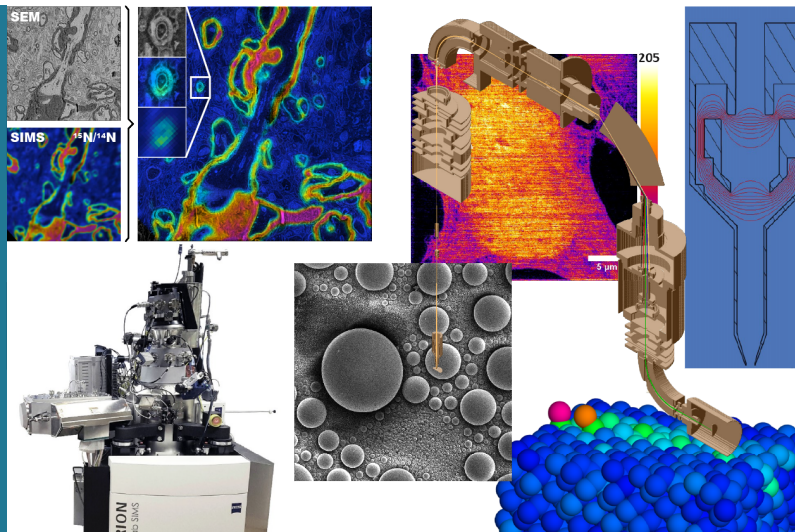


# Advanced Instrumentation for Nano-Analytics



The "Advanced Instrumentation for Nano-Analytics" (AINA) group focuses on the development of scientific instruments based on charged particle beams and laser beams and correlative workflows taking advantage of these instruments. The group's R&D activity covers fundamental investigations, instrument development and application development. The targeted fields of application of the instrumentation and methodologies developed by AINA are:

- nano-imaging
- nano-analysis
- in-situ process control for nano-fabrication
- neutral gas, plasma & liquid flow diagnostics



Our research activities are performed in cooperation with leading international instrument manufacturers and with research groups specialized in the relevant fields.

## Main expertise fields

- [Nano-analytics](#)
- [Charged particle optics](#)
- [Laser optics](#)
- [Vacuum and laser ion extraction](#)
- [Instrument development and prototyping \(including mechanics, electronics, software development\)](#)

## Research challenges

The development of innovative characterization tools is of paramount importance to advance the frontiers of materials science. Due to the ever-increasing complexity of devices and continuously shrinking geometries in materials science and engineering, the characterization tools and techniques are facing new challenges and need to anticipate future trends.

- The development of new hardware to improve following aspects of nano-analytics:
  - Lateral resolution
  - Sensitivity
  - Throughput
  - Automation
- The development of correlative workflows to maximize information by combining results from different, complementary techniques
- The development of new algorithms and software to deal with the increasing complexity of data and to prepare for automation of data treatment
- The aforementioned developments need to be applicable to the fields of:
  - materials science
  - life sciences
  - and beyond

## Application areas

- [Instrumentation for correlative microscopy](#)
- [Instrumentation for nano-analysis](#)
- [Correlative microscopy and applications in materials science and life sciences](#)
- [In-situ treatment and manipulation in correlative microscopy](#)
- [Particle - matter interactions for ion microscopy](#)

## Main assets

- Experienced and multidisciplinary team
- Expertise covering the full spectrum required to turn innovative concepts and ideas into prototype instruments
- Long-term collaborations with world-leading instrument manufacturers
- Strong patent portfolio in the fields of focus



## Equipment

- 2 Zeiss ORION NanoFab HM equipped with in-house developed SMS, STM, etc.
- 1 Thermo Fisher Scion Quattro equipped with in-house developed SMS
- 1 Thermo Fisher Tescan F20 TEM equipped with in-house developed SMS
- 1 Prototype MS for field-portable and space applications
- 1 SMS for fundamental studies and component testing (CMS)
- 1 In-house build re-STM microscope for ion transmission studies (Gaileo)
- 1 Test benches for charged particle optics instrumentation
- 1 specialised glove box for cryo preparation and sample transfer purposes
- 1 prototype coherent X-ray Bragg scattering laser (2.5 J/pulse, 100Hz chop rate)
- 1 Continuum Powerlite (2.8 J @ 1064 nm, 1 J @ 532nm)
- 1 Scan Precision scan (200 million)
- 1 Topica Femtoforce ultra 2050

## Review papers and book chapters

- Audinet, J.-R.; Philipp, P.; De Castro, D.; Blaesmeier, A.; Hoang, Q. H.; Wirtz, T. Highest resolution chemical imaging based on secondary ion mass spectrometry performed on the helium ion microscope. *Rep. Prog. Phys.* 2021, **84**, 105901. DOI: 10.1088/1361-6633/abc13d
- Wirtz, T.; De Castro, D.; Audinet, J.-R.; Philipp, P. Imaging and Analytics on the Helium Ion Microscope. *Annu. Rev. Anal. Chem.* 2019, **12** (1), 523-543. DOI: 10.1146/annurev-anchem-061318-115457
- Ewara, S.; Polanski, A.; Yella, L.; Hwang, Q. H.; Lovic, J.; Philipp, P.; Wirtz, T. Correlative Microscopy Combining Transmission Electron Microscopy and Secondary Ion Mass Spectrometry: A General Review on the State-of-the-Art, Recent Developments, and Prospects. *Appl. Phys. Rev.* 2019, **6** (2), 021312. DOI: 10.1063/1.5064768
- Wirtz, T.; Dörschner, D.; Philipp, P. SMS on the Helium Ion Microscope: A Powerful Tool for High-Resolution High-Sensitivity Nano-Analytics. In *Helium Ion Microscopy*; Hawasak, G.; Götzsche, A., Eds.; Springer International Publishing Switzerland, 2016. DOI: 10.1007/978-3-319-41866-9\_13
- Wirtz, T.; Philipp, P.; Audinet, J.-R.; Dörschner, D.; Ewara, S. High-Resolution High-Sensitivity Elemental Imaging by Secondary Ion Mass Spectrometry: From Traditional 2D and 3D Imaging to Correlative Microscopy. *Nanotechnology* 2015, **26** (43), 434001. DOI: 10.1088/0957-4484/26/43/434001

## Partners

inspace Europe, Luxembourg, Photonis, The Netherlands, RAITH, Surface Concept, Germany, Thermo Fisher, The Netherlands, Zeiss, Germany, Zeiss PCS, USA, zeroK, US

## Contact

5, avenue des Hauts-Fourneaux  
L-4362 Esch-sur-Alzette  
phone: +352 275 888 - 1 | [LIST.lu](http://LIST.lu)

Dr Tom WIRTZ ([tom.wirtz@list.lu](mailto:tom.wirtz@list.lu))  
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