STEM（走査型透過電子顕微鏡）に CL、PL 測定機能を追加
近赤外光の検出も可能！

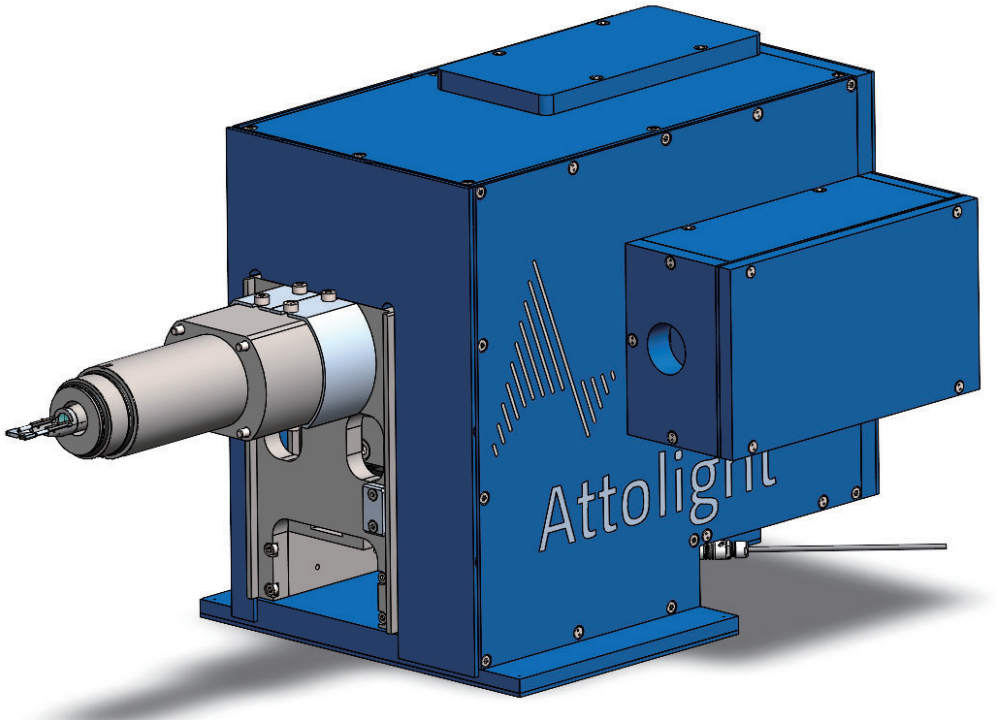
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STEM 用 CL/PL 測定システム

MÖNCH

Light collection and injection add-on for (S)TEMs

Cathodoluminescence - Photoluminescence - Gain spectroscopy - Local thermal excitation



Benefit from a versatile system that includes both light collection and injection modes.

Reveal unprecedent features of your sample: composition, structure and defects.

Take advantage from a fully optimized system with large collection angle.

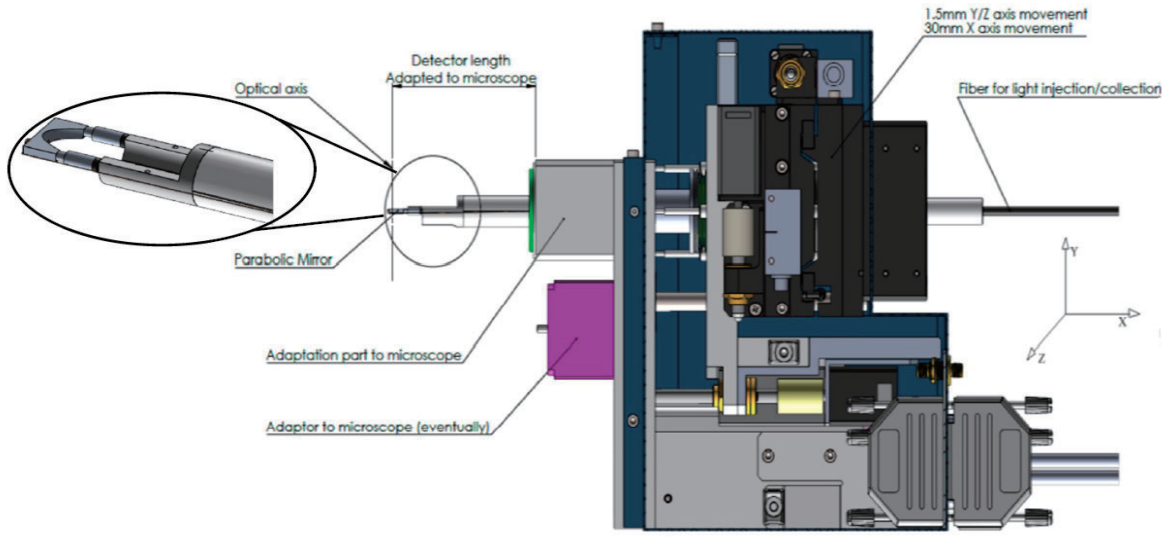
Excite samples to reveal local behaviour under light/thermal excitation.

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The Mönch is an easy to use and accurate add-on for light collection or injection in (S)TEM thanks to:

- A **mirror independent from the sample holder** allowing for a perfect and optimized alignment ;
- An absolute encoding system ensuring **high alignment precision and reproducibility** (100nm-precision) ;
- The ability to **inject and/or collect light** either in **free space or via an optical fiber**.

System overview



Light collection mode:

The Mönch has been designed and carefully optimized to achieve unprecedent signal-to-noise ratio thanks to:

- A **proprietary parabolic collection mirror** designed to fit into pole piece gap ;
- A **positioning system** with sub-micrometer precision for perfect alignment of the mirror with respect to the sample;
- A **high curvature parabolic mirror** with a NA > 0.4;
- A **working distance reduced to 300µm** to maximize the light collection/injection efficiency;
- A **patented asymmetric optical fiber** designed to preserve brightness and spectral resolution.

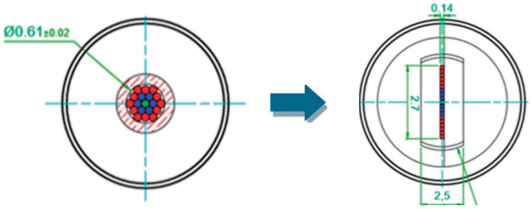
Light injection mode:

The Mönch reaches unprecedent level of performances and versatility thanks to:

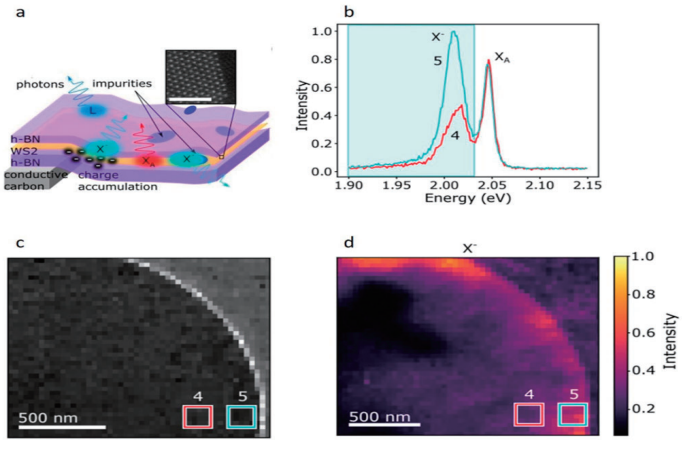
- A **beam size reduced to few microns** for localized light or thermal excitation of samples;
- The ability to perform **injection and light collection measurements simultaneously.**

Patented optical fiber:

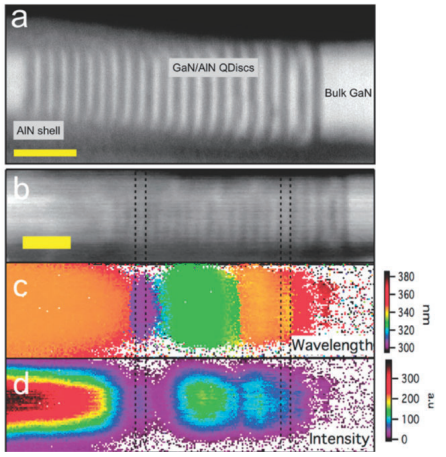
The Mönch uses of an asymetric optical fiber with a bundle rearrangement from round to parallel to the entrance slit of the imaging spectrograph. This enables keeping constant spectral resolution even when the slit is opened and the spot moving at the entrance of the slit due to scanning.



Light input Light output



a) h-BN/WS2/h-BN heterostructure shows three emission lines: excitons (XA), trions (X-) and localized emitters (L). b) CL spectra for the regions highlighted in c and d. c) HAADF region measured in d and d) the X- intensity map revealing local trion enhancement.
(Bonnet et al., avarXiv:2102.06140 (2021)).



Spectral imaging of a GaN/AlN NW with 20 QDisks (a) HAADF image of a GaN/AlN nanowire Scale bar is 20 nm. (b) HAADF of the NW, acquired simultaneously with the CL. (c) Wavelength position of the most intense peak. (d) Intensity of the most intense peak.
(L.Zagonel et al., Nano letters, 11(2), 568-573 (2011)

Light collection/injection modes

Mode	Excitation source	Analysis (detection)
Light collection Sample under vacuum → Outside	E-beam, Laser, Thermal, Electrical...	Cathodoluminence (light)
Light injection Outside → Sample under vacuum	Laser ...	Electron imaging (electron) in photoemission/thermoionic regimes
Light injection + collection Outside ⇆ Sample under vacuum	Laser...	Photoluminesence (light)

Topics:

- Electronics & Optoelectronics (GaN, InP, SiC...)
- Photovoltaic cells (GaAs, CdTe, Perovskites...)
- Light emitting diodes (LEDs)
- 2D materials (Graphene, BN, WS2, diamond...)
- Noble metals (plasmonic)
- Photonic crystals
- Quantum wells & quantum dots
- Minerals, glasses, ceramics and gemstones)
- Inorganic coatings
- Organic, polymer samples

Mönch: Unique Light collection/injection add-on for STEM

High spectral resolution • High collection efficiency • Fits into small pole-piece gap
Versatile and flexible system • Mirror independant from the sample • Sub-micrometer alignment of mirror
No need for sample pre-aligment • CL analysis of whole sample area • High field of view • No vignetting
Large choice of detectors • Fast hyperspectral map measurement time• Unprecedent signal-to-noise ratio
No compromise between brighness and spectral resolution • Compatible with other techniques (EELS, EDS...)

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Mönch Features

Specifications

Mirror:

- High numercial aperture parabolic mirror (NA>0.4)
- Mirrror reflection : up to 90% from 200nm to 1.7µm
- Compatibility for light collection and injection modes
- Optimized sample to mirror distance : 300µm

Micro-positionning system:

- Travel range: 30mm (X), +/-1.5mm (Y), +/-1.5mm (Z)
- Automated retractable mirror
- Absolute encoders with 100nm-precision
- Stage touch alarm
- X-Rays Protection (300keV-compatible)
- Compact module

System control:

- External scanning card with 4 inputs (12 bits) for additional single channel detectors (PMT...); 2 outputs for controlling the STEM scan (X and Y); 1 output for the beam blanker.
- Fastest measurement speed: 900Hz (18s for a 128x128 map)

Software:

- Arm/mirror control software (Windows® 10 or higher, 64 bits)
- Acquisition/visualisation module for GMS® sotfware

Light collection/injection couplings:

- Optical fiber with adaptated insertion slot
- Free space to avoid loss of spatial coherence and degradation of signal power density

Switching possible between both modes

Dispersive spectrometer

- 328 mm focal length
- Up to 4 turrets with large choice of gratings

Detectors

- High speed UV-Visible EM-CCD or CCD camera (200 nm–1100 nm)
- InGaAs near Infra-Red detector (900 nm–1700 nm)
- Panchromatic detection (PMT; 200 nm–900 nm)

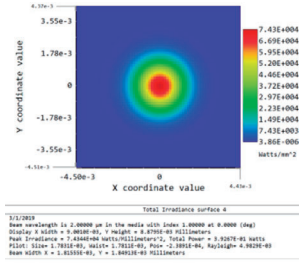
Others detectors on request

Light injection : Beam size simulation

The specific mirror shape enables generating a micrometer beam spot size on the sample surface.
For a input laser beam diameter of 0.5mm, the beam spot size on the sample surface is approx. 2.0µm-diam.

Optical simulation:





STEM compatibility:

- Compatible with most of the (S)TEM models : TFS, JEOL, Nion, VG...
- One available port in the PPG plane
- Contact us at : contact@attolight.com to check the compatibility of your (S)TEM models

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