FDG 15 & FDG 150

HOT FILAMENT ION SOURCES

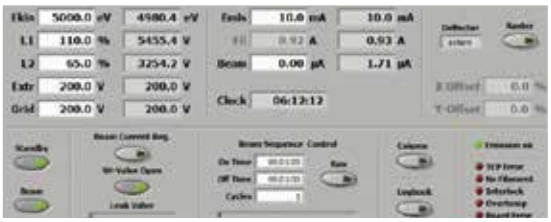
Brochure

The FDG range of hot filament ion sources, are the premium product when you need to: clean metals and semiconductors[1)-4)] or undertake XPS Depth Profiling, ISS/LEIS experiments or as a <15eV Charge Neutralization source.

All variants operate as standard with Argon gas but other noble gases, Hydrogen or Oxygen are also fully compatible.

Both ion sources are made of completely non-magnetic materials and are compatible with high-resolution electron spectroscopy.

An ultra clean ion beam is ensured by an indirect filament, a direct gas inlet for minimizing dead volume and effective differential pumping.



Window of GUI for parameter input

The power supply can be fully controlled with the front panel or via a TCP/IP interface. ProIon, an easy to use LabVIEW™ – based PC software is provided.

In addition, the power supply comes with a high stability emission current based flux regulation.

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All about electrons...

FDG 15

VARIABLE FOCUS ION SOURCE

- Differential pumping
- Non line-of-sight filament
- Integrated port aligner
- 30 - 300 mm working distance
- Variable spot size
- Down to 10 eV kinetic energy (optional)

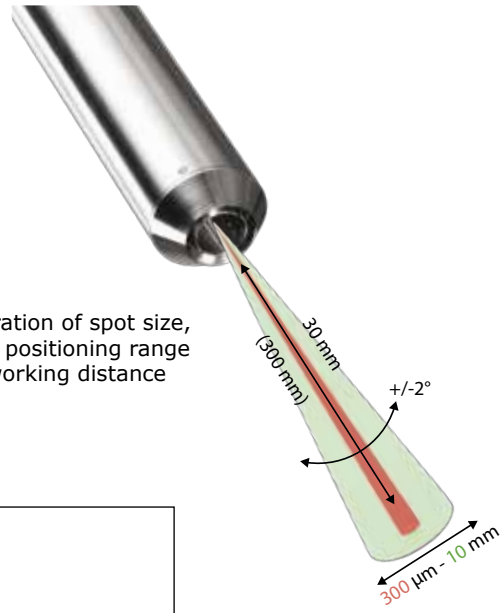
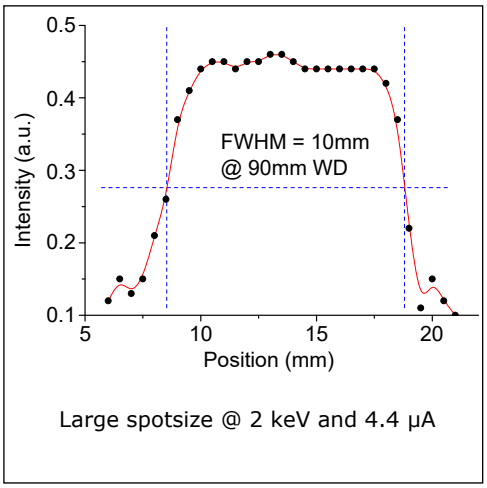
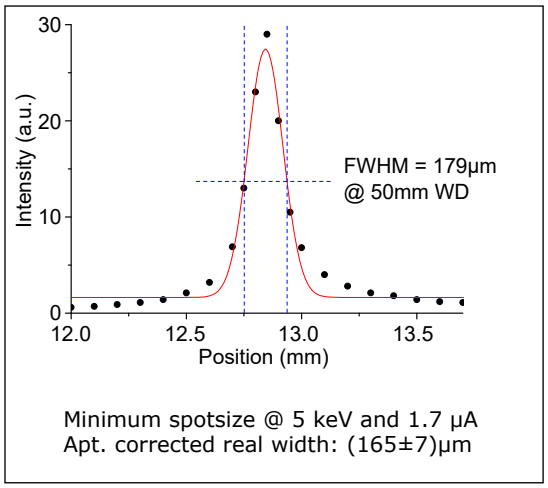


Illustration of spot size, beam positioning range and working distance



Large spotsize @ 2 keV and 4.4 µA



Minimum spotsize @ 5 keV and 1.7 µA
Apt. corrected real width: (165±7)µm

A dedicated ion focusing optics allows to reduce the spot size down to 300 µm @ 50 mm working distance for sputtering of small crystals and to adapt for large working distances up to 300 mm.

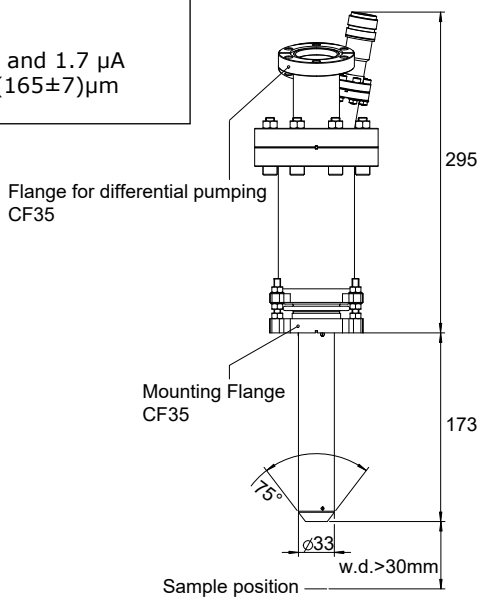
Alternatively a broad spot profile can be chosen for homogeneous large area sputtering.

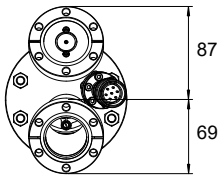
The optional low energy mode provides a comparable large ion current of > 1 µA @ 50 eV.

It has been found that ion sputtering at low energies of semiconductors close to the threshold energy is critical to minimise ion implantation and surface damage[1)-4)].

Lower energy ion sputtering, at 50 eV, has been shown to even maintain the sample magnetisation during XPS depth profiling[5)].

The source can be operated with or without differential pumping. The latter provides improved residual gas pressure of typ. 10^{-8} mbar.



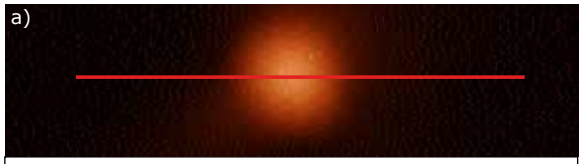


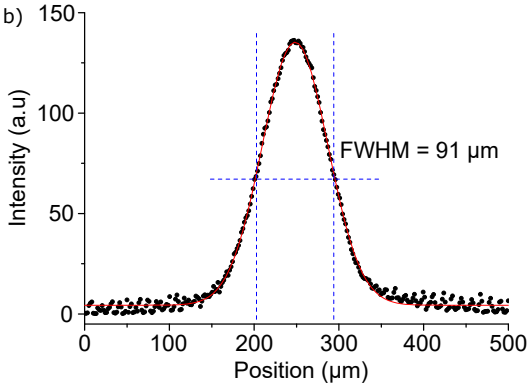
FDG 150

FINE FOCUS SCANNING ION SOURCE

- Spot size 150 µm @ 50 mm working distance.
- Scanning up to 10 mm x 10 mm
- Keystone correction
- XPS Depth Profiling
- Down to 10 eV kinetic energy

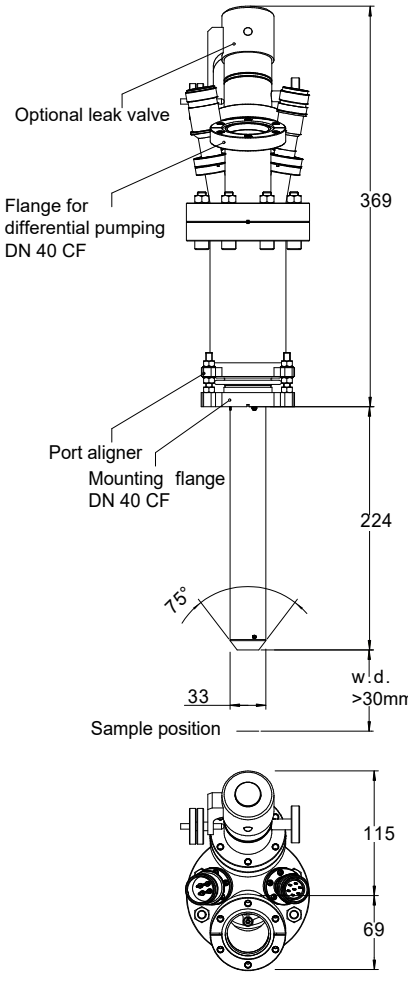
The FDG 150 provides all features of the FDG 15 and in addition dedicated depth profiling with a rasterized small spot down to less than 150 µm @ 50 mm working distance for XPS and Auger spectroscopy, charge neutralization for ESCA applications and sensor cleaning in scanning probe microscopy.



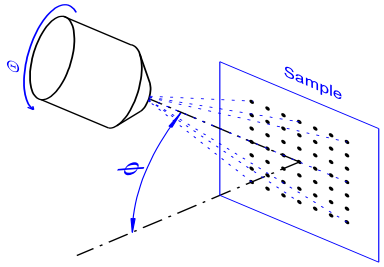


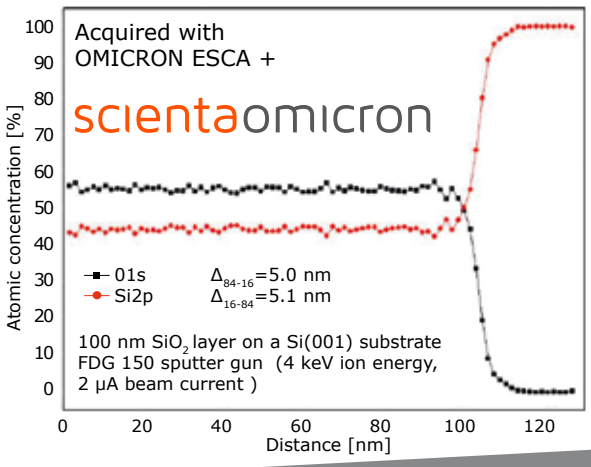
a) Image of the argon ion spot scanned across a 50 µm aperture.

b) Cross section along the red line of a) showing a minimum spotsize @ 5 keV and 1.6 µA.
Apt. corrected real width: **(76.4±0.4)µm**



c) Illustration of keystone correction: In order to achieve a homogeneous sputter rate across the sputtered sample area any tilt φ or rotation θ, between ion source and sample, can be compensated to maintain an undistorted raster field.





d) XPS depth profiling through a 100 nm SiO2 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. The FDG 150's small spot size of 150 µm and the Keystone correction are essential to achieve high precision in depth resolution. To shorten measurement time both features allow to adjust the sputter area with the Energy Analyser's field of view as well as the x-ray source spot size.

Brochure

FDG 15 / 150

HOT FILAMENT FOCUSED ION SOURCES

Specifications	FDG 15 & power supply	FDG 150 & power supply
Mounting flange	DN 40 CF	
Working Distance (WD)	30 to 300 mm	
Min. beam diameter (D)	< 300 µm (@ 5 keV and 50 mm WD)	< 150 µm (@ 5 keV and 50 mm WD)
Beam energy 1	500 eV to 5 keV > 15 µA (@ 5 keV and 50 mm WD)	
Beam energy 2	optional	10 eV to 500 eV; > 1 µA @ 50 eV
Beam current density	> 4 mA/cm2 with > 5 µA, D < **350 µm** (@ 5 keV and 50 mm WD)	> 4 mA/cm2 with > 5 µA, D < **200 µm** (@ 5 keV and 50 mm WD)
Scan area	not available	up to 10 mm x 10 mm (@ 5 keV and 50 mm WD)
Beam current regulation	✓	✓
Integrated Port Aligner	✓	✓
Current measurement	✓	✓
TCP/IP Interface	✓	✓
LabVIEW based software	✓	✓
Fully non-magnetic	✓	✓
Yttria coated tungsten filament (compatible with O2)	✓	✓
Tungsten filament (compatible with H2)	optional	
Leak Valve	optional	

*Differential pumping improves the beam purity and saves significant time during outgasing and when changing gas flow to different values. Alterntively to full differential pumping a passive by-pass to main chamber with gate valve is recommended.

1) Chebotarev, S. N. et al. "Low-Energy Ion Technique for Semiconductor Surface Preparation." Solid State Phenomena, doi:10.4028/www.scientific.net/ssp.284.198;

2) Dongwan Seo et. al. „Behavior of GaSb (100) and InSb (100) surfaces in the presence of H2O2 in acidic and basic cleaning solutions", doi.org/10.1016/j.apsusc.2016.12.114

3) Shiou-Min Wu et al. "Sputtering yields of Ru, Mo, and Si under low energy Ar^+ bombardment", Journal of Applied Physics 106, 054902 (2009); doi: 10.1063/1.3149777

4) Hye Chung Shin et al. "Sputter damage in Si surface by low energy Ar^+ ion bombardment", Current Applied Physics 3 (2003) 61–64

5) B. J. McMorran et al., Measuring the effects of low energy ion milling on the magnetization of Co/ Pd multilayers using scanning electron microscopy with polarization analysis. Appl. Phys. 107, 09D305 (2010); https://doi.org/10.1063/1.3358218

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