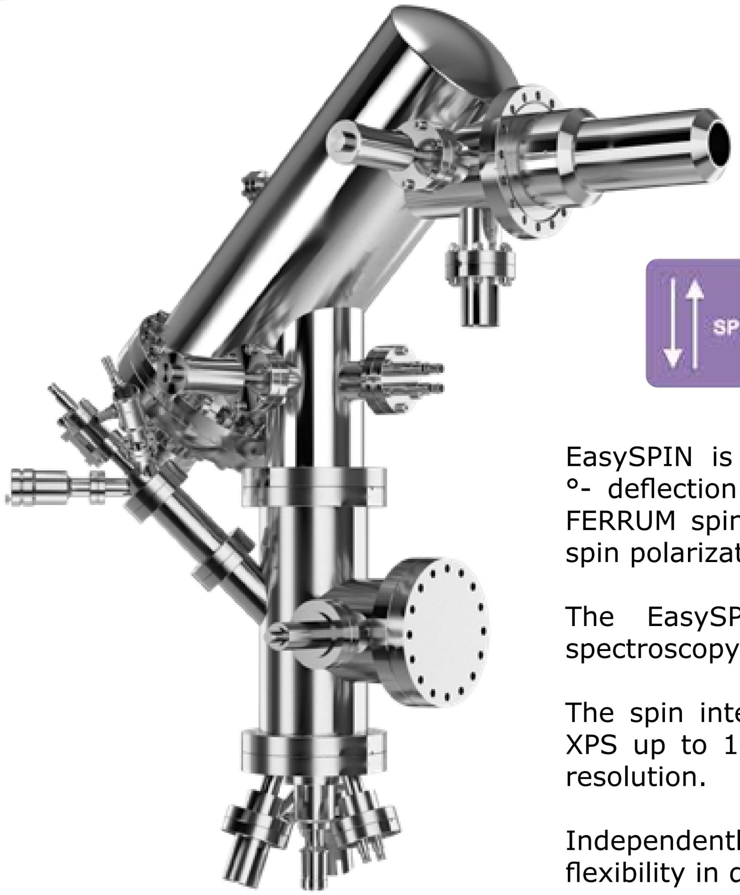
The scattered electrons are measured with a channeltron.

Magnetic coils switch the magnetization of the iron film in order to measure subsequently two orthogonal spin components in both directions.



Polarized secondary electrons excited with He I (21.2 eV) from a magnetized iron film are used to characterize the FERRUM and prove a figure of merit of 8,8 x 10^{-3}.

Ref.: M.Escher et al. e-J. Surf. Sci. Nanotech., **9** (2011)



EasySPIN

SPIN FILTERED SPECTROSCOPY

Brochure

EasySPIN is a compact electron analyzer combining the 90 °- deflection of a cylindrical sector energy analyzer with the FERRUM spin detector for simultaneous in- and out of- plane spin polarization measurements.

The EasySPIN enables unsurpassed fast spin resolved spectroscopy in a user friendly and affordable manner.

The spin integrated mode supports both standard Auger and XPS up to 1.6 keV kinetic energy and UPS down to 10 meV resolution.

Independently variable entrance and exit slits provide high flexibility in determining signal and energy resolution.

Fig. 1

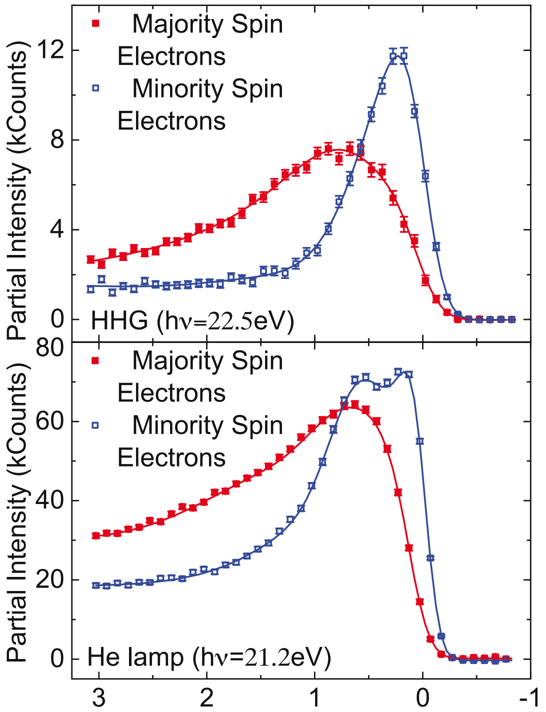


Fig. 2

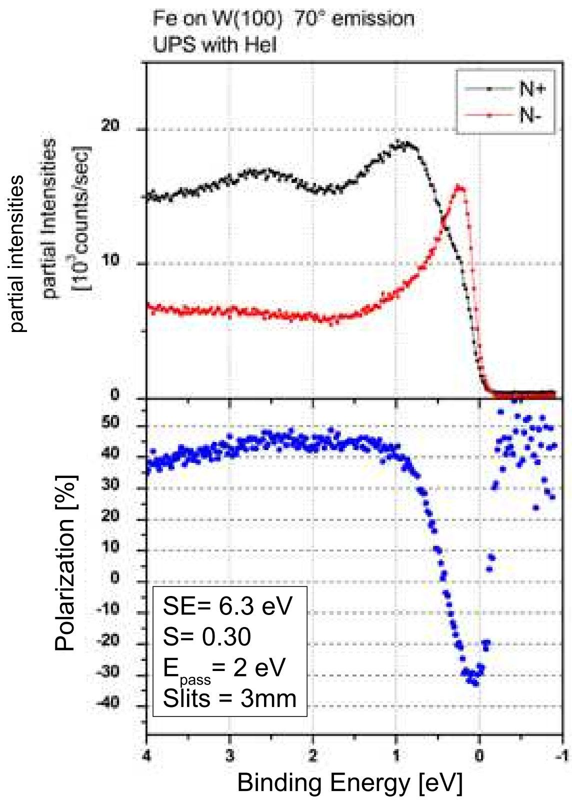


Fig. 1: M. Plötzing et al.
Rev.Sci.Inst. , 87 (2016)

Fig. 2: Ref.: M.Escher et al.
e-J. Surf. Sci. Nanotech., 9 (2011)

Photo electrons polarization
(He I excitation) from a magnetized Iron film on W (100).
Measurement: M. Escher, FOCUS GmbH

Brochure

SEMPA DETECTOR

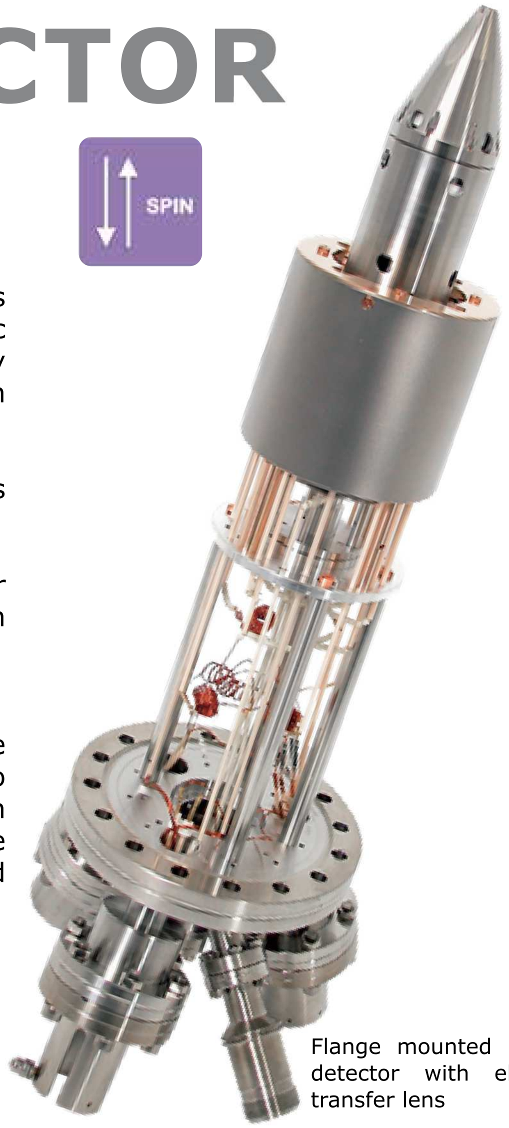
SEM IMAGING WITH SPIN CONTRAST

Scanning Electron Microscopy with Polarization Analysis (SEMPA) is a technique for directly imaging the magnetic structure of surfaces and thin films at the mesoscale by means of a scanning electron microscope, equipped with a suitable spin detector.

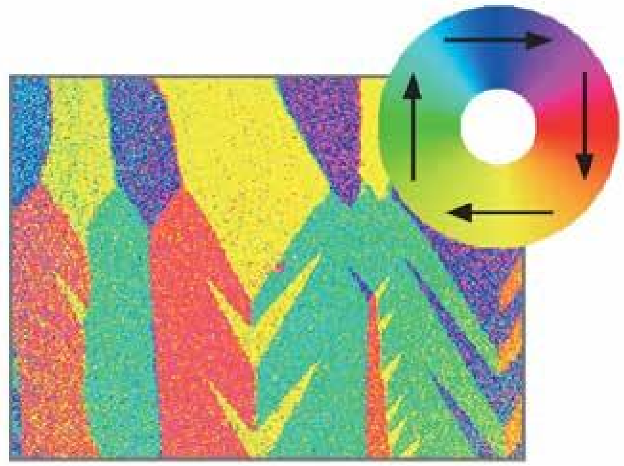
A lateral resolution in the SEMPA image down to 10 nm is achievable with state of the art UHV SEMs.

The FOCUS SEMPA detector is a dedicated spin detector that allows for parallel detection of two orthogonal spin channels.

It is based on the well proven FOCUS SPLEED design. Combined with the ease of use of the SEM the FOCUS SEMPA-detector provides a powerful tool to investigate electron transport in dependence of the pattern shape and magnetic domain structure. Alternatively the SEMPA detector has been already succesfully ecquipped with the FERRUM spin detector.



Flange mounted SEMPA detector with electron transfer lens



SEMPA image using Focus SPLEED of the magnetic domains of an iron whisker with a typical „fir tree" structure. Each colour indicates a different direction of the magnetisation (4 different domain orientations) as indicated with the insert above.

UHV Spintronics Cluster Tool (Scienta OMICRON) that features a UHV Gemini based SEMPA system (SEM with polarization analysis) for magnetic imaging combined with FIB nano-structuring facilities.

Data measured in an OMICRON NanoSAM lab

scientaomicron

Today the FERRUM spin detector is also available for use as a SEMPA detector.

FOCUS LaVa
LASER BEAM WELDING IN VACUUM

- LaVa stands for laser welding in vacuum and combines the well known benefits of laser welding with those of a low pressure environment.
- At a wide pressure range between 0.1 - 100 mbar the key hole is much more stable which results in up to twice the welding depth at a given laser power.
- Another advantage of the vacuum environment is a significant reduction of pores and weld spatter. The investigation of laser welds performed under vacuum demonstrates impressive results e.g. for welding of copper.
- The FOCUS LaVa is configured and offered with different types of laser in the power range between 100-6000 W.

MEBW-60

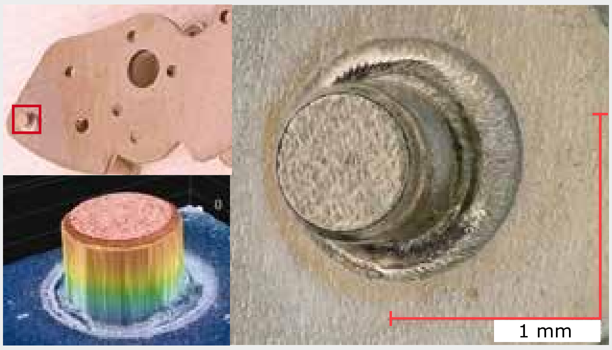
MICRO ELECTRON BEAM WELDER

The MEBW-60 stands for high precision electron beam welding and surface modification at many hightech fields of application such as watch/jewelry, air- and space, R&D, medical instrumentation and implants, micro electronics and sensors as well as E-Mobility.

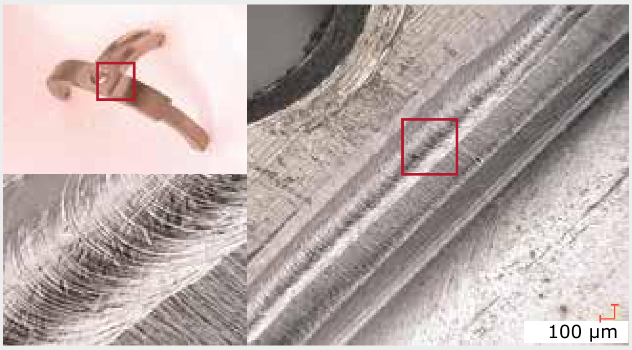
The Micro Electron Beam Welder MEBW-60 is a table top electron beam processing machine with up to 2.0 kilowatt power and a beam focus of down to below 50 microns. The fine focused power beam allows for micro joining & drilling, micro surface structuring and micro hardening.

Beside standard metals the electron beam can join the technological relevant metals like titanium, aluminum, tungsten or memory shape materials. The MEBW-60 L8 is a highly cost effective small chamber machine for R&D and small batch production whereas the MEBW-60 CNC is designed for more complex applications and small lot production using a CNC-driven X/Y- and rotary table.

Micro Joining

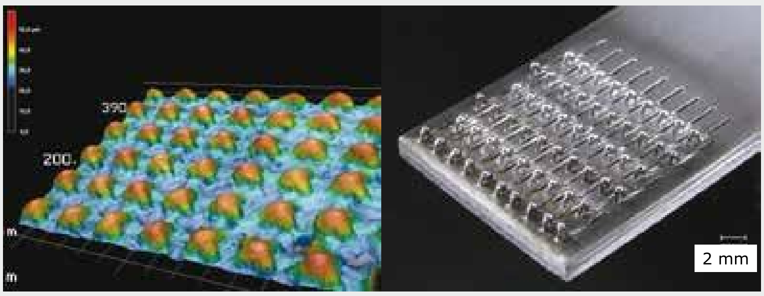


Part of a mechanical wrist watch consisting of NiCu. The bolt has a diameter of 800 µm and the weld witdh is less than 200 µm.



Part of an electron microscope consisting of titanium. The weld width is about 150 µm and is free of any defect.

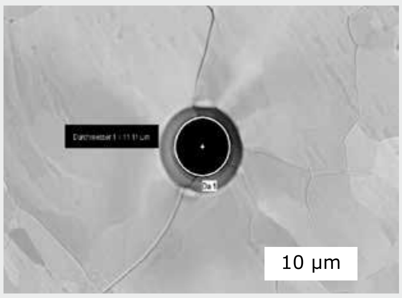
Surface Modifications



Surface Modification in the micro range by fast beam deflection can increase the joining properties of adhesive bonds and polymer-steel joints, hardness of a surface or can be used for engraving. One possible method is Surfi Sculpt® which was used in the examples above.

Surfi-Sculpt® is a registered & patented trademark of TWI.

Micro Drilling



EB-Drilling with a fine focus beam on a 100 µm molybdenum metal sheet. Drilling of very smooth and precise holes with diameter less than 10 µm can be achieved.

Brochure

FOCUS

FOCUS is an owner-managed German company situated in Hünstetten only 30 min drive away from Frankfurt airport.

Since its foundation in 1990, FOCUS develops and builds scientific instruments in the field of electron spectroscopy and electron microscopy, in close co-operation with several universities and research centers as a platform for new and innovative products.

Those products are developed, manufactured and tested in-house. This holds for most of the vacuum components as well as the related electronics, software and the electron optics. Special value is set on software development and intelligent control concepts to combine ease of use with most recent technology. A dedicated team of electronic engineers, software engineers, designers and physicists, in co-operation with external partners, ensures that FOCUS products always meet the latest demands of the high technology branches in long term.

The scientific instruments of the FOCUS product range include electron beam evaporators, electron spectrometer and the patented NanoESCA, an energy dispersive microscope to image photoelectrons.

FOCUS occupies a unique position in the field of electron spin polarization. Based on decades of experience, FOCUS supplies powerful spin detectors for spectroscopy and microscopy.

With its sound foundation of long experience in the development and construction of electron beam devices, FOCUS has entered the field of electron beam welding in 2007 and has firmly established itself since then with the Micro electron beam welder MEBW-60.

More on:

focus-e-welding.com

Visit our webpage:

www.focus-gmbh.com

for detailed and up to date product information.

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