

## ALLALIN

*Hybridized SEM-Spectroscopic platform*

SEM-Cathodoluminescence - Photoluminescence - Pump&Probe-Electrical measurements



Access to composition, structural, defects information of your samples.

Adaptable spectroscopic, optical, electronic analysis platform.

Nanometric spatial and picosecond temporal resolutions.

Static and dynamic analysis modes.

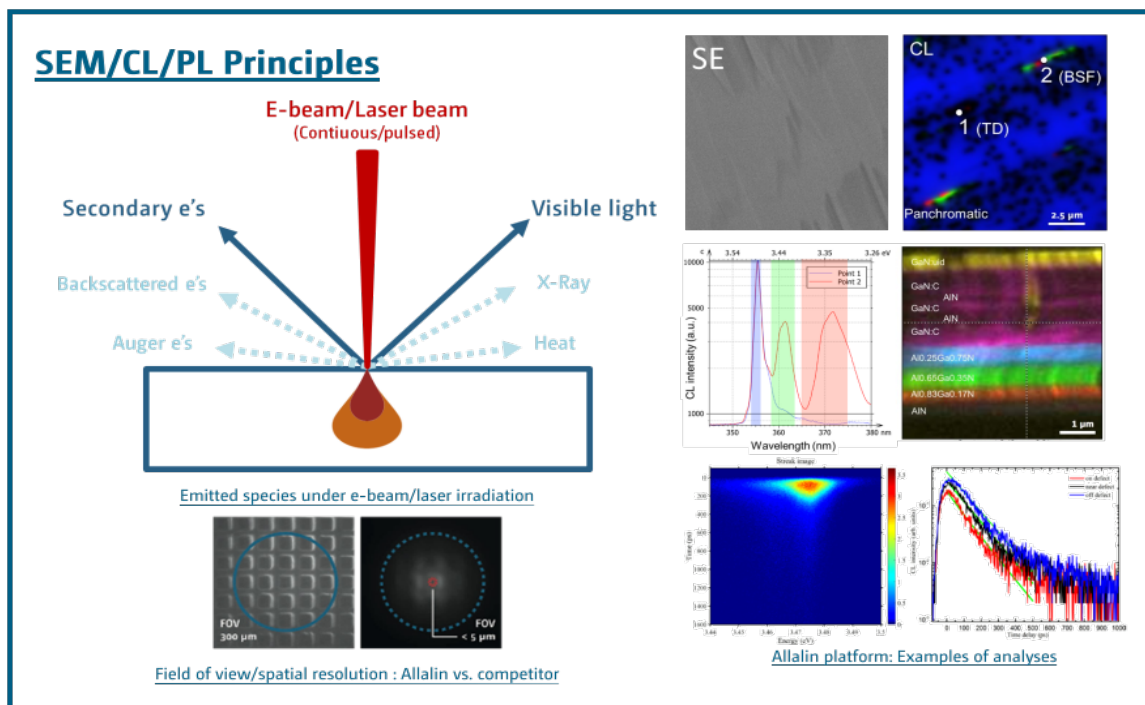
The Allalin spectroscopic equipment is a versatile and flexible equipment gathering on the same platform:

- A **unique spectro-optical base** including an electronic source and an innovative high-collection optical objective;
- The ability to perform **any type of SEM, Cathodoluminescence, Photoluminescence, Pump and Probe, EBIC/EBAC/RCI...** analyses in static and in dynamic modes.
- The possibility to choose amongst **multiple sources, detectors, stage options...** to match your analytical needs;

The base system was constructed from the ground up to obtain the best luminescence collection efficiency without sacrificing the SEM performance.

- The light microscope and the SEM objective lens are carefully integrated so that their focal planes match each other;
- The light microscope includes an achromatic, high numerical aperture detection (NA=0.71) with superior photon collection efficiency over a large field of view (up to 300  $\mu\text{m}$ ) compared with traditional optical/spectroscopic technologies.

The Allalin platform allows for 'No compromise'  
Large field/fast scanning simultaneous SEM imaging with hyperspectral or panchromatic map.



## Topics:

- Electronics & Optoelectronics (GaN, InP, SiC...)
- Photovoltaic cells (GaAs, CdTe, Perovskites...)
- Light emitting diodes (LEDs)
- 2D materials (Graphene, BN, WS<sub>2</sub>...)
- Noble metals (plasmonic)
- Nano-micro particles
- Nano-micro wires/rods
- Photonic crystals
- Quantum wells & quantum dots
- Minerals, glasses, ceramics and gemstones
- Inorganic coatings
- Polymers layers
- Organic materials
- Biological samples, cells, vesicles...

## Main applications:

### Electronics and Optoelectronics

- Strain/dislocation/defect detection and mapping
- Local electronic band gap measurement
- Quantum wells and dots analysis
- Doping distribution/mapping
- Core-shell structure analysis

### Material Science

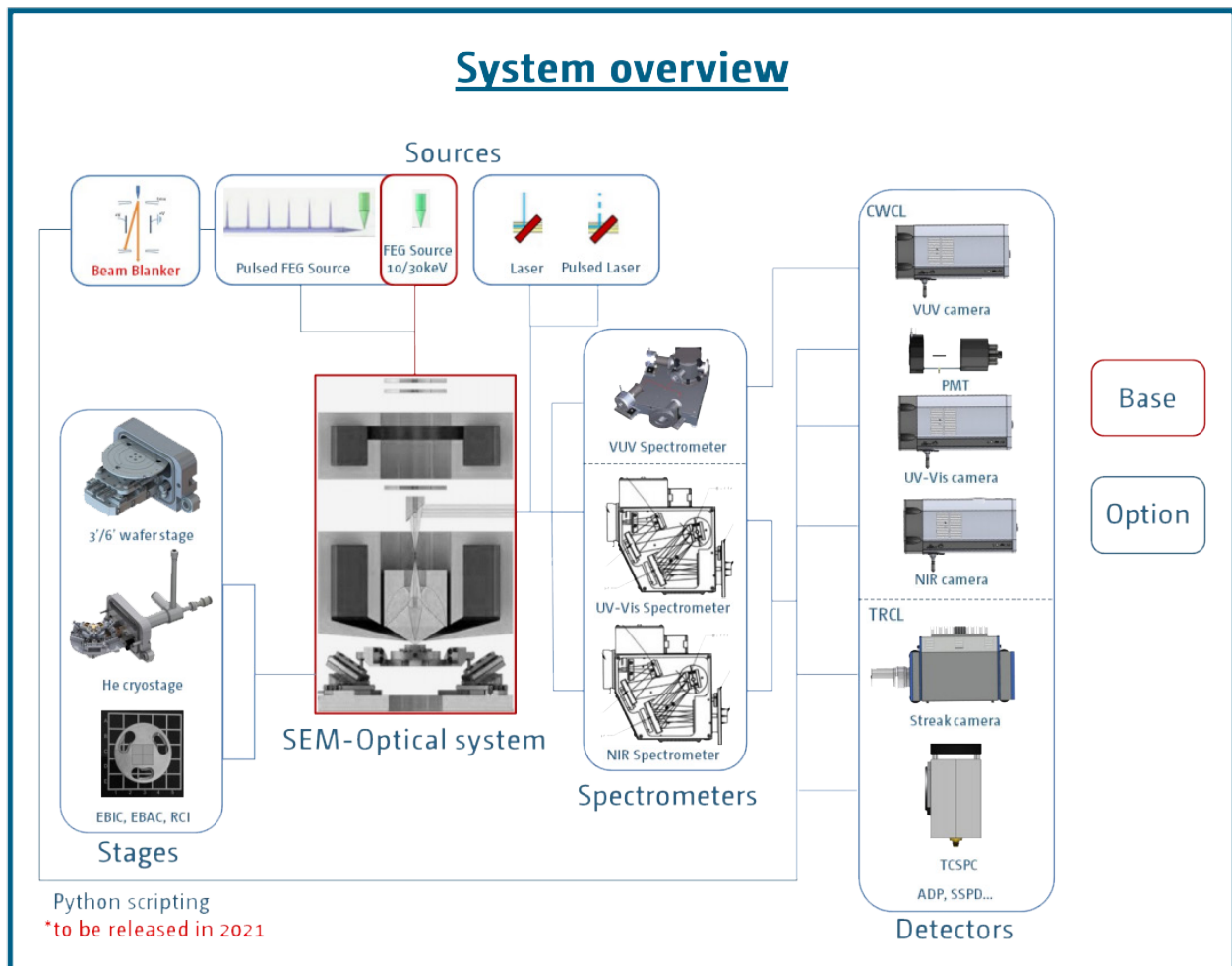
- Micro/nano-wires, fiber, particles spectral mapping
- Micro/nanostructure spectral analysis
- Surface plasmon resonance mode analysis
- Molecule distribution mapping and composition
- Crystal growth localisation, crystallinity analysis

### Biology: Pharmaceuticals & Nanomedecine

- Strain/dislocation/defect detection and mapping
- Local electronic band gap measurement
- Quantum wells and dots analysis
- Doping distribution/mapping
- Core-shell structure analysis

### Biology: Pharmaceuticals & Nanomedecine

- Cell, bacteria, ECM, DNA... imaging and spectral analysis
- Biological structures mapping and composition
- Functionalized vesicles/nanocarrier analysis



## Allain: a performant and flexible platform

- Zero optical alignment
- Highest collection efficiency
- Uniformity and reproducibility
- Large field of view
- Simultaneous SEM CL image/mapping
- High lateral resolution
- Sample nanopositioning
- Low beam dosage
- Applicable to sensitive sample
- Large choice of source, detectors, stages
- Fast hyperspectral map measurement time
- Scripting functionality to automate measurements

## Specifications

### Base:

#### Spectro-optical chamber with electron gun

- High-vacuum stainless steel chamber (10–7mbar)
- Schottky thermal field emission gun
  - Beam energy: 1 keV–10 keV
  - Electron probe current: 30 pA to 300 nA
  - Electron spotsize: down to 3 nm (@10 kV)
- Achromatic reflective objective
  - Optical range: 180 nm to 1.7  $\mu$ m
  - Numerical aperture: NA 0.71 (f/0.5)
  - Field of view: up to 300  $\mu$ m
- Nano-positioning stage
  - 25 mm (X;Y), 3 mm (Z), 3° tilt (X;Y), 10° rotation (Z)
  - Smallest increment: 1 nm
  - Sample size: 50mm diameter, 1.5 mm thickness
- Touch screen workstation
- Python Interface

#### System lay-out

- Footprint : 1219 mm (length)  $\times$  1039 mm (width)
- Tool weight : ~1110 kg

### Options:

#### Source

- Pulsed e-beam (Laser 80MHz; pulse length: <10ps)
- Laser : Large range of continuous/pulsed lasers (on request)

#### Spectrometers

- Dispersive spectrometer
  - Two imaging exits
  - Large choice of gratings over 200–1700nm

### Detectors

#### Continuous mode (CW)

- UV CCD camera (20–330nm)
- High speed UV-Visible CCD camera (200 nm–1100 nm)
- InGaAs near infra-red camera (900 nm–1700 nm)
- Panchromatic detection (PMT; 200 nm–900 nm)

#### Time-Resolved mode (TR)

- Streak camera : multichannel time-resolved detector (200 nm to 850nm; temporal resolution: 2ps)
- Time-Correlated Single Photon Counting (temporal resolution: 20ps; combined with a continuous detectors)

### Others

- Avalanche Photodiode (APD; 900nm to 1700nm)
- Super conducting single photon detectors (SSPD; 400nm to 1700nm)

Others detectors on request

### Stages

- Low Temperature Cryostat
  - Temp. range from 10 K to room temp. (0.1 K precision)
  - Less than 300nm drift per hour at 10 K
- Electron beam induced/adsorbed current (EBIC/EBAC)
  - Current measurement induced in the structure
  - Measurement limit of 100 fA
  - Gain 104 to 1015 V/A, bandwidth up to 100 kHz

### Post-Treatment data analysis

- Attomap:
  - Powerful analysis and reporting solution
  - 2D/3D imaging/mapping, hyperspectral. analyse

## Build-up your own system or choose amongst dedicated versions:

Allalin Version	Allalin-CL	Allalin-CL/PL	Allalin-TR CL/PL
Source	E-beam (Continuous)	E-beam (Continuous)/ Laser (Continuous)	E-beam (Continuous-Pulsed)/ Laser (Continuous-Pulsed)
Range of detectors (up to 4 per system)	PMT, UV-Visible CCD, InGaAs near infrared cameras	PMT, UV-Visible CCD, InGaAs near in- frared cameras	All detectors
Cryostage (4K) option	✓	✓	✓
EBIC/EBAC/RCI option	✓	✓	✓
Examples of applications	Strain/dislocation/defect detection and mapping, Local electronic band gap measurement, Doping distribution and mapping, Quantum wells and dots analysis...		Charge carrier dynamics, Energy transfer, Ul- trafast spectroscopy, Local carrier lifetime...

### About Attolight AG:

Attolight AG started off to revolutionise cathodoluminescence (CL) by designing top of the line CL instruments that deliver superior performance, maximum ease-of-use and make quantitative cathodoluminescence. The Company firmly believes in the potential of cathodoluminescence and aims at establishing the technology as a standard in-line inspection method in semiconductor industry.

Attolight AG is a company with global presence with systems in Europe, Asia, and North America. The Company headquartered at the EPFL Innovation Park where the Attolab is located as well.

