CATALOGUE OF TECHNIQUES

Technique Catalogue for ReMade@ARI

If you are looking at the catalogue to plan for your proposal, we would like to highlight that the Smart Science Cluster is available to help you.

For the discussion of suitable techniques please submit a pre-proposal:
https://apply.remade-project.eu/submit-call/remade-pre-proposal-submission

or write your scientific question to:
sciencesupport@remade-project.eu

We are looking forward to hearing from you!

All instruments marked in purple are actively involved in the industry access routes. If you are a company and wish to access another of our instruments, please contact us at:
industry@remade-project.eu

Instruments in marked in orange are currently not available.

This document was last updated: 11 September 2025

It is a work in progress, which we try to keep up to date to the best of our knowledge.
We do not give a guarantee that all listed instruments are available.

If you spot any inaccurate information, please feel free to reach out via
sciencesupport@remade-project.eu

Thank you!

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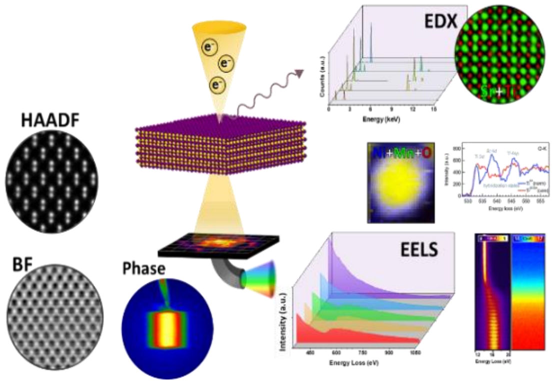
Contents

Electron Microscopy

Electron Microscopy based techniques employ electrons to visualize and analyse the structure, morphology and composition of a sample at an atomic level achieving a resolution up to 50 pm. Usually, electron transparent samples (thinner than 100 nm) are illuminated with a "parallel" electron beam in **conventional transmission electron microscopy (CTEM)** or **scanned with an electron probe in scanning transmission electron microscopy (STEM).** Both techniques are capable of providing an atomic-level understanding of structures, properties and fundamental mechanisms in structural, functional and electronic materials.

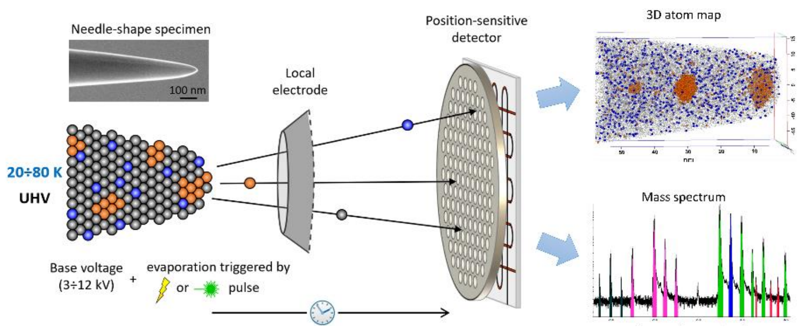


Schematic representation of Electron microscopy techniques. Image credit to Sara Martí-Sánchez.

In order to obtain information about the elemental composition in **TEM mode**, energy-filtered transmission microscopy can be used. Here, only inelastically scattered electrons with specific, characteristic energies are used for imaging, and only these contribute to the generation of energy-filtered images. In this way, the distribution of chemical elements can be displayed. In **STEM**, energy dispersive X-ray spectroscopy (EDS) is used to determine the elemental composition of a sample at the atomic level. At the same time, Electron Energy Loss Spectroscopy (EELS) can be employed for determining the elemental composition, oxidation state / bonding information and electronic band structure and collective excitations in the material (plasmons, band gap, JDOS, excitons, phonons…).

Ga based FIBs are widespread and are commonly used for the preparation of TEM lamella and in combination with an SEM and EDS or EBSD detectors for tomography, furthermore, cryo stages and nanomanipulators can enhance the versatility of this technique.

Atom probe tomography (APT) is a powerful technique for quantitative three-dimensional elemental analysis of solids at the near-atomic scale. The method employs the phenomenon of field evaporation, where atoms are ionized and desorbed from the surface of a tiny needle-shaped specimen (30-200 nm end radius) in a high electric field. This field is generated by applying a standing voltage of a few kV, combined with extremely short voltage or laser pulses that trigger ion-by-ion evaporation events. The emitted ions are then accelerated toward a position-sensitive detector.



Schematic representation of APT.

By analysing detector hit positions and ion time-of-flight, software algorithms reconstruct the 3D atomic distribution within the specimen with sub-nanometer precision. APT essentially combines ion projection microscopy with time-of-flight mass spectrometry, producing a dataset where each detected ion has spatial coordinates (x, y, z) and a mass-to-charge ratio.

Key features: high spatial resolution (~ 1 nm), high mass resolution (m/Δm > 1000, resolving isotopes), quantitative elemental composition without external standards, detection sensitivity down to 10 ppm, equal sensitivity to all elements in the periodic table.

APT is highly complementary to electron microscopy-based methods, particularly transmission electron microscopy (TEM). While TEM provides structural information, APT delivers exceptionally high analytical sensitivity in true 3D space but lacks structural details.

Techniques

- **In situ (S)TEM** – Temperature (heating, cooling), gas, liquid, bias, strain… induced changes can be analysed at the atomic scale
- **Electron Diffraction (ED)** – Crystal phase identification
- **Electron tomography (ET)** – 3D reconstruction of the materials
- **High Resolution Transmission Electron Microscopy (HRTEM)** – Crystal structure visualization
- **(Aberration Corrected) - Scanning Transmission Electron Microscopy ((AC-)STEM)** – Imaging of the samples (with atomic resolution) with different contrast sources including high-angle annular dark field (HAADF), medium-angle annular dark field (MAADF), low-angle annular dark field (LAADF), annular bright field (ABF) and bright field (BF)
- **High-angle annular dark field (HAADF) imaging** – imaging of incoherently scattered electrons, Z-contrast image, sensitive to the atomic number, heavier atoms with brighter contrast
- **Integrated differential phase contrast (IDPC)** – phase contrast of projected electrostatic potential, roughly proportional to the atomic number, sensitive to the light elements compared to HAADF
- **4-Dimensional Scanning Transmission Electron Microscopy (4D-STEM)** – Phase contrast technique, in-situ strain, phase, electric and magnetic field mapping
- **Electron holography (EH)** – Phase contrast technique, electric and magnetic field mapping
- **Electron Energy Loss Spectroscopy (EELS)** – Compositional mapping, valence state determination and low energy excitations mapping (plasmons, phonons, bandgap…), sensitive to light elements
- **Energy Dispersive X-Ray Spectroscopy (EDS)** – Compositional mapping
- **Energy Filtered TEM (EFTEM)** – Compositional mapping with improved contrast in both image and diffraction pattern
- **Lorentz Microscopy** – magnetic materials, imaging the magnetic domain structure at large defocus
- **Scanning Electron Microscopy (SEM)** – Surface morphology and compositional information
- **Electron Paramagnetic Resonance (EPR)** – Anisotropy and spin states, identification of paramagnetic substances, geometric and electronic structure of a paramagnet, information about distances of radicals
- **TEM lamellae preparation** - thanks to the IBL capabilities, it is possible to cut and manipulate small structures to produce samples to be studied in a dedicated TEM (optionally in Cryo conditions).
- **Electron Back Scatter Diffraction (EBDS)** – crystal structure determination through backscattered electrons for grain, defects and plastic deformation analysis
- **Atom probe tomography (APT)** – Analysing elemental segregation at grain boundaries and interfaces, mapping and quantifying dopants in nanostructures, investigating clustering and precipitation in materials, determining local compositions at the nanoscale.

Infrastructures

Network	Coun-try	Access provider	Infra-structure	Instrument	Technique	Link	Available until:
e-DREAM	IT	CNR	CNR	SEM Laboratory	SEM, EDS	learn more	20/02/2026
e-DREAM	IT	CNR	CNR	TEM Laboratory	TEM, STEM, EDS	learn more	20/02/2026
e-DREAM	DE	FZJ	ER-C	TFS Arctica G2	cryo SEM, TEM	learn more	12/12/2025
e-DREAM	DE	FZJ	ER-C	FEI Helios NanoLab 400S FIB-SEM	SEM, EDS, FIB	learn more	12/12/2025
e-DREAM	DE	FZJ	ER-C	FEI Helios NanoLab 460F1 FIB-SEM	SEM, EDS, FIB	learn more	12/12/2025
e-DREAM	DE	FZJ	ER-C	FEI Tecnai G2 F20	TEM, EELS, EFTEM, STEM with HAADF STEM imaging, Lorentz microscopy, ET, in-situ heating/ cooling/ strain	learn more	12/12/2025
e-DREAM	DE	FZJ	ER-C	FEI Titan 80-300 STEM	EELS, ET, HRSTEM with HAADF STEM imaging, monochromator	learn more	12/12/2025
e-DREAM	DE	FZJ	ER-C	FEI Titan 80-300 TEM	HRTEM, in-situ heating/ cooling/ strain	learn more	12/12/2025
e-DREAM	DE	FZJ	ER-C	FEI Titan G2 60-300 HOLO	HRTEM, EELS, EFTEM, HRSTEM with HAADF STEM imaging, off-axis EH, Lorentz microscopy, ET, in-situ heating/ cooling/ strain	learn more	12/12/2025
e-DREAM	DE	FZJ	ER-C	FEI Titan G2 80-200 ChemiSTEM	EELS, ET, HRSTEM with HAADF STEM imaging, 4D-STEM, IDPC, EDS, in-situ heating/ cooling/ strain	learn more	12/12/2025

e-DREAM	DE	FZJ	ER-C	Hitachi HF 5000 TEM/STEM	EELS, ET, HRSTEM with HAADF STEM imaging, 4D-STEM, IDPC, EDS, in-situ gas	learn more	12/12/2025
e-DREAM	DE	FZJ	ER-C	TESCAN Tensor	STEM, EDS, 4D-STEM	learn more	12/12/2025
e-DREAM	DE	FZJ	ER-C	TFS Spectra 300	HRTEM, EELS, EFTEM, HRSTEM with HAADF STEM imaging, Lorentz microscopy, ET, 4D-STEM, IDPC, monochromator	learn more	12/12/2025
e-DREAM	DE	FZJ	ER-C	LEAP 4000X HR (Cameca Scientific Instruments, Madison, WI, USA)	APT		12/12/2025
e-DREAM	ES	ICN2	ICN2	FEI MAGELLAN 400L SEM	SEM, EDS, STEM	learn more	27/03/2026
e-DREAM	ES	ICN2	ICN2	FEI Quanta 650F ESEM	SEM, EDS, STEM	learn more	27/03/2026
e-DREAM	ES	ICN2	ICN2	FEI Tecnai F20 (S)TEM	TEM, EELS, EFTEM, STEM with HAADF STEM imaging, Lorentz microscopy, ET	learn more	27/03/2026
e-DREAM	ES	ICN2	ICN2	Thermo Fisher SPECTRA 300	HRTEM, EELS, EFTEM, HRSTEM with HAADF STEM imaging, Lorentz microscopy, ET, 4D-STEM, IDPC, monochromator	learn more	27/03/2026
non-ARIE	EU	CERIC-ERIC	CERIC-ERIC	FEI Titan Krios 3Gi@SOLARIS	cryo TEM	learn more	17/10/2025
non-ARIE	EU	CERIC-ERIC	CERIC-ERIC	FE-SEM@CUP	SEM	learn more	14/11/2025
non-ARIE	EU	CERIC-ERIC	CERIC-ERIC	JEOL JEM ARM 200F@NIMP	HR TEM/STEM, EDS & EELS	learn more	27/03/2026

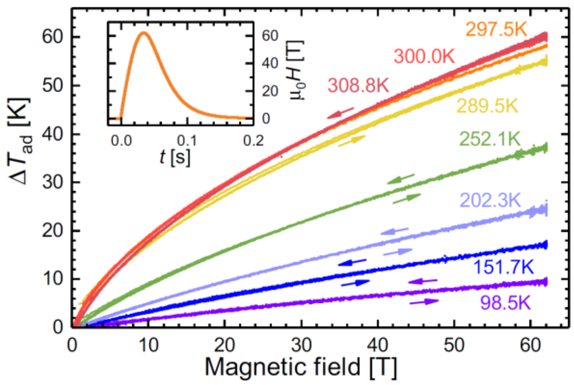
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	HRSEM FEI NanoSEM 450 (UACH4)	HRSEM, STEM	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	Scanning Electron Microscope, Hitachi (UFCH22)	FESEM, EDS	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	Scanning Electron Microscope (SEM) Hitachi SU6600 (UPOL10)	SEM, EDS	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	Transmission Electron Microscope (TEM) JEOL 2100 (UPOL11)	TEM, EDS	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	Electron-Paramagnetic-Resonance Spectrometer (UPOL13)	EPR	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	High resolution transmission electron microscope (JEOL) JEM 3010 (UACH10)	HRTEM, EDS, ED, phase/orientation mapping	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	High resolution transmission electron microscope, HRTEM FEI Talos F200X (UACH16)	HRTEM, STEM-HAADF, EDS	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	High resolution transmission electron microscope (UFCH21)	HRTEM	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	High Resolution Transmission Electron	HRTEM, EDS, EELS	learn more	27/03/2026

				Microscope (UPOL5)			
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	XPS/ESCA and Auger electron spectroscopy (UJEP3)	XPS, ESCA, AES, SEM	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	Precision Ion Polishing System (PIPS) Model 691(Gatan) (UACH12)	Sample preparation	learn more	27/03/2026
Laserlab-Europe	HR	LLE-AISBL	CALT	SEM	SEM	learn more	06/02/2026
Laserlab-Europe	CZ	IP-ASCR	HiLASE	SEM	SEM	learn more	27/02/2026

High magnetic fields

The application of high magnetic fields allows a controlled tuning of the physical properties of bulk and thin film material samples. The electronic or lattice magneto response can be investigated by various experimental techniques. The high magnetic fields are generated either as pulsed or continuous fields with maximum strengths of up to 95 T and up to 38 T, respectively, and at sample temperatures down to about 1 K. For selected techniques, hydrostatic pressures of up to several GPa can be applied to the samples.

High magnetic fields are suitable, for example, for characterising new materials with hard magnetic properties for electric motor technology, or with pronounced magnetocaloric properties for applications in cooling technology.



Magnetocaloric effect of single-crystalline gadolinium: adiabatic temperature change in pulsed magnetic fields up to 62 T. The inset shows the temporal profile of the magnetic field pulse (T. Gottschall et al., Phys. Rev. B 99, 134429 (2019)).

Techniques

- **Magnetocaloric effects (MCE)** – measures an adiabatic temperature change of a material, caused by a pulsed magnetic field
- **Magnetotransport** – measures the electrical resistance and Hall effect in magnetic fields
- **Magnetization / Vibrating Sample Magnetometer (VSM)** – measures the uniform bulk magnetization
- **Ultrasound** – measures the sound velocity and attenuation
- **Electric polarization** – measures the electric bulk polarization of a material
- **Electron magnetic resonance (ESR)** – measures electronic magnetic properties and low-energy magnetic excitations
- **Electrical Transport Option (ETO)** - supports three types of measurements including resistivity, IV curves and differential resistance
- **Magnetostriction** – measures the relative length change of a sample in a magnetic field
- **Nuclear magnetic resonance (NMR)** – measures the internal magnetic fields and crystal electric field gradients at the nuclear sites
- **Magnetic torque** – measures the magnetic torque due to the bulk magnetization of a sample in a magnetic field
- **Magneto-optical transmission** – measures the absorption of light in the presence of a magnetic field
- **Magnetic Birefringence** – measures the refractive index of a material in a magnetic field
- **Microscopy** – visual study of organisms, materials or solutions
- **Far-infrared Spectroscopy** – probes low-energy optical excitations
- **Ultrafast Spectroscopy** – probes the dynamics in materials on extremely short time scales

Infrastructures

Network	Coun-try	Access provider	Infra-structure	Instrument	Technique	Link	Available until:
EMFL	DE	HLD	HLD	Various types of pulsed-field magnets, fields up to 95 T and pulse durations of about 100 ms, several 10 mm^3 of sam-ple space	MCE, Magnetotransport, Magnetization, Ultrasound, Electric polarization, ESR, Magnetostriction, NMR, Magnetic torque, Magneto-optical transmission	learn more	25/04/2026
EMFL	NL	HFML	HFML	Various types of continuous-field magnets, fields up to 38 T, several 10 mm^3 of sam-ple space	Magnetotransport, Magnetization, Magnetic torque, VSM, Magnetic Birefringence, Microscopy, Far-infrared Spectroscopy, Ultrafast spectroscopy	learn more	25/04/2026
LEAPS	NL	SRU	FELIX	DC Magnet	High magnetic field (also possible in combination with IR/THz spectroscopy)	learn more	23/01/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	Physical Prop-erties Meas-urement Sys-tem - PPMS (UPOL2)	VSM, DC measurements, Electrical transport option (ETO)	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	Low tempera-ture induction magnetome-ter - PPMS (UPOL14)	VSM, DC and AC, ETO	learn more	27/03/2026

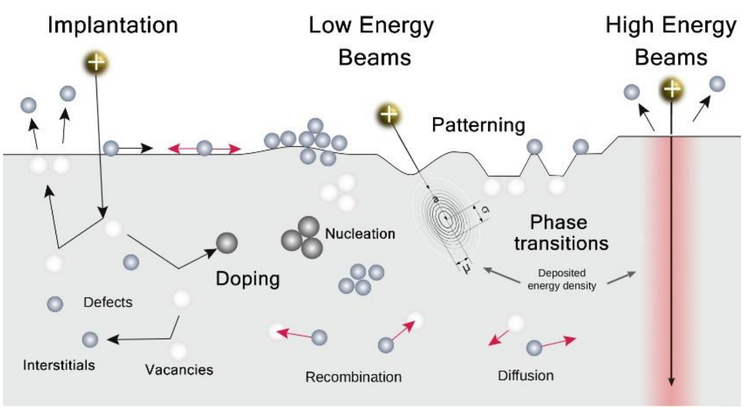
A hub for material research

Ion beam materials modification

Ion beams have been for the past decades used routinely to **modify and study** the structure and **properties of metals, insulators and semiconductors**. Making use of different ion-target interactions, either by nuclear collisions or electronic excitations, ion beams are used to:

- **introduce dopants and defects** in materials by ion-implantation and hence induce impurity-defect interactions that change the electronic behaviour of the materials (e.g. semiconductors, optoelectronics, stress-strain engineering);
- **create nano-patterns** on surfaces by ion sputtering or in bulk through ion-induced phase-transitions (refer to the following section on Focus Ion Beams);
- **grow layered structures** by ion-beam assisted deposition;
- perform radiation-related **degradation studies**;
- **inspect** composition and crystallographic structure of materials, with depth resolution, by studying their response to the impinging ions (see following sections Ion Beam Analysis: Spectrometry and Mapping).

Radiate offers beams of a large variety of ion species across a broad spectrum of kinetic (from a few eV to several GeV) and potential energies (charge states up to +45). Furthermore, RADIATE provides nanometric ion beams that can be used for maskless lithography in micro and nanofabrication workflows by atomic sputtering of the surface. Additionally, RADIATE beams (including broad, micro- and nano-metric beams) can perform a wide range of Ion Beam Analysis (IBA) experiments. Please refer to the subsequent sections for more details on Focus Ion Beams and IBA.



Schematic of the main techniques and mechanisms involved in the modification of materials by ion beams. Image credit to Stefan Facsko.

Techniques

- **Ion Implantation -** keV-MeV beams are used to introduce dopants and defects in materials. Moreover, these beams are employed in IBA, either in- or ex-situ.
- **Low-Energy Ion Beams -** keV irradiation experiments, such as Highly Charged Ions (HCL) or Low Energy Irradiation (LEI) radiations, are used in surface modification and degradation studies. Furthermore, these beams are used for near-surface high-resolution IBA).
- **High-Energy Beams -** Such beams typically consist of heavy and highly energetic ions (SHI) that interact with solids mainly through ion-electron excitation processes, contrasting with typical ion implantation, where the impinging ions lose their energy primarily by nuclei collisions. These beams are explored in nanofabrication and to test radiation-hard electronics.

- **Focus Ion Beams -** Nanometric ion beams used for maskless lithography in micro and nanofabrication workflows by atomic sputtering. They are also used to characterise samples.

The table below provides a general overview of the principal technical contributions delivered by each of the participating laboratories of RADIATE. Note that the list does not reflect the entire range of competencies available at each lab. Please refer to the subsequent sections for the possibilities related to Focus Ion Beams and IBA within ReMade@ARI.

Infrastructures

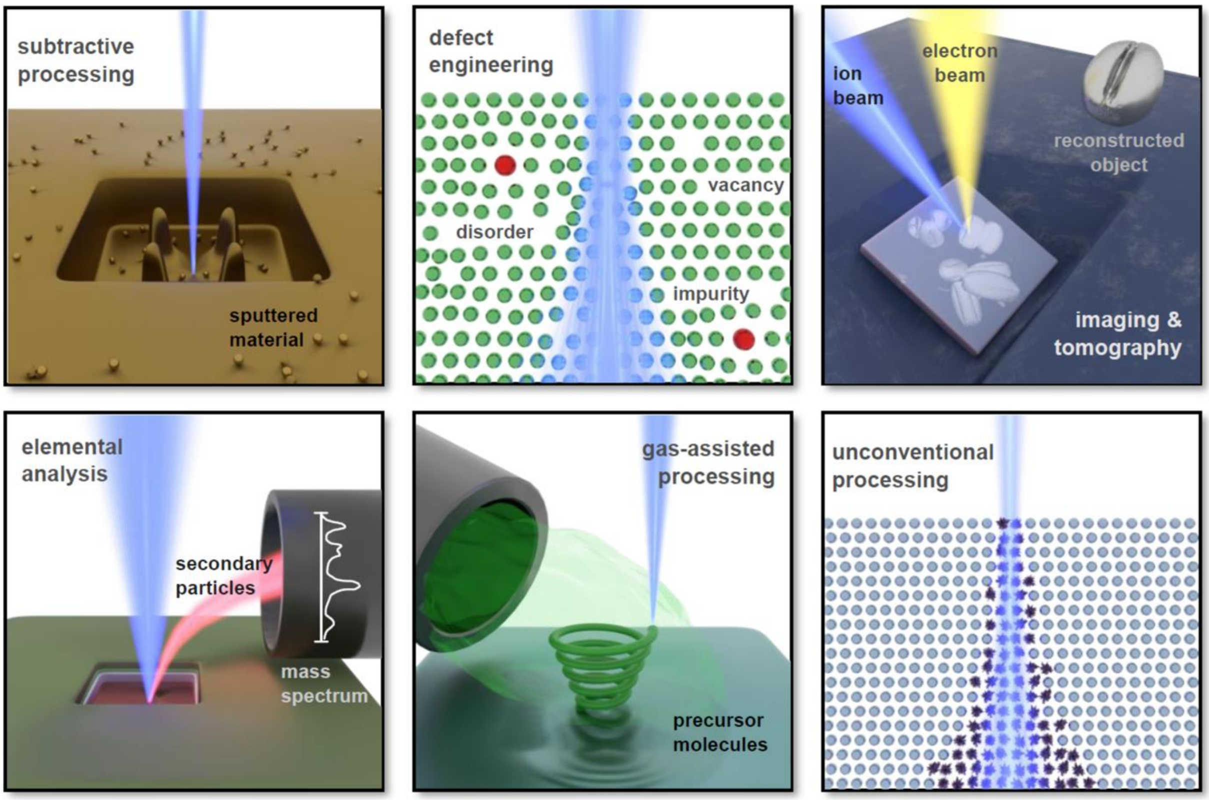
Network	Country	Access provider	Infrastructure	Instrument	Techniques	Link	Available until:
RADIATE	FR	CNRS	GANIL	GANIL	Swift-heavy ion and highly charged ion irradiations	learn more learn more	30/04/2026
RADIATE	CH	ETHZ	LIP	6 MV Tandem and 1.7 MV Tandetron Accelerators	Deep implantations in the MeV ion energy range.	learn more	27/03/2026
RADIATE	DE	HZDR	IBC	Tandem Accelerators, 500 kV Implanter, low-energy ion irradiation	High/low-energy and highly-charged ion implantation, focused ion implantation, clean-room environment	learn more	29/05/2026
RADIATE	PT	IST	IBL	high flux 210 kV ion implanter, S1090 Danfysik	High flux implantations at different temperatures.	learn more	08/05/2026
RADIATE	PT	IST	IBL	2.5 MV Van de Graaff and 2.5 MV Tandem accelerators	proton irradiation, in situ electrical characterization	learn more	08/05/2026
RADIATE	BE	KU Leuven	IMBL	High Flux ion Implanter, Danfysik S1090	High flux implantations.	learn more	24/04/2026
RADIATE	CZ	NPI	LT	Ion beam lines at Tandetron	Ion beam lithography and implantation, external beam.	learn more	08/05/2026
RADIATE	HR	RBI	RBI-AF	6 MV Tandem and 1 MV Tandentron Accelerators	Multi-beam radiations, single ion implantation and deep implantations.	learn more	24/04/2026
RADIATE	ES	UAM	CMAM	5MV tandem + Implantation BL + internal and external microbeam	High energy implantations coupled to optical in-situ measurements (e.g. tem-	learn more	24/04/2026

					perature monitor-ing), concurrent ion-laser irradia-tions.		
RADIATE	SE	UU	Tandem Laborator y	350 kV Implanter	Provides MeV ra-diations for mate-rial modification.	learn more	10/04/2026

Focused Ion Beams for material modification

A focused ion beam (FIB) is a class of ion beams that utilizes a nanosized beam of ions with a few keV to a few 10 keV of energy for the modification and analysis of materials (see also sections on Ion Beam Materials Modification and Ion Beam Analysis). It is in particular the ability for on-demand spatially resolved implantation, removal, or addition of material and defect generation which makes the FIB tools so interesting for micro and nanoengineering.

A wide variety of ions can be used in a FIB tool. This includes commercially available ions like He, Li, N, O, Ne, Si, Ar, Ga, Ge, Xe, Cs, Au, Bi as well as academic developments including B, C, Fe, Co, Cu, Rb, Ce, Pr, Dy, Pb and many others. A special variant of the FIB employs a pattern generator and precursor gases for 3D additive manufacturing of metallic and insulating structures. In combination with in-situ methods like µ-manipulators, heating stages, specialized detectors (Scanning Transmission Ion Microscopy, Secondary Ion Mass Spectrometry, etc) they become powerful instruments for spatially resolved studies of material modification and analysis. While all ions can be used for imaging, it is Helium Ion Microscopy that stands out due to the capability to also investigate uncoated insulating samples without additional coatings while inducing minimal damage.



Schematic overview on the different FIB techniques. Reused from: K . Höflich et al, Roadmap for focused ion beam technologies. arXiv:2305.19631.

Techniques

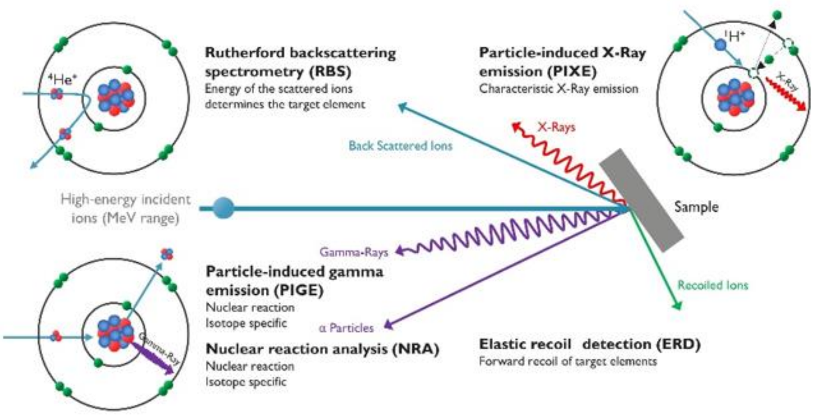
- **Spatially resolved doping** using Liquid metal alloy ion sources
- **Single Ion Implantation** for quantum technology applications
- **Defect engineering** in oxides, semiconductors, metals and 2D materials
- **Radiation hardness** for semiconductors and metals
- **Direct write** material removal and additive manufacturing
- **Ion Beam lithography** for resist-based processes

Infrastructures

Network	Country	Access provider	Infrastructure	Instrument	Technique	Link	Available until:
RADIATE	DE	HZDR	IBC	Helium Ion Microscopy	IBL, ET, EBDS	learn more	29/05/2026
RADIATE	DE	HZDR	IBC	Ga and non-Ga FIB	IBL	learn more	29/05/2026
e-DREAM	DE	FZJ	ER-C	FEI Helios NanoLab 400S FIB-SEM	IBL, SEM, EDS	learn more	12/12/2025
e-DREAM	DE	FZJ	ER-C	FEI Helios NanoLab 460F1 FIB-SEM	IBL, SEM, ET, EDS	learn more	12/12/2025
e-DREAM	ES	ICN2	ICN2	Thermo Fisher HELIOS 5UX FIB	SEM, ET, EDS	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	Precision Ion Polishing System (PIPS) Model 691(Gatan) (UACH12)		learn more	27/03/2026

A hub for material research

Ion beam analysis: spectrometry



Schematic representation of different ion beam analysis techniques. Image credit to Masoud Dialameh.

Ion beam analysis (IBA) comprises a suite of analytical techniques that explore the interaction between high-energy ions and atoms within a substrate. This interaction gives rise to various outcomes, enabling to obtain information about elemental quantification, compositional analysis, elemental depth profiling, density analysis and even crystallographic analysis. The incident ions are typically in MeV energy range, with interactions encompassing elastic scattering (RBS), elastic recoil scattering (ERD), nuclear reactions (NRA), X-ray emission (PIXE), etc. Frequently, diverse IBA techniques can be simultaneously applied, offering complementary insights. The utility of these IBA techniques extends beyond the confines of traditional analysis. By precisely characterizing materials and products, these techniques aid in optimizing recycling processes, identifying material degradation, and ensuring the quality and longevity of products throughout their lifecycle. Additional advantages lie in the non-destructive nature of these techniques for certain samples and the possibility of both in-situ and ex-situ experiments during radiation.

Techniques

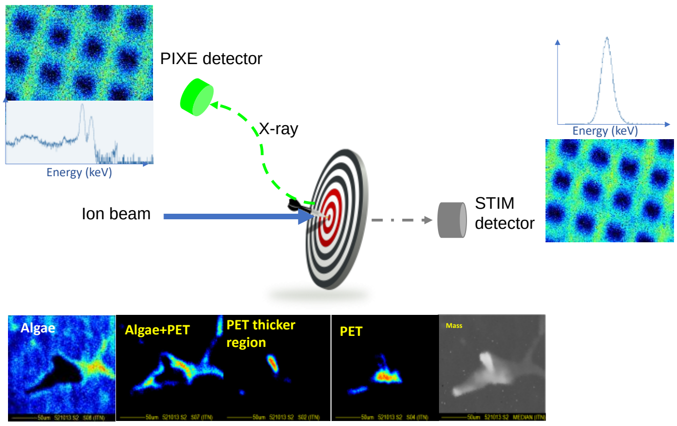
- **Rutherford backscattering spectrometry (RBS) and Ion Channeling –** for elemental quantification, depth profiling of elements heavier than the substrate with a sensitivity down to 1E+13 atoms/cm^2, and defect studying depth profiles.
- **Elastic recoil detection (ERD) –** for compositional analysis and depth profiling for a wide range of elements starting from H up to heavy elements with a sensitivity reaching to 1E+14 atoms/cm^2.
- **Nuclear reaction analysis (NRA) and Particle-induced gamma emission (PIGE) –** isotope-specific elemental quantification of low Z elements (below Na) and depth profiling with a sensitivity down to 1E+12 atoms/cm^2.
- **Particle-induced X-ray emission (PIXE) -** for elemental identification and compositional analysis from sodium onwards with a sensitivity down to 100 ppm.
- **Proton elastic Scattering Analysis (PESA) -** proton beams are used for hydrogen detection in very thin samples in transmission mode.
- **Accelerator mass spectrometry (AMS) -** most famous for radiocarbon (^{14}C) dating, uses similar set-ups as IBA, but samples needs to be chemically processed before being introduced in the ion source. Negative ions (e.g., C^-) are extracted from the sample, further accelerated to MeV, stripped to positively-charged ions and radionuclide-to-stable nuclide ratios are detected.

Infrastructures

Network	Coun-try	Access provider	Infra-structure	Instrument	Techniques	Link	Available until:
RADIATE	CH	ETHZ	LIP	1.7 MV Tandetron and 6 MV HVEC EN-Tandem accelerator	RBS, ERD-ToF, NRA, PIXE	learn more	27/03/2026
RADIATE	DE	HZDR	IBC	6 MV Tandem Accelerator, 3 MV Tandem Accelerator, 100 kV Ion Platform	RBS, RBS-C, ERD-ToF, NRA, PIGE, PIXE	learn more	29/05/2026
RADIATE	IT	INFN	LABEC	3 MeV Tandetron	RBS, PIGE, PIXE	learn more	13/02/2026
RADIATE	PT	IST	IBL	2.5 MV Van de Graaff and 2.5 MV Tandem accelerators	RBS, ERD, NRA, PIGE, PIXE	learn more	08/05/2026
RADIATE	FI	JYU	AL	1.7 MV Tandem Pelletron	RBS, ERD-ToF	learn more	01/05/2026
RADIATE	BE	KU Leuven	IMBL	1.7 MV Tandem Pelletron and 2.5 MV Van de Graaff	RBS, ERD-ToF, PIXE	learn more	24/04/2026
RADIATE	CZ	NPI	LT	Ion beam lines at Tandetron	RBS, RBS-C, ERD, ERD-ToF, PESA, PIXE	learn more	08/05/2026
RADIATE	HR	RBI	RBI-AF	1 MV Tandentron and 6 MV Tandem Van de Graaff	RBS, ERD, NRA, PIGE, PIXE	learn more	24/04/2026
RADIATE	ES	UAM	CMAM	5 MV Tandem	RBS, ERD-ToF, NRA, PIGE, PIXE, microbeam	learn more	24/04/2026
RADIATE	AT	UNIVIE	VERA	Accelerator mass spectrometry facil-ity (3 MV tandem)	AMS	learn more	22/05/2026
RADIATE	ES	USE	CNA	3 MeV Tandem	RBS, ERD, NRA, PIGE, PIXE	learn more	09/01/2026
RADIATE	SE	UU	Tandem Labarator y	5 MV pelletron ac-celerator, Low-en-ergy Ion Scattering System	RBS, ERD, NRA, PIXE	learn more	10/04/2026

Ion beam composition mapping and imaging

The techniques used for ion beam composition mapping and imaging are also included in the IBA techniques mentioned in the section [IBA: spectrometry](). The IBA technique can be implemented using both defocused and focused ion beams. Using a focused ion beam enables the achievement of composition mapping and imaging. The dimensions of the focused beam are predominantly within the micrometric range, although on occasion, they can become even finer, extending into the submicrometric scale. Furthermore, MeV ions have a greater penetration depth into samples compared to keV electrons, and they also exhibit significantly reduced lateral scattering. There are two methods: the beam is swept over a stationary target, or the sample is moved with the beam fixed. These characteristics prove particularly advantageous when analysing samples with thicknesses spanning a few micrometres, allowing for the visualization of micrometric or submicrometric details. The insights gleaned from the maps are contingent on the technique employed, spanning from elemental composition (PIXE, RBS and PIGE) and mass density distribution (STIM) to the electronic properties inherent in semiconductors (IBIC).



General scheme of STIM, PIXE, and its simultaneously measurement of a copper grid. *Bottom:* STIM mass and elemental maps of algae sample contaminated with microplastics.
Image credit to Noelia Maldonado-Gavilán.

Techniques

- **Particle Induced X-ray Emission (PIXE) –** for elemental identification and compositional analysis from sodium onwards with a sensitivity down to 100 ppm.
- **Particle Induce Gamma-Ray Emission (PIGE)** – for determining and quantifying low-Z elements such as F, Al, Li, …
- **Scanning Transmission Ion Microscopy (STIM)** – for evaluation of density distribution, via final energy of transmitted ions.
- **Ion Beam Induced Charge (IBIC) -** for measuring and imaging the electron transport properties of semiconductor materials and devices.

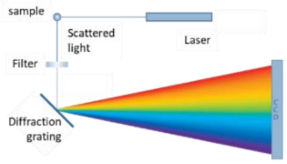
Infrastructures

Network	Coun-try	Access provider	Infra-structure	Instrument	Techniques	Link	Available until:
RADIATE	DE	HZDR	IBC	Helium Ion Microscopy, 100 kV Ion Platform, 6 MV Tandem Accelerator		learn more	29/05/2026
RADIATE	IT	INFN	LABEC	3 MeV Tandetron	PIXE, PIGE, STIM	learn more	13/02/2026
RADIATE	PT	IST	IBL	2.5 MV Van de Graaff with Oxford microprobe	PIXE, RBS, IBIL	learn more	08/05/2026
RADIATE	SI	JSI	MIC	Ion beam lines at Tandetron	PIXE, PIGE	learn more	24/04/2026
RADIATE	FI	JYU	AL	1.7 MV Tandem Pelletron	PIXE, PIGE, IBIC	learn more	01/05/2026
RADIATE	BE	KU Leuven	IMBL	1.7 MV Tandem Pelletron	PIXE, PIGE	learn more	24/04/2026
RADIATE	CZ	NPI	LT	Ion beam lines at Tandetron	PIXE, STIM	learn more	08/05/2026
RADIATE	HR	RBI	RBI-AF	1 MV Tandentron and 6 MV Tandem Van de Graaff	PIXE, PIGE, STIM	learn more learn more	24/04/2026
RADIATE	ES	UAM	CMAM	5MV tandem + internal and external microbeam	PIXE, PIGE, STIM	learn more	24/04/2026
RADIATE	SE	UU	Tandem Labaratory	350 kV Implanter	PIXE	learn more	10/04/2026

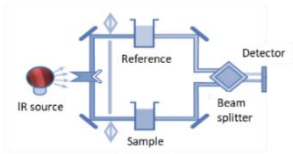
A hub for material research

Laser photo chemistry & spectroscopy

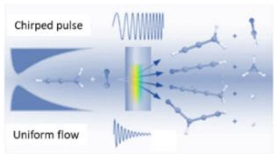
Laser photo chemistry and spectroscopy includes a plethora of laser-based techniques to promote and probe chemical and physical events. Several steady-state and time-resolved spectroscopic techniques are available covering wide ranges of energy and time, applying a multitude of specialized sampling techniques.



Raman spectroscopy



Infrared spectroscopy



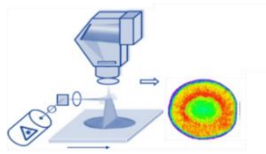


Image credit to Rui Fausto.

Techniques

- **Raman and infrared (IR) spectroscopies** - for vibrational studies, with micro-sampling techniques available, which include Raman and IR mapping/imaging.
- **Specialized IR spectroscopy** - for low temperature matrix-isolation research, for characterization of short-living species, evaluation of photochemical mechanistic aspect of organic chemistry reactions, and studies of intramolecular energy redistribution. The technique is also applicable for direct observations of quantum mechanically-driven processes and their entanglement with vibrationally-induced processes.
- **Chirped-pulse Fourier transform microwave (CP-FTMW) spectroscopy coupled with supersonic jet expansions sampling** - for structural studies, including of complex mixtures.
- **Photoacoustic calorimetry (PAC) and photoacoustic tomography (PAT)** - for monitoring non-radiative molecular processes following photo-excitation and imaging.
- **Transient absorption spectroscopy (TAS) in fs, ps and ns timescales -** ns laser flash photolysis and fs pump-probe spectroscopy set-ups for UV, Vis and NIR regions, for detection of transient species in different experimental conditions.
- **Fluorescence and phosphorescence spectroscopy** - for studies in different phases, including solid state fluorescence quantum yield determinations.
- **Scattering-type Scanning Near-field Optical Microscopy (s-SNOM) –** for material-characteristic maps of chemical and optical properties of the sample surface.
- **Hyperspectral microscopy (HSM)** - based on a birefringent interferometry to acquire hyperspectral images in the visible and NIR ranges.
- **Fluorescence Lifetime Imaging Microscopy (FLIM)** - a molecular fluorescence lifetime-based microscopy technique used to map the spatial distribution of biological cells and materials.
- **Reflectron time-of-flight mass spectrometer (RETOFMS):** for studies of ablation plasma composition, to determine elemental or isotopic signature of a sample and masses of particles and molecules.

Infrastructures

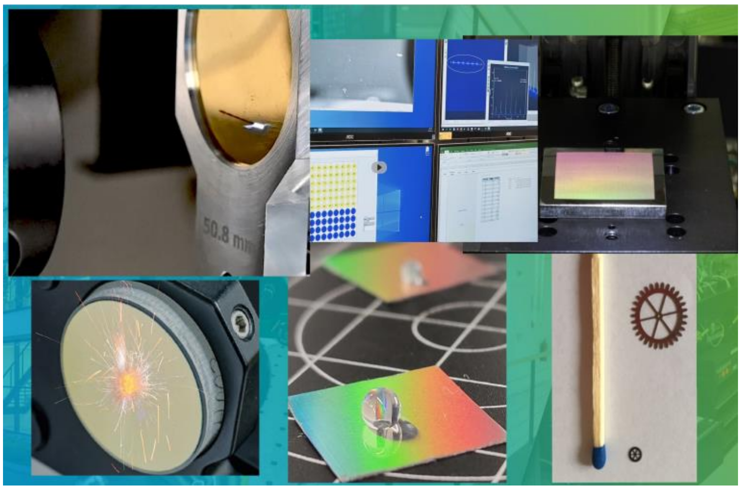
Network	Coun-try	Access provider	Infra-structure	Instrument	Link	Available until:
Laserlab-Europe	GR	FORTH	IESL-FORTH	time-resolved spectros-copy (UV-VIS-NIR-THz-white light, fs-ps)	learn more	22/05/2026
Laserlab-Europe	GR	FORTH	IESL-FORTH	micro-absorption/PL spec-troscopy (4K-380K)	learn more	22/05/2026
Laserlab-Europe	CZ	IP-ASCR	HiLASE	Raman and AFM	learn more	27/02/2026
Laserlab-Europe	CZ	IP-ASCR	HiLASE	RETOFMS	learn more	
Laserlab-Europe	ES	LLE-AISBL	CLPU	VEGA	learn more	
Laserlab-Europe	IT	LLE-AISBL	CUSBO	Hyperspectral imaging VIS-NIR-SWIR	learn more	08/05/2026
Laserlab-Europe	IT	LLE-AISBL	CUSBO	Hyperspectral microscope	learn more	08/05/2026
Laserlab-Europe	IT	LLE-AISBL	CUSBO	Time resolved fluorescence & microscopy	learn more	08/05/2026
Laserlab-Europe	IT	LLE-AISBL	CUSBO	Ultrafast transient absorption	learn more	08/05/2026
Laserlab-Europe	ES	LLE-AISBL	ICFO	Attoseconds SXR beamline	learn more, learn more	31/03/2026
Laserlab-Europe	HR	LLE-AISBL	CALT	Home-made Raman spectrometer	learn more	06/02/2026
Laserlab-Europe	HR	LLE-AISBL	CALT	Ti:Sapphire Femtosecond Laser	learn more	06/02/2026
Laserlab-Europe	HR	LLE-AISBL	CALT	Near field sSNOM	learn more	06/02/2026
Laserlab-Europe	NL	LLE-AISBL	LLAMS	Stimulated Raman Scattering microscopy	learn more	03/04/2026
Laserlab-Europe	NL	LLE-AISBL	LLAMS	Deep-UV Raman spectroscopy	learn more	03/04/2026
Laserlab-Europe	NL	LLE-AISBL	LLAMS	Low-frequency Raman spectroscopy	learn more	03/04/2026
Laserlab-Europe	PT	UC	CLL	Transient Absorption and Photoaccoustics	learn more	24/04/2026
Laserlab-Europe	PT	UC	CLL	Fluorescence	learn more	24/04/2026
Laserlab-Europe	PT	UC	CLL	FLIM	learn more	24/04/2026
Laserlab-Europe	PT	UC	CLL	Raman Spectroscopy	learn more	24/04/2026
Laserlab-Europe	PT	UC	CLL	Matrix-Isolation Infrared spectroscopy	learn more	24/04/2026
Laserlab-Europe	PT	UC	CLL	Single Photon Counting	learn more	24/04/2026
Laserlab-Europe	PT	UC	CLL	Vibrationally-Induced Photochemistry	learn more	24/04/2026
Laserlab-Europe	PT	UC	CLL	Rotational Spectroscopy (MRR and CP-FTMW)	learn more	24/04/2026

non-ARIE	CZ	NanoEnviCz	NanoEnvi Cz	Fluorescence inverted confocal spinning disk microscope Olympus SpinSR10 (UEM12)	learn more	27/03/2026

LEAPS	NL	SRU	FELIX	US 11	Ultrafast spectroscopy with IR/THz and table top laser systems	learn more	23/01/2026
LEAPS	NL	SRU	FELIX	US 12	IR pump-probe	learn more	23/01/2026
LEAPS	NL	SRU	FELIX	US 10	Infrared spectroscopy combined with FTICR and ion mobility	learn more	23/01/2026
LEAPS	NL	SRU	FELIX	US 3	Ultrafast spectroscopy with IR/THz and table top laser systems	learn more	23/01/2026
LEAPS	NL	SRU	FELIX	US 9	Infrared spectroscopy combined with mass spectrometry	learn more	23/01/2026
LEAPS	NL	SRU	FELIX	FELICE beamline	Cluster spectroscopy	learn more	23/01/2026

Laser processing

Laser processing is primarily focused on surface material modification, testing and assessment. Often nanosecond and shorter laser pulses are utilized for treatment of various materials, while available services are not limited on material processing itself but include damage testing and general laser ablation field and related phenomena. Equipment and facilities thus can be used for variety supporting activities, as laser processing window assessment, ablation rate studies or process optimization and materials qualification for space environment. Also, in combination with ultra-short pulses and high energy lasers, facilities can be used for laser plasma generation and EUV/XUV secondary source development or particle acceleration.



Top: laser multibeam processing of substrate, diagnostics of the beam and diffractive structure written on alloy. Bottom: laser damage of thin film, superhydrophobic surface prepared by laser surface processing and miniature composite cogwheels prepared by laser micromachining. Image credit to Jan Vanda.

Techniques

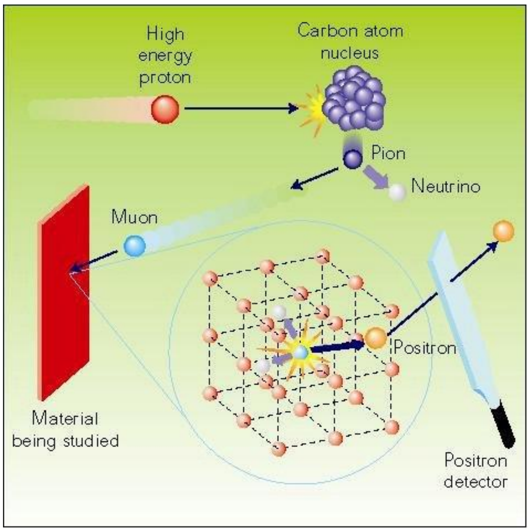
- **Laser Shock Peening (LSP)** – increase of stress corrosion cracking resistance via plasma-induced deep compressive stresses.
- **Laser Micro-Machining (LMM)** – material structuring for surface functionalization (hydrophobicity/hydrophilicity, tuned friction, bio-compatibility, optical properties).
- **Laser Induced Damage Threshold (LIDT)** – laser resistance testing, laser ablation rate and laser processing window research.
- **Pulsed Laser Deposition (PLD)** – thin film deposition at high vacuum with possibility of assistant gas
- **Ultrafast laser ablation (ULA)** and **micromaterial processing (MMP)**
- **2D and 3D sub-micron structures processing** - for tailored physical and biological properties
- **Laser additive manufacturing (LAD) and photochemical modification (LPM)** - for micro- and nano- scale structures

Infrastructures

Network	Country	Access provider	Infrastructure	Instrument	Link	Available until:
Laserlab-Europe	GR	FORTH	IESL-FORTH	material micro-/nano 2D & 3D processing	learn more	22/05/2026
Laserlab-Europe	GR	FORTH	IESL-FORTH	additive manufacturing and photochemical modification	learn more	22/05/2026
Laserlab-Europe	CZ	IP-ASCR	HiLASE	BIVOJ, nanosecond, 100 J, 1 kW, 1030 nm	learn more	27/02/2026
Laserlab-Europe	CZ	IP-ASCR	HiLASE	Laser shock peening station	learn more	27/02/2026
Laserlab-Europe	CZ	IP-ASCR	HiLASE	LIDT station	learn more	27/02/2026
Laserlab-Europe	CZ	IP-ASCR	HiLASE	Micromachining station	learn more learn more	
Laserlab-Europe	CZ	IP-ASCR	HiLASE	PERLA B, picosecond, 10 mJ, 100 W, 1030 nm	learn more	27/02/2026
Laserlab-Europe	CZ	IP-ASCR	HiLASE	PERLA C PERLA C, picosecond, 5 mJ, 500 W, 1030 nm	learn more	27/02/2026
Laserlab-Europe	CZ	IP-ASCR	HiLASE	PLD workstation for thin film deposition and laser ablation plume analysis	learn more	
Laserlab-Europe	ES	LLE-AISBL	CLPU	LAB2 - ULAMP	learn more	
Laserlab-Europe	IT	LLE-AISBL	ENEA	ABC Laser Facility	learn more	08/05/2026
Laserlab-Europe	IT	LLE-AISBL	ENEA	CETRA Facility	learn more	08/05/2026
Laserlab-Europe	HR	LLE-AISBL	CALT	Nd:YAG laser	learn more	06/02/2026
Laserlab-Europe	HR	LLE-AISBL	CALT	PLD chamber	learn more	06/02/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	Industrial femtosecond pulsed laser (TUL13)	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	MicroWriter ML3 Pro (UFCH25)	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	Laser scanning confocal microscop (UPOL15)	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	Confocal microscope - LEICA CLSM SP8/DLS (UJEP40)	learn more	27/03/2026

Muon Spectroscopy

Muons provide a complementary probe of materials to neutrons. Muons are short-lived heavy versions of the electron. Fully spin-polarised muons are implanted into materials where they sense the local magnetic fields and the polarisation of the muon ensemble responds to these. This makes muons extremely sensitive to magnetism and superconductivity effects. They can also be used to study ionic diffusion, e.g. in battery materials, and can be used as mimics of isolated hydrogen to investigate hydrogen behaviour in materials. Muon studies of materials can be performed at the ISIS Neutron and Muon Source.



Life of a Muon.

Source: https://nmi3.eu/muon-research/characteristics-of-muons.html

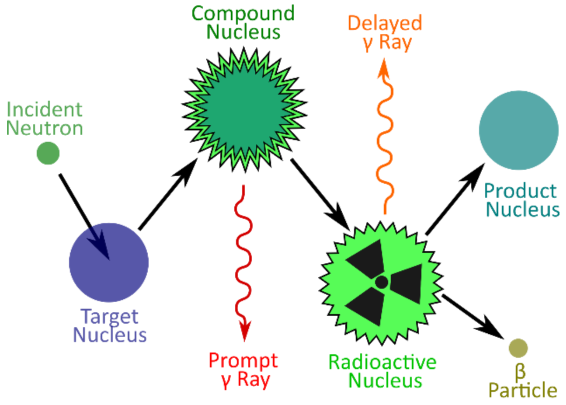
Infrastructures

Network	Country	Access provider	Infra-structure	Instrument	Technique	Link	Available until:
LENS	GB	UKRI	ISIS[1]	MuSR	longitudinal and transverse measure-ments	learn more	14/11/2025
LENS	GB	UKRI	ISIS[1]	EMU	zero field and longi-tudinal field meas-urements, mag-netism and ion diffu-sion in solids	learn more	14/11/2025
LENS	GB	UKRI	ISIS[1]	HiFi	applied longitudinal fields up to 5T	learn more	14/11/2025

[1] LIMITED ACCESS ONLY for proposals requiring environments ONLY available at ISIS. All other requests will be transferred to BNC (Hungary) or SINQ/PSI (Switzerland).

Neutron-based elemental composition analysis

Neutron activation analysis methods use the neutron-induced transient radioactivity or nuclear reactions to obtain information on the elemental composition of samples. Two basic types of neutron activation analysis exist from a practical point of view - Neutron Activation Analysis (NAA) and Prompt Gamma Activation Analysis (PGAA, or PGNAA). If the irradiation and the detection of neutron-induced radioactivity are separated in time and space, this is the “traditional”, Instrumental NAA (INAA), suitable to trace element analysis. In PGAA, the neutrons are transferred to the sample in form of a guided beam, and the irradiation and the detection of gamma-rays take place simultaneously.



Principle of neutron activation analysis.
Image credit to Christina Ossig.

These techniques are non-destructive, bulk-representative, applicable to materials where “exotic” elements (such as light elements (H, B, Cl, S), valuable noble metals, rare-earth elements, environmentally-relevant heavy metals) are to be quantified, if the material is not soluble, or where standard reference material are unavailable. They can be combined for an almost panoramic analysis. A relevant application example is to follow material recovery yields during subsequent stages of production or reprocessing.

Techniques

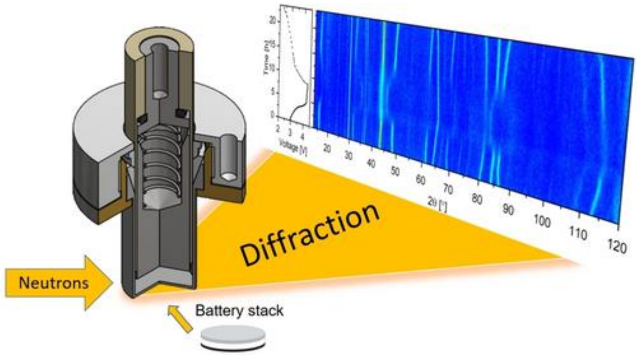
- **Neutron Activation Analysis (NAA)** – For trace elemental analysis
- **Prompt Gamma Activation Analysis (PGAA)** – For average elemental composition
- **Neutron Depth Profiling (NDP)** – For near-surface analysis of concentration of light elements
- **Prompt-Gamma Activation Imaging – (PGAI)** - For determination of the composition and the spatial distribution of traced elements
- **Neutron Radiography (NR)** – utilizes the transmission of neutrons and photons to obtain visual information on the structure and/or dynamic processes inside of an object
- **Neutron Tomography (NT)** – For 3D spatial resolution
- **Prompt-Gamma Irradiation (PGI)** – For qualitative and quantitative elemental analysis

Infrastructures

Network	Country	Access provider	Infrastructure	Instrument	Technique	Link	Available until:
LENS	HU	EK	BNC	NAA	NAA	learn more	20/02/2026
LENS	HU	EK	BNC	NIPS-NORMA	PGAI, NR, NT, PGAA	learn more learn more	20/02/2026
LENS	HU	EK	BNC	PGAA	PGAA	learn more	20/02/2026
LENS	DE	TUM	FRM II	FaNGaS	Irradiation of large samples, PGI	learn more	15/01/2026
LENS	DE	TUM	FRM II	NAA	NAA	learn more	15/01/2026
LENS	DE	TUM	FRM II	PGAA	PGAA	learn more	15/01/2026

Neutron diffraction

Neutron diffraction reveals structural information on the arrangement of atoms and magnetic moments in condensed matter. Single-crystal diffraction provides the most precise and detailed information but requires crystal samples of suitable quality and size. Otherwise samples exist in a form in which some of the structural information is spatially averaged and the corresponding experimental technique is here referred to generically as 'powder diffraction'. It however includes diffraction on liquids, biological samples (e.g. membranes) and engineering components. In the latter case the measurement is focussed to determine atomic distances of a well-known structure within a given small gauge volume. Scanning a region of interest enables the determination of stress fields inside the component.



Specific sample cells allow the measurement of in-operando neutron diffraction patterns of battery materials. Source: https://doi.org/10.1002/cmtd.202200046

Techniques

- **Single-crystal neutron diffraction** – for specific structural information
- **Powder neutron diffraction** – for average structural information
- **Zero-field spherical neutron polarimetry (SNP)** – for magnetic structure determination
- **Polarised neutron diffraction (PND)** in magnetic field named also Flipping-Ratio method
- **Non-polarised diffraction under special conditions** (very low temperatures, magnetic and electric fields, high pressures, high temperatures and their combinations) using dedicated sample environments and out-of-plane lifting counter

Infrastructures

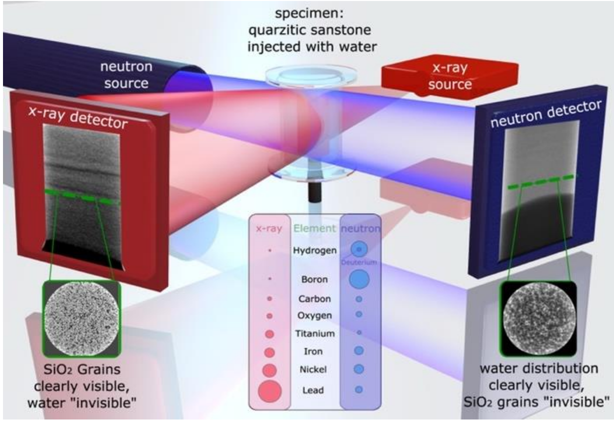
Network	Country	Access provider	Infrastructure	Instrument	Technique	Link	Available until:
LENS	HU	EK	BNC	ATHOS	phonon dispersion relations, tunneling mode studies, quasielastic scattering studies of rotational and non-local diffusion, vibrations of surfaces or molecules adsorbed on surfaces, phonon density of states, neutron scattering to the study of hydrogenous materials	learn more	20/02/2026
LENS	HU	EK	BNC	MTEST	material testing diffractometer, powder, liquid and amorphous total diffraction	learn more	20/02/2026

LENS	HU	EK	BNC	PSD	atomic structure investigations, amorphous, liquids and crystalline materials	learn more	20/02/2026
LENS	FR	ILL	ILL	D3, D9, D10, D15, D19, D23, VIVALDI	Neutron single-crystal diffraction	learn more	28/11/2025
LENS	FR	ILL	ILL	D1B, D2B, D4, D7, D20	Neutron powder diffraction	learn more	28/11/2025
LENS	FR	ILL	ILL	SALSA	Neutron stress / strain diffraction instrument	learn more	28/11/2025
LENS	CH	PSI	SINQ	HRPT, DMC, Zebra, POLDI	High-Resolution Powder Diffractometer for Thermal Neutrons, Cold Neutron Powder Diffractometer, Single Crystal Neutron Diffractometer, Time-Of-Flight Neutron Diffractometer	learn more	06/02/2026
LENS	DE	TUM	FRM II	BioDiff	Protein crystallography, structure determination of biological macromolecules	learn more	15/01/2026
LENS	DE	TUM	FRM II	Heidi, Poli	Single crystal diffractometer on hot source, SNP, PND	learn more; learn more	15/01/2026
LENS	DE	TUM	FRM II	Spodi	HR- powder diffraction	learn more	15/01/2026
LENS	DE	TUM	FRM II	StressSpec	Stress and texture measurements	learn more	15/01/2026
LENS	GB	UKRI	ISIS[2]	Neutron diffraction instruments		learn more	14/11/2025
LENS	GB	UKRI	ISIS[2]	Engin-x	Neutron stress / strain diffraction instrument	learn more	14/11/2025

[2] LIMITED ACCESS ONLY for proposals requiring environments ONLY available at ISIS. All other requests will be transferred to BNC (Hungary) or SINQ/PSI (Switzerland).

Neutron imaging

Neutron imaging is a non-destructive technique, highly complementary to X-ray imaging, that can see inside materials and examine processes therein. White beam imaging is based on the attenuation of the neutron beam, due to absorption or scattering, through an object. Grating interferometry is sensitive to materials properties such as porosity down to the micrometer-scale. Polarised neutron imaging reveals magnetic domains and textures. Monochromatic and energy-resolved imaging enhances element specific contrasts or diffraction contrast of materials. Tomography is performed by rotating the sample and reconstructing the 3-dimensional volume from a series of images. The high sensitivity to hydrogen containing materials reveals even small contaminations. In some instruments, such as NeXT at ILL, neutrons and X-rays can be used in parallel.



Neutron and X-ray imaging can be performed in parallel, e.g., at NeXT/ILL. Source: https://doi.org/10.1016/j.nima.2020.163939

Techniques

- **Neutron Radiography (NR) / Tomography (NT)** – are methods to provide 2D projections (radiographs) and 3D reconstructed volumes of attenuation of specimens. NR and NT are tools to investigate internals such as features, structures, cracks, and defects of a sample for spatial resolutions as low as 10 µm.
- **Energy resolved neutron imaging (ERNI) –** provides information about element concentrations (via resonance analysis) or microstructure information such as phase composition and residual strain (via Bragg edge analysis) typically in 2D (although possible in 3D) for spatial resolutions of hundreds of microns.
- **Grating interferometry (GI)** or Dark Field Imaging (DFI) – produces maps of attenuation, phase contrast and ultra-small angle scattering (dark field) signals, providing information about concentrations, porosity, and magnetic domains, for real-space spatial resolutions of tens or hundreds of microns.
- **Combined imaging with X-rays or gamma-rays** – bi-modal approach that enhances material contrast by taking advantaging different sensitivities of X-rays and neutrons for different elements and isotopes.
- **Prompt gamma activation imaging (PGAI)** – provides spatially resolved element compositions for a large number of elements and isotopes, for resolutions of hundreds of microns.
- **Neutron diffraction mapping (ND)** – provides spatially resolved composition, strain and texture information, typically for 1D or 2D real space resolutions of hundreds of microns up to a few millimetres.

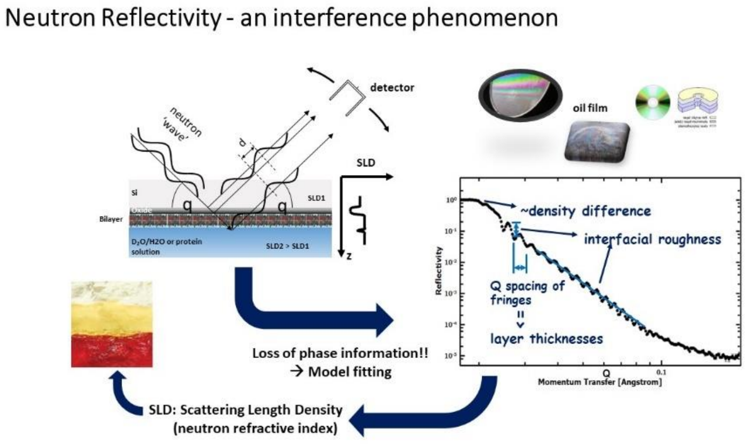
Infrastructures

Network	Coun-try	Access provider	Infra-structure	Instrument	Techniques	Link	Available until:
LENS	HU	EK	BNC	NORMA	PGAI-NT	learn more	20/02/2026
LENS	HU	EK	BNC	RAD	Static/dynamic white-beam-neutron and X-ray imaging station	learn more	20/02/2026
LENS	FR	ILL	ILL	Neutron imaging instrument NeXT	Imaging and in-situ X-ray imaging	learn more	28/11/2025
LENS	CH	PSI	SINQ	ICON, NEUTRA	HR-tomography, GrI, ERI	learn more	06/02/2026
LENS	DE	TUM	FRM II	Antares	Cold neutron radiog-raphy and tomography facility	learn more	15/01/2026
LENS	DE	TUM	FRM II	Nectar	fission neutron radiog-raphy and tomography	learn more	15/01/2026
LENS	CH	PSI	SINQ	ICON, NEUTRA	HR-tomography, GrI, ERI	learn more	06/02/2026
LENS	BG	UKRI	ISIS[3]	Neutron imaging instrument IMAT	neutron radiography, neutron tomography, and energy-resolved neutron imaging	learn more	14/11/2025

[3] LIMITED ACCESS ONLY for proposals requiring environments ONLY available at ISIS. All other requests will be transferred to BNC (Hungary) or SINQ/PSI (Switzerland).

Neutron reflectometry

Neutron reflectometry (NR) gives information on the structure of surfaces and interfaces (depth-dependent composition). It is also a powerful technique to study air/solid, solid/solid, solid/liquid, liquid/liquid and liquid/air interfaces.



Schematic of neutron reflectivity. Image credit to Philip King.

Reflectivity is the ratio of the reflected intensity to the incident intensity for a beam directed onto an interface or surface. The technique provides valuable information over a wide variety of scientific and technological applications including chemical aggregation, polymer and surfactant adsorption, structure of thin film magnetic systems, biological membranes, etc.

In the simplest case contrast matching can be employed to isolate the reflected signal from a particular adsorbate within a mixture. The signal is directly proportional to the adsorbed amount and often the NR technique is the only way such quantitative information can be obtained. Building on this idea specific deuteration can be employed to vary the refractive index of components both intra and inter molecular. A set of reflectivity data for the same chemical or biological system is obtained and used to constrain a real space model of the molecular organisation with a resolution of ~0.2nm or better.

Techniques

- **Reflectometry**: chemical composition (depth profile) at interfaces
- **Polarised Neutron Reflectometry**: magnetic depth profile at interfaces

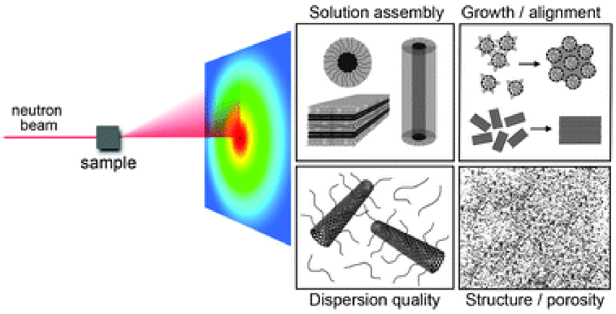
Infrastructures

Network	Coun-try	Access provider	Infra-structure	Instrument	Techniques	Link	Available until:
LENS	HU	EK	BNC	GINA	Neutron Reflectometer with Polarized Beam Option	learn more	20/02/2026
LENS	HU	EK	BNC	REF	neutron reflectometry	learn more	20/02/2026
LENS	FR	ILL	ILL	Neutron reflectometry instruments D17, Figaro, SuperAdam, D16	neutron reflectometry	learn more	28/11/2025
LENS	CH	PSI	SINQ	AMOR	neutron reflectometry	learn more	06/02/2026
LENS	DE	TUM	FRM II	Maria, N-ReX, Refsans	VR with HIA, Polarized, vertical neutron reflectometry, Horizontal ToF	learn more	15/01/2026
LENS	GB	UKRI	ISIS[4]	Neutron reflectometry instruments (Inter, Offspec, Polref, Surf)	neutron reflectometry	learn more	14/11/2025

[4] LIMITED ACCESS ONLY for proposals requiring environments ONLY available at ISIS. All other requests will be transferred to BNC (Hungary) or SINQ/PSI (Switzerland).

Neutron small angle scattering

Small-angle neutron scattering (SANS) snapshots the collective characteristics of particles and molecules in dispersed or assembled systems, rather than looking at single atoms or molecules. The signal is based on the contrast of the targeted matter and the background. Due to the distinctive scattering length density (SLD) of light elements of similar atomic numbers, neutron scattering will enable differentiation of species abundant in light elements.



Typical information extractable from the data acquired at a SANS instrument.

Source: https://doi.org/10.1039/C3CP50293G

As the scattered neutrons show information as in the reciprocal space (or q-space) instead of real space, the larger the target objects are, the smaller the scattering angle we get. Since the lower end of q is limited by the beamline setup, typically, the length scale of structures that can be investigated using SANS ranges from a few nanometres to hundreds of nanometres. With a spin-echo SANS (SESANS) setup, one may extend the range to characterise larger structures up to tens of microns. A wide scope of systems can be studies using SANS, including soft matters (gels and colloids), biological materials, and magnetic materials, with controlled environment enabling us to study materials structure under (not limited to) different temperature, pressure, moisture, and mechanically stressed conditions.

Additionally, using isotopic substitution (e.g., hydrogen (H) to deuterium (D), called “deuteration”), one can alter the scattering signals of hydrogenated groups in the molecules. This contrast variation method is based on the significant difference in the SLD of the isotopes, and is widely used in hydrogen-rich systems such as soft matters and biological samples (e.g., protein binding). This allows us to render specific parts of the sample with minimal interference from the other parts.

Infrastructures

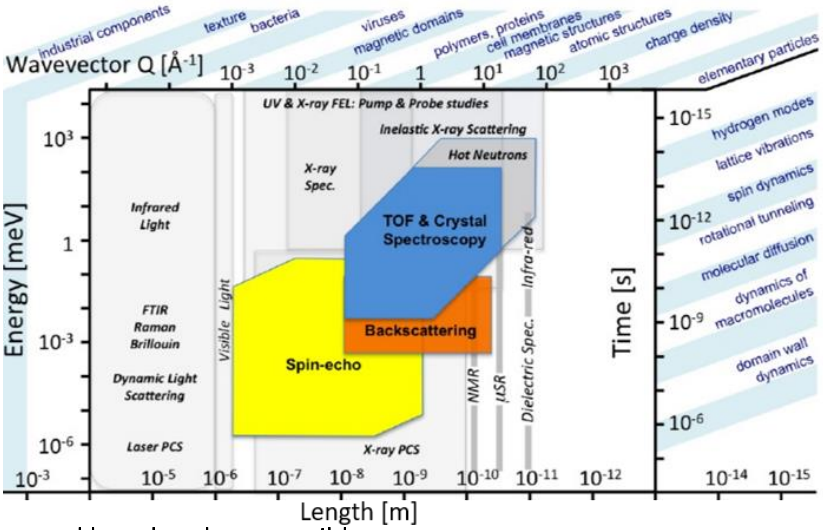
Network	Coun -try	Access provider	Infra-structure	Instrument	Technique	Link	Available until:
LENS	HU	EK	BNC	F-SANS	SANS	learn more	20/02/2026
LENS	HU	EK	BNC	Yellow Submarine	SANS	learn more	20/02/2026
LENS	FR	ILL	ILL	Small angle scattering instruments (D11, D22, D33, D16)	SANS	learn more	28/11/2025
LENS	CH	PSI	SINQ	SANS-I	SANS	learn more	06/02/2026
LENS	DE	TUM	FRM II	KWS-1, KWS-2, KWS-3, SANS-1	SANS	learn more	15/01/2026
LENS	GB	UKRI	ISIS[5]	Small angle scattering instruments (Zoom, Sans2d, LoQ, Larmor)	SANS	learn more	14/11/2025

[5] LIMITED ACCESS ONLY for proposals requiring environments ONLY available at ISIS. All other requests will be transferred to BNC (Hungary) or SINQ/PSI (Switzerland).

A hub for material research

Neutron spectroscopy

Neutron spectroscopy probes the dynamics of magnetic moments, atoms, molecules or atom lattices over length scales ranging from fractions of a nanometer to tens of nanometers, and over timescales from tens of femtoseconds (molecular vibrations) up to the microsecond (motion of large biological molecules). Within neutron spectroscopy, there are 4 main techniques which use different methods to determine the energy of the incident and scattered neutrons and are adapted to different kinds of scientific studies.



Time- and lengthscales accessible to neutrons.

Source: https://europeanspallationsource.se/sites/default/files/downloads/2017/09/TDR_online_ver_all.pdf

Techniques

- **Time-of-flight (ToF) spectroscopy / quasi-elastic spectroscopy (QENS)** – Surveys of lattice and magnetic dynamics or atom diffusion on the ps timescale.
- **Vibrational spectroscopy** – for assessing molecular bonds, typically in the fs timescale.
- **Triple-axis spectroscopy (TAS)** - More focussed studies of lattice and magnetic dynamics in the ps timescale.
- **High resolution neutron backscattering (HR-BS) / neutron spin-echo (NSE) spectroscopy** – for slow and diffuse motions

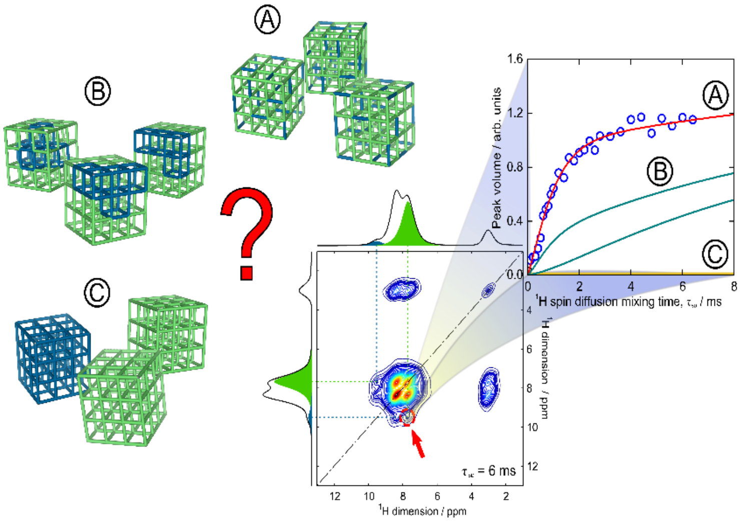
Infrastructures

Network	Country	Access provider	Infrastructure	Instrument	Technique	Link	Available until:
LENS	FR	ILL	ILL	IN13, IN15, IN16B, WASP	Neutron spectroscopy – high resolution	learn more	28/11/2025
LENS	FR	ILL	ILL	IN5, IN8, IN12, IN20, IN22, SHARP, Thales	Neutron spectroscopy medium resolution	learn more	28/11/2025
LENS	FR	ILL	ILL	IN1-Lagrange, Panther	Neutron spectroscopy - vibrational spectroscopy	learn more	28/11/2025
LENS	CH	PSI	SINQ	FOCUS, TASP, CAMEA, EIGER	ToF for cold neutrons, thermal triple-axis, cold triple-axis	learn more	06/02/2026
LENS	DE	TUM	FRM II	Kompass, LaDiff, Puma, Panda, Trisp	lattice excitations and magnetic excitations	learn more	15/01/2026
				TOFTOF	ToF		15/01/2026
				Spheres	HR-BS		15/01/2026
				NSE, Reseda	Spin-echo spectrometers		15/01/2026
LENS	GB	UKRI	ISIS[6]	MAPS, MARI, LET, MERLIN	Neutron spectroscopy – excitations instruments	learn more	14/11/2025
LENS	GB	UKRI	ISIS[6]	IRIS, OSIRIS, TOSCA, VESUVIO	Neutron spectroscopy – molecular spectroscopy	learn more	14/11/2025

[6] LIMITED ACCESS ONLY for proposals requiring environments ONLY available at ISIS. All other requests will be transferred to BNC (Hungary) or SINQ/PSI (Switzerland).

Nuclear Magnetic Resonance

NMR is an abbreviation for Nuclear Magnetic Resonance. The advantages of NMR for the analysis of molecular structures at the atomic level are that sample measurements are non-destructive and that there is little sample preparation required. NMR spectroscopy is a versatile tool that provides information not only on the structures, but also on the dynamics of various biological and synthetic molecules at an atomic level. The investigated samples are put in a magnetic field that is tens of thousands of times stronger than the earth's magnetic field. The NMR method is very sensitive to the features of molecular structure because the neighboring atoms influence the signals from individual nuclei as well and this is important for determining the 3D-structure of molecules. With NMR spectroscopy one can study liquid, solid and semi-liquid samples. Fields of application include bio, foods, chemistry, as well as new ones such as batteries.



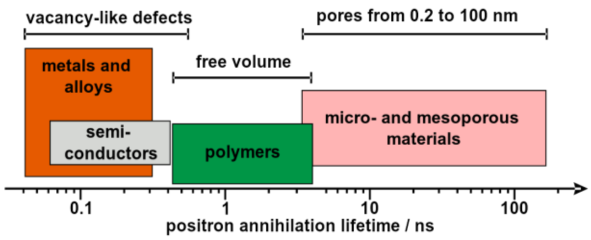
Linker molecules in metal-organic frameworks can be distinguished as shown in the work of Krajnc et al.
Image adapted from: A. Krajnc et al., (2015), Angew. Chem. Int. Ed., 54: 10535-10538. https://doi.org/10.1002/anie.201504426

Infrastructures

Network	Country	Access provider	Infrastructure	Instrument	Link	Available until:
non-ARIE	EU	CERIC-ERIC	CERIC-ERIC	ASKA@SloNMR	learn more	14/11/2025
non-ARIE	EU	CERIC-ERIC	CERIC-ERIC	DAVID@SloNMR	learn more	14/11/2025
non-ARIE	EU	CERIC-ERIC	CERIC-ERIC	LARA@SloNMR	learn more	14/11/2025
non-ARIE	EU	CERIC-ERIC	CERIC-ERIC	MAGIC@SloNMR	learn more	14/11/2025
non-ARIE	EU	CERIC-ERIC	CERIC-ERIC	NIKA@SloNMR	learn more	14/11/2025
non-ARIE	EU	CERIC-ERIC	CERIC-ERIC	ORO@SloNMR	learn more	14/11/2025
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	Solid State NMR Spectrometer Jeol (TUL15)	learn more	27/03/2026
EMFL	DE	HZDR	HLD	Pulsed-field magnet	learn more	25/04/2026

Positrons

Being the anti-particle of electrons, positrons are used to probe material defects on the nanometre scale, at low concentrations and with high sensitivity. It is a non-destructive method developed to serve as a proven tool for the study of metals, semiconductors, polymers, and open or closed microporous systems. Positron based techniques are used to study a variety of phenomena and material properties on a nanometre scale, like:



Lifetime scale of positrons for different materials. Image credit to Eric Hirschmann.

- performance parameters in semiconductors or alloys by characterization of **atomic defects**, there types (e.g. mono-/ di- vacancies) or concentration.
- optimization of process parameters in e.g. polymer membranes or composites regarding **free/open volume** effects (e.g. interstitial volume in polymer chains due to fatigue).
- determination of **pore size and pore size distribution (up to 100 nm diameter)** in e.g. nano filters or catalysts for high-performance or innovative applications.

It is recommended to discussed sample size, sample preparation as well as in-situ / operando options with the experts.

Techniques

- **Doppler broadening spectroscopy (DBS**) – electron momentum at annihilation site for the investigation of defect decoration and concentration
- **Positron annihilation lifetime spectroscopy (PALS) –** electron density at annihilation site for the investigation of defect size/type and concentration
- **Positron Auger Spectroscopy (PAES) –** Positron initiated emission of Auger electrons for chemical analysis of the near-surface area

Infrastructures

Network	Coun -try	Access provider	Infra-structure	Instrument	Techniques	Link	Available until:
ELBE	DE	HZDR	ELBE	Monoenergetic Positron Source (MePS)	PALS, DBS	learn more	27/02/2026
ELBE	DE	HZDR	ELBE	Slow-Positron System of Rossendorf (SPONSOR)	DBS for thin films and depth profiling up to 3000 nm	learn more	27/02/2026
ELBE	DE	HZDR	ELBE	Conventional Positron Spectroscopy (CoPS)	PALS for bulk solids and powders, in-situ temperature (30 - 510 K) and humidity measurements	learn more	27/02/2026
LENS	DE	TUM	FRM II	Nepomuc	Pulsed low-energy positron system (PLEPS) Coincident Doppler Broadening Spec-trometer (CDBS)	learn more	15/01/2026

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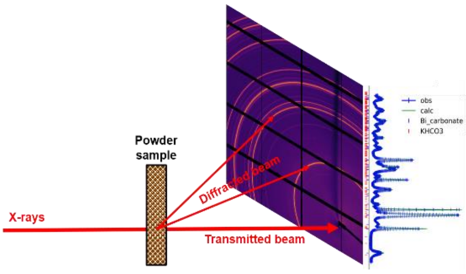
X-ray diffraction

X-ray diffraction (XRD) enables the identification of crystalline materials by their atomic structure.

The high flux of synchrotron sources allows for fast data acquisition, and the use of high energy photons (hence, high transmittivity through samples) enables operando/in situ studies in real operating systems (e.g., electrochemical cells).



Scheme of an X-ray beam scattered onto a detector.
Image credit to Marta Mirolo.

Through the analysis of the XRD data, one can retrieve the different phase(s) in the sample from the peaks position, while the intensities of the peaks provide information about the quantity of each crystalline phase present in the sample. Finally, the analysis of the peak broadening provides insights into the crystallite size and microstrain in the crystal.

Techniques

- **High-resolution XRD** - for the identification of an unknown phase
- **High space- and time-resolution XRD** - to identify the onset of a reaction
- **Microdiffraction XRD** - to study the behaviour of single particles
- **High-energy XRD** - for operando/in situ or high-throughput materials screening
- **Surface XRD** - for the investigation of layers growth on single crystals or flat surfaces
- **Laboratory XRD** - for ex situ materials screening

Infrastructures

Network	Country	Access provider	Infrastructure	Instrument	Technique	Link	Available until:
LEAPS	ES	ALBA-CELLS	ALBA	MSPD	High-angular resolution and high-throughput Powder Diffraction, High-pressure Micro Diffraction	learn more	07/11/2025
LEAPS	DE	HZB	BESSY II	KMC-2	Diffraction	learn more	
LEAPS	DE	DESY	PETRA III	P02.1	Powder diffraction, Bragg diffraction, PDF analysis	learn more	28/02/2026
LEAPS	DE	DESY	PETRA III	P07	GISAXS, GIWAXS	Learn more	28/02/2026
LEAPS	DE	DESY (GEMS-Hereon)	PETRA III	P07[7]	XRD, 3D-XRD, mirco-tomography	learn more	28/02/2026

[7] For SME-access only feasibility studies with up to max. 4 hours beamtime are possible.

LEAPS	DE	DESY	PETRA III	P08	HRXRD	learn more	28/02/2026
LEAPS	DE	DESY	PETRA III	P10	XPCS, CDI, Bragg CDI, Holographic imaging	learn more	28/02/2026
RADIATE	PT	IST	IBL	Lab XRD (Bruker D8)	Powder diffraction	learn more	08/05/2026
LEAPS	IT	ELETTRA	ELETTRA	MCX	Non-single crystal XRD, grazing angle diffraction and reflectivity, residual stress and texture analysis, phase analysis, kinetic studies	learn more	
LEAPS	FR	ESRF	ESRF	ID01	CDI, GISAXS, XRD, Ptychography	learn more	08/10/2025
LEAPS	FR	ESRF	ESRF	ID11	Diffraction contrast tomography, 3D-XRD, Imaging, PDF analysis, Powder diffraction, XRD	learn more	08/10/2025
LEAPS	FR	ESRF	ESRF	ID13	µXRF, µCrystallography, Ptychography, SAXS, XRD	learn more	08/10/2025
LEAPS	FR	ESRF	ESRF	ID15A	DCT, EDD, Imaging, Laminography, PDF analysis, Pump-probe, SAXS, TR-WAXS, X-ray scattering	learn more	08/10/2025
LEAPS	FR	ESRF	ESRF	ID22	XRD, Powder diffraction, PDF analysis, anomalous diffraction, anomalous scattering	learn more	08/10/2025
LEAPS	FR	ESRF	ESRF	ID31	XRD, Compton scattering, XRR, WAXS, GISAXS, PDF analysis, SAXS, GID	learn more	08/05/2026
LEAPS	CH	PSI	SLS	Debye	XAS, XRD, SAXS, (PDF), QEXAFS	learn more	27/03/2026
LEAPS	FR	SOLEIL	SOLEIL	PSICHE	EDXRF, ADXRD, Tomography	learn more	12/12/2025
Laserlab-Europe	CZ	IP-ASCR	HiLASE	Lab XRD	XRD, (RIR) phase analysis, Rietveld analysis, analysis of crystallinity, crystallite size and lattice stress, lattice parameter refinement, X-ray reflectivity and SAXS	learn more	27/02/2026
e-DREAM	IT	CNR	CNR	XRD Lab	2D, 1D XRD, temperature stage	learn more	20/02/2026

non-ARIE	CZ	NanoEnviCz	NanoEnviCz	Multipurpose X-ray powder diffractometer PANalytical XPertPRO MPD (UACH14)	X-ray powder diffraction, X-ray powder micro-diffraction, quantitative phase analysis, qualitative phase analysis	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	Multipurpose X-ray powder diffractometer (Co tube), Empyrean, series 3 (UACH17)	X-ray powder diffraction, X-ray powder micro-diffraction, quantitative phase analysis, qualitative phase analysis	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	X-ray Powder Diffraction (UPOL7)	X-ray powder diffraction, phase analysis, structure, crystallinity, particle size, solid state transformations	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	X-ray difractometer Panalytical X (UJEP5)	Phase analysis of materials, structure analysis of nanomaterials, lattice parameters, lattice strain, crystallinity.	learn more	27/03/2026

IR- to VUV-beamlines

The instruments sorted into this category cover an energy range which also includes that of typical lasers, but their photon source is based at a synchrotron, free-electron laser, or large-scale laser system.

Beamline based IR- to VUV-light sources can allow for high stable beams, with a wide spectral range and potentially very short pulses.

Techniques

- **Fourier-transform infrared (FTIR) spectroscopy -** for measuring infrared absorption and emission spectra, to determine chemical composition and functional groups
- **Synchrotron radiation circular dichroism (SRCD)** - Very fast acquisition of data about folding and stability of biomacromolecules
- **Pump-probe measurements** – for measuring fast dynamics of systems

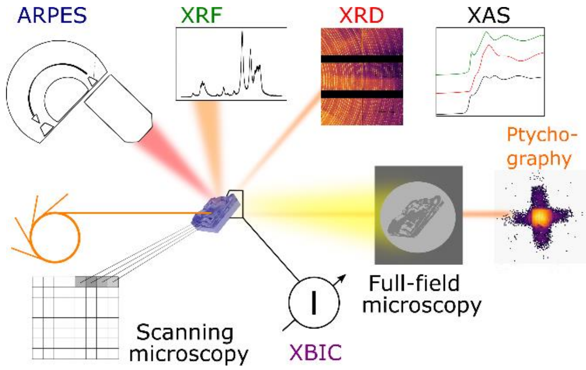
Infrastructures

Network	Country	Access provider	Infra-structure	Instrument	Technique	Link	Available until:
LEAPS	ES	ALBA-CELLS	ALBA	MIRAS Beamline	Fourier Transform Infrared (FTIR) spectroscopy and microscopy	learn more	07/11/2025
LEAPS	DE	DESY	FLASH	FLASH	Pump-probe, X-ray spectroscopy, XUV RAMAN, TR-RIXS	learn more	
LEAPS	IT	ELETTRA	ELETTRA	SISSI	IR spectroscopy, microspectroscopy and imaging	learn more	
Laserlab-Europe	ES	LLE-AISBL	CLPU	VEGA	Pump-probe meas-urements	learn more	
LEAPS	FR	SOLEIL	SOLEIL	DISCO	VUV: SRCD, micro-spectrofluorimeter, full-field inverted microscope, DUV imaging	learn more	12/12/2025

A hub for material research

X-ray imaging

X-ray imaging refers to the set of techniques that provide two-dimensional visualizations of a sample. Images are obtained by recording one or more effects of the interaction between matter and X-rays. Emission of electrons or X-ray photons, absorption or diffraction of the impinging beam, creation of free charge carriers are some of these effects and can be used as a contrast mechanism for image formation.



Schematic representation of multiple possible X-ray imaging modalities.
Image credit to Giovanni Fevola and Christina Ossig.

Imaging experiments can be performed in a **full-field** setup, where the sample is illuminated by the whole X-ray beam and the transmitted beam is recorded by a pixelated detector, or in a **scanning** setup, where the sample is raster-scanned through the highly focused X-ray beam.

Regardless of the setup, synchrotron images can be recorded much faster than with a laboratory source and enable live visualization of physicochemical processes. Furthermore, synchrotrons allow variation of the X-ray energy with few eV resolution. That allows, by scanning the energy over the absorption edge of a specific element, to gain chemical information about an element in a system.

Depending on their energy, X-rays can probe different elements, although with varying penetration depth. Soft X-rays, with energy below 2.5 keV, can probe low-Z elements that are of particular interest for life sciences, but have a low penetration depth. Hard X-rays, with energy above 10 keV, can be used to probe heavy metals and thicker samples.

Resolution is generally linked to the size of the focus spot or to the pixel size of detectors, although methods such as holography and ptychography exploit coherence of X-ray beam to achieve higher resolution (typically 100 to 10 nm).

Techniques

- **X-ray fluorescence** – measures chemical composition of a material
- **X-ray diffraction** – evaluates the crystal structure of a material
- **X-ray beam induced current** – measures charge collection efficiency in a semiconductor
- **X-ray transmission** – measures transmittance (absorptance) of a material
- **X-ray absorption spectroscopy** – probes chemical state of an element
- **Scanning photoemission spectroscopy** – probes the electronic states of the valence bands

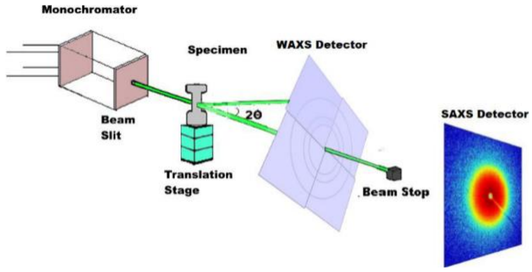
Infrastructures

Network	Country	Access provider	Infrastructure	Instrument	Technique	Link	Available until:
LEAPS	ES	ALBA-CELLS	ALBA	MISTRAL	FFTXM, cryo-nano tomography, spectroscopy imaging, magnetic imaging	learn more	07/11/2025
LEAPS	DE	DESY (GEMS-Hereon)	PETRA III	P05[8]	Holography, Tomography	learn more	28/02/2026
LEAPS	DE	DESY	PETRA III	P06	XRF, XAS, XRD, Ptychography, Tomography	learn more	28/02/2026
LEAPS	DE	DESY (GEMS-Hereon)	PETRA III	P07[9]	XRD, 3D-XRD, mirco-tomography	learn more	28/02/2026
LEAPS	IT	ELETTRA	ELETTRA	ESCA	SPEM	learn more	
LEAPS	IT	ELETTRA	ELETTRA	NANOSPECTROSCOPY	XPEEm, LEEM, SPLEEM	learn more	
LEAPS	IT	ELETTRA	ELETTRA	TwinMic	soft XTM, XEM	learn more	
LEAPS	FR	ESRF	ESRF	ID13	µXRF, µCrystallography, Ptychography, SAXS, XRD	learn more	08/10/2025
LEAPS	FR	ESRF	ESRF	ID19	µTomography	learn more	08/10/2025
LEAPS	FR	SOLEIL	SOLEIL	ANTARES	HRPES, XAS, ResPES, PhD, XPD, ARPES	learn more	12/12/2025
LEAPS	FR	SOLEIL	SOLEIL	NANOSCOPIUM	XRF, FF XAS, µTomography	learn more	12/12/2025
Laserlab-Europe	ES	LLE-AISBL (CLPU)	CLPU	VEGA	Pump-probe measurements	learn more	
non-ARIE	EU	CERIC-ERIC	CERIC-ERIC	DEMETER-STXM@SOLARIS	STXM, XRF, XAS	learn more	17/10/2025

[8] For SME-access only feasibility studies with up to max. 4 hours beamtime are possible.
[9] For SME-access only feasibility studies with up to max. 4 hours beamtime are possible.

X-ray small/wide-angle scattering (SAXS-WAXS)

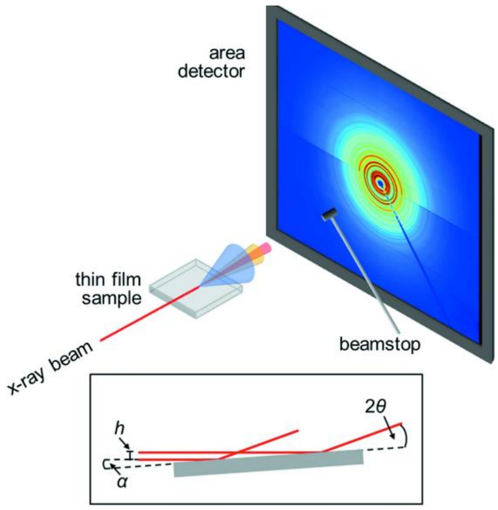
Small- and wide-angle X-ray scattering (SAXS/WAXS) probe the size, shape, orientation, and crystallinity of mesoscale structures on length scales ranging from about one to several hundred nanometers. The techniques can be applied to solids, liquids, and dispersions in both bulk and, with restrictions, thin films.



Scheme of WAXS and SAXS geometry.
From: Connolly et al., J. of Pipeline Science and Engineering, **2** (3), 10068, 1011, https://doi.org/10.1016/j.jpse.2022.100068

By focusing the X-ray beam, SAXS/WAXS can be used as an imaging technique in scanning mode. In this case, one can map nanoscale structures within the sample, with the real-space resolution essentially given by the size of the incident X-ray beam. Scanning-based imaging can be carried out in two, three, or six dimensions, depending on the sample.

In the study of surfaces, interfaces and thin films, the structure of a single monolayer up to material thickness of up to tens of nanometers on or within a bulk sample are investigated. To limit the penetration depth of the X-ray beam to the surface-near/interface-near region grazing incidence (GI) geometry is very effective, where the sample is illuminated under an incident angle smaller or around the critical angle of total external reflection, which amounts to values < 0.1° at high photon energies. To successfully perform GI experiments, the positional alignment of the surface/interface with respect to the X-ray beam requires high precision. To restrict the X-ray footprint resulting from the very shallow incident angle to not exceed the sample dimension, a tightly focused X-ray beam is essential.



Scheme of a GiSAXS geometry.
From: Dippel *et al.* (2019). *IUCrJ*, **6**, 290-298, https://doi.org/10.1107/S2052252519000514

Techniques

- **SAXS/WAXS –** probing size, shape, orientation, and crystallinity of mesoscale structures
- **Scanning SAXS/WAXS imaging –** for real space spatial resolution
- **Grazing-incidence (Gi)SAXS/WAXS** - for surface layers on flat substrates.

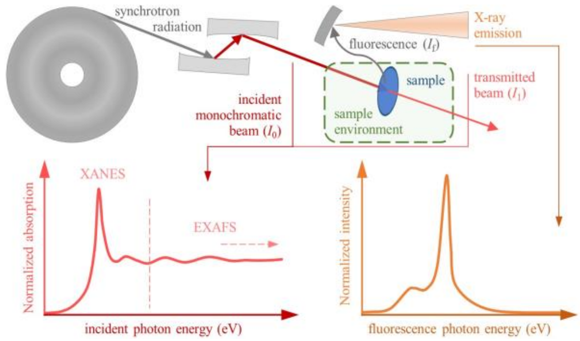
Infrastructures

Network	Coun-try	Access provider	Infra-structure	Instrument	Technique	Link	Available until:
LEAPS	ES	ALBA-CELLS	ALBA	NCD-SWEET Beamline	SAXS/WAXS, GISAXS/GIWAXS	learn more	07/11/2025
LEAPS	DE	DESY	PETRA III	P03	GISAXS, GIWAXS	learn more	28/02/2026
LEAPS	DE	DESY	PETRA III	P07	SAXS, WAXS, GiSAXS, GiWAXS	learn more	28/02/2026
LEAPS	FR	ESRF	ESRF	ID01	GISAXS	learn more	08/10/2025
LEAPS	FR	ESRF	ESRF	ID13	SAXS	learn more	08/10/2025
LEAPS	FR	ESRF	ESRF	ID15A	SAXS, TR-WAXS	learn more	08/10/2025
LEAPS	FR	ESRF	ESRF	ID31	SAXS, GISAXS , WAXS	learn more	08/05/2026
LEAPS	FR	SOLEIL	SOLEIL	SWING	SAXS, WAXS	learn more	12/12/2025
LEAPS	SE	ULUND	MAX IV	ForMAX beam-line	SAXS, WAXS	learn more	27/02/2026
non-ARIE	CZ	NanoEn-viCz	NanoEn-viCz	X-ray powder diffractometer with optics for nanolayers and nanosurfaces Panalytical X Pert PRO (UJEP33)	X-ray diffractometer equipped with optics for structure analysis of polycrystalline thin films and nanosur-faces.	learn more	27/03/2026

A hub for material research

X-ray spectroscopy

X-ray spectroscopy (XAS) is sensitive to the local atomic and electronic structure around the element of interest. This element selective technique has versatile applications for solid, liquid and even gaseous materials, including time-resolved in situ studies. X-ray absorption near-edge structure spectroscopy (XANES), which covers the region of 50-100 eV above the absorption edge, probes the transition from the core-level to unoccupied electronic states, being sensitive to the oxidation state, ligand surrounding and local symmetry of the absorbing atom. Extended X-ray absorption fine structure (EXAFS) provide the coordination numbers and interatomic distances for the absorbing atom.



Scheme of X-ray spectroscopy setup and measured data.
Image credit to Aram Bugaev.

If the concentration of element of interest is high enough, XAS can measured in transmission geometry. Such measurement can be performed under in situ/operando conditions, high pressures and temperatures and with sub-second time resolution. In fluorescence mode samples with low concentrations of the element of interest down to few ppm can be measured. High time resolution (down to 100 ps) can be also achieved in pump-probe regime. This regime can be applied to liquid samples such as metalloproteins, colloidal nanoparticles and homogenous catalysts, solid samples with low concentration of element of interest or/and the presence of other highly absorbing elements (e.g. led oxide doped with noble metal), and samples that cannot be manipulated to optimize their thickness for transmission geometry (e.g. artefacts of cultural heritage). The energy profile of the fluorescence signal can be also scanned resulting in X-ray emission spectrum (XES) or resonant XES (RXES), if the incident photon energy is tuned to the absorption edge of the element under consideration. The spectra are sensitive to the electronic configuration of the absorbing atom, thus providing important information about chemical bonding. In case both incident and florescence photon energies are scanned, the high-energy-resolution fluorescence-detected (HERFD)-XANES spectra or resonant inelastic X-ray scattering (RIXS) maps are obtained. Finally, in X-ray photoemission spectroscopy (XPS), the kinetic energy of the excited photoelectrons is measured providing information on the binding energies of electrons in materials. The XPS spectra are therefore sensitive to the atomic composition of the sample and the chemical state of each type of atom. Since the photoelectron mean free path is not big, XPS is surface sensitive (1-10 nm).

Techniques

- **X-ray absorption spectroscopy** – element selective local atomic and electronic structure: oxidation state, ligand surrounding, coordination numbers and interatomic distances.
- **Pump-Probe XAS** – time resolved (down to 100 ps) electronic changes of active site
- **X-ray emission spectroscopy** – electronic configuration of the element of interest
- **X-ray photoelectron spectroscopy** – chemical composition and chemical state of surface atoms

Infrastructures

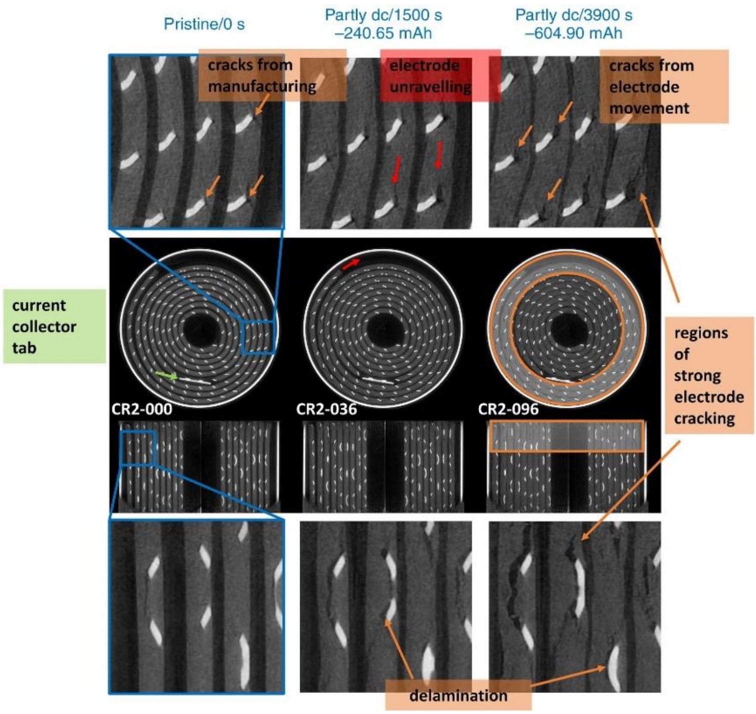
Network	Coun-try	Access provider	Infra-structure	Instrument	Technique	Link	Available until:
LEAPS	ES	ALBA-CELLS	ALBA	CLAESS Beamline	XAS, XES, XRF, in-situ	learn more	07/11/2025
LEAPS	ES	ALBA-CELLS	ALBA	CIRCE Beamline	PEEM, NAPP, XPS-PEEM, XMC(L)D-PEEM, IV-LEEM and u-LEED, NEXAFS or XAS	learn more	07/11/2025
LEAPS	DE	DESY	PETRA III	P22	HAXPES, HAXPEEM, high pressure XPS, k-microscopy	learn more	28/02/2026
LEAPS	DE	DESY	PETRA III	P64/P65	EXAFS, QEXAFS, RXES, XAFS	learn more learn more	28/02/2026
LEAPS	DE	DESY	FLASH	FLASH	Pump-probe, X-ray spectroscopy, XUV RA-MAN, TR-RIXS	learn more	
LEAPS	IT	ELETTRA	ELETTRA	ESCA	SPEM	learn more	
LEAPS	IT	ELETTRA	ELETTRA	ALOISA	XPS, NEXAFS, PED	learn more	
LEAPS	DE	HZB	BESSY II	KMC-2	XANES	learn more	
LEAPS	CH	PSI	SLS	Debye	XAS, XRD, SAXS, (PDF), QEXAFS	learn more	27/03/2026
LEAPS	CH	PSI	SLS	SuperXAS	XAS, XES, QEXAFS, pump-probe, TR-XAFS	learn more	27/03/2026
LEAPS	FR	SOLEIL	SOLEIL	LUCIA	µXRF, µXAS, XANES, EXAFS, Raman spec-troscopy	learn more	12/12/2025
LEAPS	FR	SOLEIL	SOLEIL	SAMBA	XAS	learn more	12/12/2025
LEAPS	FR	SOLEIL	SOLEIL	HERMES	STXM, X-PEEM, XMCD, XMLD, XAS, XANES, XPS, ARPES	learn more	12/12/2025
LEAPS	FR	SOLEIL	SOLEIL	ANTARES	HRPES, XAS, ResPES, PhD, XPD, ARPES	learn more	12/12/2025
LEAPS	SE	ULUND	MAX IV	Balder beamline	EXAFS, XANES, XAS, XES, XRF	learn more	27/02/2026
non-ARIE	EU	CERIC-ERIC	CERIC-ERIC	Envi-roESCA@CUP	XPS	learn more	14/11/2025
non-ARIE	EU	CERIC-ERIC	CERIC-ERIC	DFEMETER-PEEM@SO-LARIS	XPS, XAS (soft X-rays)	learn more	17/10/2025
non-ARIE	EU	CERIC-ERIC	CERIC-ERIC	PHE-LIX@SO-LARIS	XAS (soft X-rays), LEED-AES, CDS	learn more	17/10/2025

non-ARIE	EU	CERIC-ERIC	CERIC-ERIC	ASTRA@SOLARIS	XAFS	learn more	17/10/2025
non-ARIE	EU	CERIC-ERIC	CERIC-ERIC	URANOS@SOLARIS	ARPES, LEED	learn more	17/10/2025
non-ARIE	EU	CERIC-ERIC	CERIC-ERIC	PIRX@SOLARIS	XAS (soft X-rays) XMCD	learn more	17/10/2025
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	X-Ray Photoelectron Spectroscopy (UPOL3)	XPS, Surface chemical composition, Valence state, Chemical quantification	learn more	27/03/2026
non-ARIE	CZ	NanoEnviCz	NanoEnviCz	WDRF spectrometer Rigaku Primus IV (UJEP 37)	Elemental analysis, WDXRF spectrometry, Thin layer analysis, Analysis of defects	learn more	27/03/2026
Laserlab-Europe	ES	LLE-AISBL	CLPU	VEGA		learn more	
Laserlab-Europe	ES	LLE-AISBL	ICFO	Attoseconds SXR beamline		learn more	31/03/2026

X-ray tomography

X-ray tomography is a non-destructive full-field imaging technique applicable to materials from metals to organic tissue. The basic experimental setup is relatively simple: the sample is placed on a rotating stage and aligned in the X-ray beam, with a detector placed some distance after the sample. A tomographic dataset is collected by rotating the sample in the X-ray beam and collecting a series of projections from different angles. The series of collected projections are fed into a reconstruction algorithm to produce a three-dimensional volume representation of electron density in the sample.

For many material science samples, preparation is minimal: the sample can simply be mounted securely on the sample stage, making tomography a simple experiment to carry out. Diverse experimental setups allow measurements optimised for different samples or approaches, with microtomography beamlines offering voxel sizes in the range of 0.35-50 µm. Hard X-rays (typically from 20 to over 250 keV) are used to enable penetration of large samples. Tomography can be readily combined with sample environments such as a cryostream or a furnace to carry out *in situ* experiments.



X-ray tomograms of a commercial Li/MnO_2 primary battery. The pristine state and two partly discharged states are presented. The images show the cracking and volume expansion of the MnO_2 electrode during cell discharging.

Source: Nat Commun 11, 777 (2020). https://doi.org/10.1038/s41467-019-13943-3

The data collected from X-ray tomography provides a 3D view of the internal structure of a sample. Important features such as inclusions or cracks can be observed non-destructively. *In situ* experiments can provide feedback on the real-time evolution of materials under processing or, for example, undergoing tests in a load frame.

Techniques

- **Full-field tomography** – absorption contrast
- **Scanning tomography –** absorption, element specific, or phase contrast
- **Ptycho-tomography –** phase contrast, high resolution

Infrastructures

Network	Country	Access provider	Infrastructure	Instrument	Technique	Link	Available until:
LEAPS	DE	DESY (GEMS-Hereon)	PETRA III	P05[10]	Holography, Tomography	learn more	28/02/2026
LEAPS	DE	DESY	PETRA III	P06	XRF, XAS, XRD, Ptychography, Tomography	learn more	28/02/2026
LEAPS	DE	DESY (GEMS-Hereon)	PETRA III	P07[11]	XRD, 3D-XRD, mirco-tomography	learn more	28/02/2026
LEAPS	FR	ESRF	ESRF	BM05	X-ray diffractometry, reflectometry, topography, tomography	learn more	08/10/2025
LEAPS	FR	ESRF	ESRF	ID19	µTomography	learn more	08/10/2025
LEAPS	FR	SOLEIL	SOLEIL	ANATOMIX	FF radiography, tomography, in absorption and phase contrast	learn more	12/12/2025
LEAPS	FR	SOLEIL	SOLEIL	PSICHÉ	EDXRF, ADXRD, tomography	learn more	12/12/2025

[10] For SME-access only feasibility studies with up to max. 4 hours beamtime are possible.
[11] For SME-access only feasibility studies with up to max. 4 hours beamtime are possible.

All NanoEnviCz Instruments

NanoEnviCz integrates the infrastructure facilities of Czech research organizations for research in nanotechnology sciences.

The program is focused on research in the field of nanomaterials and nanocomposites for environmental and related applications. Our services include controllable syntheses of nanomaterials, their complex chemical, structural, morphological and surface characterization, tuning their functional properties, monitoring their potential toxicity and hazard.

All of the NanoEnviCz instruments are also available in the industry access routes.

Analysers

Instrument	**Description**	**Link**	**Available until:**
Electrokinetic analyser SurPASS (UJEP6)	Measurement of zeta potential of solid samples. Solid surfaces can be measured in the form of flat samples (polymer foils, glass, etc.) and powders or fibres (all size has to be higher than 25 micrometers).	learn more	27/03/2026
Laboratory of computational chemistry (UJEP 34)	This laboratory is composed of two computer clusters for high performance computing. The newer cluster consists of 18 nodes "DELL PowerEdge T640 Server", providing a great background, especially for more demanding parallel computations. Each node is equipped with 2 Intel Xeon Gold 6240 processors and 192 GB (16 nodes) or 384 GB (2 nodes) RAM. In addition, 10 nodes are equipped with four GeForce RTX 2080 Ti graphics cards for GPU or GPU/CPU calculations. The older cluster consists of 9 older nodes "Dell PowerEdge R720" (2x Intel Xeon E5-2695 v3, 128 GB RAM) and two newer nodes "TYAN - GPU Server FT48TB7105" (2 x Intel Xeon Gold 6240, 192 GB RAM) which are moreover equipped also with 3 x GeForce RTX 2080 Ti for GPU accelerated calculations.	learn more	27/03/2026
Microarray laser scanner - NEW (UJEP27)	Development of novel sensitive optical microarray diagnostic devices (biosensors) in the area of biosensing for environmental or biomedical applications.	learn more	27/03/2026

Centrifuges

Instrument	Description	Link	Available until:
Refrigerated Centrifuge (UFCH5)	Centrifuge is power-driven machine that separates liquids from solid matter, liquids mixtures, or solid mixtures by centrifugal force. The max. rotation speed is 15000 rpm and max. volume capacity 3200 ml. Refrigerated centrifuge is equipped by temperature controller controller in range of -20 to +40°C.	learn more	27/03/2026
Ultracentrifuge (UFCH16)	The ultracentrifuge is a centrifuge optimized for spinning a rotor at very high speeds, capable of generating acceleration as high as 1 000 000 g (approx. 9 800 km/s^2). It can also be used for gradient separations, in which the tubes are filled from top to bottom with an increasing concentration of a dense substance in solution.	learn more	27/03/2026

Electrochemical techniques

Instrument	Description	Link	Available until:
FRA - PhotoEchem System (UFCH 20)	Integrated electrical and optical measurement system. Set-up for electrochemical measurements including Frequency Response Analyzer interfaced to electrochemical impedance spectroscopy, Potentiostat/Galvanostat, Solar simulator and IPCE module	learn more	27/03/2026

Chromotographic techniques

Instrument	Description	Link	Available until:
GC-qMS Agilent (UJEP16)	Gas chromatograph Agilent 7980 with electron ionization and simple quadrupole detection (MS 5977E) equipped with autosampler CombiPAL for liquid, headspace and SPME sample introduction. Agilent MassHunter Workstation Software is used for data acquisition and analysis.	learn more	27/03/2026
GC/MS/MS (TUL11)	Gas Chromatograph Thermo Trace 1310 with two injection ports (SSL and PTV). Autosampler CTC CombiPal RTC), Mass spectrometer TSQ 8000 Evo – triple quadrupole with unit mass resolution.	learn more	27/03/2026
HPLC/MS/MS (TUL1)	The instrument is an HPLC chromatograph with a triple quadrupole/linear ion trap mass spectrometer. The HPLC is a binary system with two pumps enabling very fast mobile phase gradients.	learn more	27/03/2026
Ion Chromaatograph DIONEX (UJEP14)	Ion Chromatograph DIONEX ICS – 1000	learn more	27/03/2026
Liquid Chromatograph (UJEP15)	Liquid chromatograph with DAD detector, Merck/Hitachi.	learn more	27/03/2026
Liquid chromatograph with MS detection (UJEP18)	Agilent 1290 Infinity UHPLC system consisting of an Agilent 1290 Infinity Binary Pump (G4220A), an Agilent 1290 Infinity High Performance Autosampler (G4226A), a sample cooler (G1330B), and an Agilent 1290 Infinity Thermostatted Column compartment (G1316C). The UHPLC system is coupled to an Agilent G6495 Triple Quadrupole LC/MS System equipped with an Agilent Jet Stream electrospray ionization source. Agilent MassHunter Workstation Software is used for data acquisition and analysis.	learn more	27/03/2026
Liquid chromatograph with diode-array detector Dionex (UJEP9)	Liquid chromatograph with DAD detector – DIONEX Ultimate 3000 Pump – LPG-3400SD Quarternary Standard Pump	learn more	27/03/2026
Two-Dimensional Gas	Gas Chromatograph (Agilent 7890) equipped with multimode inlet (split/splitless/LVI/PTV), GCxGC	learn more	27/03/2026

Chromatograph (UJEP36)	modulator ZOEX and coupled with flame ionization detector and mass spectrometry detector (Agilent 7250) quadrupole – time-of-flight (q-ToF). Deans Switch placed blind GCxGC modulator allows two-dimensional chromatography on FID or q-ToF.		

Microbiologic techniques

Instrument	Description	Link	Available until:
Laboratories for mammalian cell cultivation (UJEP21)	Complete infrastructure for mammalian cell cultivation and related experiments equipped by Biohazard box class 2 , inverted fluorescence microscope and flow cytometer Attune	learn more	27/03/2026
Laboratory of Nanotoxicology and Model Organisms (UJEP29)	Laboratory of model organism - Danio Rerio - for toxicity testing	learn more	27/03/2026
Laboratory of biosensors and microfluidics (UJEP22)	Complete infrastructure for the design, manufacturing and testing of biosensors and microfluidic devices for biomedical and environmental applications. Scanning electron microscope with electron lithography module , UV photolithographic instrument , magnetron sputtering device, microabrasive CNC lathe, reactive ion etching station , microfluidic liquid sample delivering system	learn more	27/03/2026
Real-time PCR device (TUL6)	The system features the LightCycler® 480 Instrument, a versatile, plate-based real-time PCR device that supports mono- or multicolor applications, as well as multiplex protocols.	learn more	27/03/2026
Respirometer - NEW (TUL12)	Continuous monitoring of metabolic gases concentrations.	learn more	27/03/2026
The LightCycler® 480 Real-Time PCR System (IEM11)	The LightCycler® 480 System is a plate-based, highly adaptable, and versatile real-time PCR system for gene expression analysis, SNP genotyping, and mutation scanning via high resolution melting (HRM). Key benefits of the LightCycler® 480 Thermal Block Cycler: - Run any assay format or application with fast PCR protocols (< 40 minutes for 40 cycles in 384-well plate format). - Obtain rapid and accurate temperature adjustment. - Achieve exceptional data homogeneity across the entire multiwell plate.	learn more	27/03/2026

Micromolecular techniques

Instrument	Description	Link	Available until:
Metafer Slide Scanning System (IEM2)	Metafer is an automated multi-purpose slide scanning platform. Equipped with CometScan software for MSearch, it enables automatic detection of single cell gel electrophoresis (Comet assay) samples.	learn more	27/03/2026
Metafer Slide Scanning System (IEM3)	The automated scanning system Metafer 4, Version 3.2.1, is a set of motorized Axio Imager Z1 microscope and software for scoring of binucleated cells and metaphases.	learn more	27/03/2026
MiSeq System (IEM6)	The Illumina MiSeq is a desktop sequencer with integrated computer which enables a broad range of applications, from targeted gene sequencing to metagenomics, small genome sequencing, targeted gene expression analysis, amplicon sequencing starting at 10 ng DNA, and HLA typing. New MiSeq reagents enable up to 15 Gb of output with 25 M sequencing reads and 2x300 bp read lengths.	learn more	27/03/2026
SpectraMax Multimode Plate Reader (IEM1)	A five-mode microplate reader with three-mode cuvette port for endpoint, kinetic, spectrum, and area-well scanning with PathCheck sensor and SoftMax Pro Software.	learn more	27/03/2026
iScan System (IEM5)	The iScan System is a laser-based, high-resolution optical imaging system that can rapidly scan and collect large volumes of data from Illumina DNA analysis and RNA analysis high-density BeadChips.	learn more	27/03/2026

Microscopic techniques

Instrument	Description	Link	Available until:
AFM (UACH1)	Atomic Force microscope provides imaging sample topography at high resolution, measuring magnetic structure of the sample surface by MFM and measuring electrical properties by STM.	learn more	27/03/2026
DXR Raman mikroscope (UACH9)	Thermo Scientific DXR Raman Microscope for phase identification and determination of the molecular structure of the chemical compounds. Analysis of the organic and inorganic compounds, carbon materials, nanomaterials, etc.	learn more	27/03/2026
Fluorescence Microscope (IEM4)	A set of fluorescent microscope and computer equipped with ISIS color fluorescence and FISH imaging system for analysis of chromosomal aberrations and fluorescently stained biological materials.	learn more	27/03/2026
Fluorescence inverted confocal spinning disk microscope Olympus SpinSR10 (UEM12)	The Olympus SpinSR10 is a fluorescence inverted confocal spinning disk microscope with super-resolution mode. It is designed for fast 3D super resolution imaging and prolonged cell viability in time-lapse experiments, the IXplore SpinSR microscope system offers XY resolution down to 120 nm without the need for dedicated labeling procedures.	learn more	27/03/2026
HRSEM FEI NanoSEM 450 (UACH4)	FEI Nova NanoSEM™ scanning electron microscopes combine best-in-class imaging with superb analytical performance in one easy-to-use instrument. It is a high-resolution scanning electron microscope, with two modes of measuring and five different detectors.	learn more	27/03/2026
High Resolution Transmission Electron Microscope (UPOL5)	High Resolution Transmission Electron Microscope (HRTEM) FEI Titan 60-300 kV an electron source of X-FEG, accelerating voltage from 60–300 kV and a point to point in TEM mode resolution of 0.08 nm. The microscope is equipped with GIF (Gatan Image Filter) and analytic methods EDS and EELS and special holders for reactive samples (vacuum holder, cryo holder, double-tilt holder). The characterization of the nanomaterial's samples (carbon structures, iron oxides, nanotubes, metal nanoparticles, ect.) in the atomic scale is provided.	learn more	27/03/2026

High resolution transmission electron microscope (UFCH21)	HRTEM will enable the viewing and imaging of details in nanostructure of nanomaterials down to the dimensions of nanometres with the resolution down to about 0.2 nm.	learn more	27/03/2026
High resolution transmission electron microscope (JEOL) JEM 3010 (UACH10)	Equipped with EDX detector (Oxford Instruments) and precession diffraction DigiStar (NanoMegas). It is used for high-quality materials characterization - morphology, phase analysis on nanometer scale, maps of various crystallographic phases and the crystal orientation.	learn more	27/03/2026
High resolution transmission electron microscope, HRTEM FEI Talos F200X (UACH16)	High resolution measurement of powder materials in the atomic scale with confirmation of the elemental composition and crystal structure for particle size up to 100nm. The identification of nanoparticles – quality of production, size and shape, determination of d-spacing, projection of atomic structure is studied including chemical composition confirmation (elemental mapping, EDS spectra).	learn more	27/03/2026
Infrared imaging microscope with FTIR spectrometer (TUL3)	FTIR spectrometer Nicolet iZ10 - DTGS (room temperature) detector, suitable spectral range 4000 – 400 cm-1, standard resolution 4 cm-1 or more. Infrared imaging microscope Nicolet iN10 MX – DTGS (room temperature) and MCTA (nitrogen cooled) detector, suitable spectral range 4000 – 400 cm-1, standard resolution 4 cm-1 or more	learn more	27/03/2026
Laser scanning confocal microscop (UPOL15)	The laser scanning confocal microscopy instrument with Airyscan 2 includes options for fast imaging with improved resolution. Suitable applications include live cell imaging/time courses, colocalization studies, Photo-activation, FRAP, FRET, spectral imaging, stitching of large areas, and imaging of fixed samples. CLSMs, enabling fast multiplexed super-resolution imaging (2x increase in spatial resolution) at 4x faster speed, especially suitable of dynamic live-cell imaging, containing linear scanner and enabling fast imaging 13images/second with resolution (512 x 512 pixels). It contains plan-apochromat objectives: 10x/0.45 M27 [working distance (WD) 2.1mm], 20x/0.8 M27 (WD 0.55mm) with DIC, 40x/1.2 Imm DIC M27 (WD 0.41mm) immersion: water, silicone oil or glycerol, 63x/1.4 Oil DIC M27 (WD 0.19mm), incubator XL multi S2 Dark premium with incubation set CO2/O2 and temperature heating desk,	learn more	27/03/2026

	antivibration table, ZEN 3.3 system with ZEN module FRAP, spectral 32 channel GaAsP PMT and 2 channels MA-PMT detectors. The confocal microscope covers the whole spectra with lasers (405, 445, 488, 514, 543,594, and 639nm).		
Low temperature UHV (UPOL8)	Set of Ultra High Vacuum chambers with Cryostat and Scanning Tunneling Microscope/Atomic Force Microscope for surface analysis.	learn more	27/03/2026
Raman microscopy (TUL4)	Raman microscopy with laser 532 nm, Nicolet DXR Raman microscopy.	learn more	27/03/2026
Scanning Electron Microscope (SEM) Hitachi SU6600 (UPOL10)	Scanning Electron Microscope (SEM) Hitachi SU6600	learn more	27/03/2026
Scanning Probe Microscope (UPOL6)	Scanning Probe Microscope (SPM) NTEGRA NT-MDT Measuring in different modes: o Atomic force microscopy (AFM) o Magnetic force microscopy (MFM) o Scanning tunneling microscopy (STM)	learn more	27/03/2026
Transmission Electron Microscope (TEM) JEOL 2100 (UPOL11)	Transmission Electron Microscope	learn more	27/03/2026
Confocal microscope - LEICA CLSM SP8/DLS (UJEP40)	Fully motorized confocal laser scanning microscope SP8 from Leica enclosed in an environmental chamber allowing temperature, humidity and CO2 levels control around the sample. Equipped with a digital light sheet (DLS) module. Laser lines: 405 nm, argon laser (458, 488, 514 nm), 561 nm, 633 nm.	learn more	27/03/2026
Scanning Electron Microscope, Hitachi (UFCH22)	Field emission scanning electron microscope FESEM model Hitachi S-4800	learn more	27/03/2026
System AFM-Raman (UPOL9)	Scanning probe microscope, NTEGRA Spectra which integrates common SPM and micro Raman scattering spectroscopy. AFM-Raman system delivers nondestructive analysis of the sample surface.	learn more	27/03/2026

Particle size distribution techniques

Instrument	Description	Link	Available until:
ZetaSizer NanoS (UFCH1)	Non-invasive back scatter (175 degrees) technology takes particles sizing to new levels of sensitivity in the nanometre to micron range size. ZS provides ability to measure three characteristics of particles or molecules in a liquid medium.	learn more	27/03/2026
Zetasizer nano ZS (IEM8)	Non-invasive, well-established technique for measuring the size and size distribution of molecules and particles typically in the submicron region - newly purchased within Pro-NanoEnviCz project	learn more	27/03/2026

Physical properties measuring systems

Instrument	Description	Link	Available until:
Equipment of the laboratory of nanotoxicology in cell cultures (IEM 9)	The set of instruments forms completely new laboratory of nanotoxicology. It includes a MPT-2 Multipurpose titrator (Malvern), a Bugbox Plus (BAKER RUSKINN), a Laminar flow cabinet (HERASAFE KS,) a CO2 incubator (HERACELL VIOS 250i), aThermo Scientific Barnstead Smart2Pure 3 UV/UF Water Purification System. New laboratory equipment was purchased within the Pro-NanoEnviCz project.	learn more	27/03/2026
Fragment Analyzer (IEM 10)	The Fragment Analyzer is a parallel capillary electrophoresis instrument for biological effects of manufactured nanoparticles´studies -a new equipment purchased within Pro-NanoEnviCz project	learn more	27/03/2026
Low temperature induction magnetometer - PPMS (UPOL14)	The physical properties measurement system (PPMS) is a complex device that allows to operator a broad option of measurements including magnetic properties, electron-transport properties, and thermal properties. PPMS uses a vibrating sample magnetometer (VSM) for the magnetic moment detection and provides both, DC (direct current) and AC (alternative current), types of measurement in a wide range of temperatures from 1.9 K – 400 K and the presence of an external magnetic field ranging from -9 T to +9 T. The Electrical Transport Option (ETO) enables users to make several different types of transport measurements over a wide range of resistance values and sample types. The ETO supports three types of measurements including resistivity, IV curves, and differential resistance. The current source has a minimum precision of 1 nA and a maximum current of 100 mA. It is capable of supplying both DC and AC current with frequencies from 0.1 Hz to 200 Hz. Last, but not least the heat capacity measurement is also possible at PPMS to complete the full magnetic information.	learn more	27/03/2026
Physical Properties Measurement System - PPMS (UPOL2)	The physical properties measurement system (PPMS) allows to operator a broad option of measurements including magnetic properties, electro-transport properties and thermal properties. Regarding magnetic properties, PPMS using a vibrating sample magnetometer (VSM) which is less sensitive than	learn more	27/03/2026

	SQUID and provide only DC (direct current) measurement option.		
Tester of Liquid Permeability of nanofibrous membranes (UJEP31)	Tester of Liquid Permeability	learn more	27/03/2026
Tester of Membrane Air Permeability of nanofibrous membranes (UJEP30)	Tester of air permeability	learn more	27/03/2026
Tester of mechanical strength of nanofiber membranes (UJEP32)	Tester of mechanical strength – tensile tests.	learn more	27/03/2026

Reactors

Instrument	Description	Link	Available until:
Autoclave for synthesis, catalysts testing and kinetic measurements (UFCH2)	Set of three autoclaves equipped for liquid phase bath synthesis, catalysts testing and kinetic measurement.	learn more	27/03/2026
Autoclave for synthesis, catalysts testing and kinetic measurements (UFCH3)	Set of three autoclaves equipped for liquid phase bath synthesis, catalysts testing and kinetic measurement.	learn more	27/03/2026
Catalytic flow microreactor B (UFCH10)	The Microactivity-Reference reactor (PCT/ES2005/070079) is an automatic and computerized laboratory catalytic micro-reactor which includes the valves and process layout in a hot box to avoid the possible condensation of volatile products, at the same time that preheats the reactants efficiently.	learn more	27/03/2026
Catalytic flow microreactor A (UFCH9)	The Microactivity-Reference reactor (PCT/ES2005/070079) is an automatic and computerized laboratory catalytic micro-reactor which includes the valves and process layout in a hot box to avoid the possible condensation of volatile products, at the same time that preheats the reactants efficiently.	learn more	27/03/2026
Fluidized Bed Reactor (UJEP2)	Equipment for plasma treatment of powder materials	learn more	27/03/2026
Laboratory reactors (UJEP12)	Laboratory – scale reactors for preparing metal oxide-based sorbents and related materials by homogeneous hydrolysis, sol-gel process, precipitation/calcination and similar techniques.	learn more	27/03/2026
Photocatalytic degradation liquide phase (UACH2)	Set of two photoreactors for the photocatalytic degradation of organic pollutants (dyes, cytostatics, pesticides, etc.) conected with UV-VIS Spectrophotometer ColorQuestXE for signal	learn more	27/03/2026

	detection of the organic pollutants and kinetic measurements and FL2000 fluorescence detector		
Universal magnetron deposition system (UJEP1)	The magnetron deposition system with variable system up to 3 magnetron with 2inch targets in diameter. Various power supplies are available RF, DC, RF pulsed, DC pulsed for sputtering of metals or metal oxides.	learn more	27/03/2026

Sample preparation techniques

Instrument	Description	Link	Available until:
Dip Coater 5 (UFCH18)	Dip Coater 5 is design for uniform deposition of layers on plates and similar objects by dipping and dragging into bath with solution.	learn more	27/03/2026
Extruder, Multi-Gran (UFCH6)	Granulator is designed to manufacture granules of ceramics, organic materials, polymers/biopolymers in form of cylinders of the diameter 1 to 3 mm adjusted by the selection of a die with proper openings.	learn more	27/03/2026
Industrial femtosecond pulsed laser (TUL13)	Industrial femtosecond laser (Onefive Origamy XP, NKT Photonics) with laser scanner head (intelliSCAN 14, SCANLAB). The tool is used for single or multielemental nanoparticle synthesis. It delivers high energy and frequency pulses capable of material ablation (LAL) and material fragmentation (LFL) in both gases and liquids. Further, it is used for laser melting in liquids (LML) and laser-mediated photoreduction approaches of nanoparticle synthesis.	learn more	27/03/2026
Laboratory electric superkanthal furnace (UFCH17)	Furnace for preparation and heat treatment of ceramics, glass phases and metals/metal alloys up to 1700°C under air or an inert atmosphere.	learn more	27/03/2026
Laboratory of nanofibrous materials (UJEP28)	Device for electrospinning - needle spinning of polymeric nanofibrous membranes (InoCure).	learn more	27/03/2026
MicroWriter ML3 Pro (UFCH25)	MicroWriter ML3 Pro (Durham MagnetoOptics Ltd.) is a direct-write photolithography machine for rapid prototyping in R&D laboratories and small clean rooms. It is compatible with most photolithography resists (385 nm), minimum feature size is 400 nm.	learn more	27/03/2026
Microarray printer - NEW (UJEP26)	Fabrication of active biosensor surfaces on different substrates	learn more	27/03/2026
Precision Ion Polishing System (PIPS) Model	Precision ion polishing system is used for thinning of prepared samples by current of ionized argon to the	learn more	27/03/2026

691(Gatan) (UACH12)	thickness of few nanometers for transmission electron microscopy.		
Reactor Speedwave four (UFCH12)	Microwave digestion system with built-in, non-contact temperature and pressure measurements. The system has been designed to perform chemical digestion procedures under extreme pressure and temperature conditions in chemical laboratories. Digestion is understood to mean the decomposition of a solid material by means of a suitable digestion reagent at increased temperature in a vessel that is permeable with regard to microwaves .	learn more	27/03/2026
T2 Glove Box (UFCH13)	Manipulating moisture and/or oxygen sensitive products and testing of materials (including long-term stability tests) in inert gas atmosphere. The glove box is equipped with cables for performing electrochemical measurements.	learn more	27/03/2026
Vacuum Apparatus for the Deposition of Size- and Composition Selected Clusters (UFCH33)	This equipment allows for the deposition of in their size and composition well defined subnanometer clusters on flat surfaces. The principle of operation is analog to the equipment described in "Atomically Precise (Catalytic) Particles Synthesized by a Novel Cluster Deposition Instrument", C. Yin, E. Tyo, K. Kuchta, B. von Issendorff, and S. Vajda; J. Chem. Phys. 140, 174201 (2014), DOI: 10.1063/1.4871799	learn more	27/03/2026
Clean room (UFCH11)	The clean room is equipped with spin coater, mask aligner, oxygen plasma etcher, sputtering machine, thermal evaporator.	learn more	27/03/2026

Spectroscopic techniques

Instrument	Description	Link	Available until:
FTIR Spectrometer (UFCH8)	FT-IR Nicolet 6700, Infrared Fourier transform spectrometer (FTIR) for qualitative and quantitative analysis for solid and liquid phase in range Mid-IR (4000-400 cm-1).	learn more	27/03/2026
Electron-Paramagnetic-Resonance Spectrometer (UPOL13)	Electron Paramagnetic Resonance (EPR) spectroscopy is similar to any other technique that depends on the absorption of electromagnetic radiation.	learn more	27/03/2026
ICP-OES Optical Emission Spectrometer (UJEP17)	Dual-view optical system (axial/radial) with High-dispersion echelle grating, spectral range 165-900 nm with resolution of < 0.009 nm (200 nm)	learn more	27/03/2026
Infrared Spectrometer (UFCH23 -new Pro-NanoEnviCzII)	The Nicolet iS50 is the scientific infrared spectrometer for universal material analysis. The spectrometer is primarily used to identify the structure of materials for heterogeneous catalytic and adsorption processes for environmental protection and for catalytic technologies.	learn more	27/03/2026
Laboratory of spectroscopy (UFCH27)	The spectroscopic laboratory consists of Horiba Raman spectrometer, WITec Raman spectrometer, Horiba photoluminescence spectrometer. The LabRAM HR Raman microscope is a suitable system for both micro and macro measurements and offers advanced confocal imaging capabilities in 2D and 3D. The true confocal Raman microscope enables detailed images and analysis. WITec microscope system has an exceptional optical throughput, unparalleled signal sensitivity, and outstanding imaging capabilities. Fluorolog 3 system is a state-of-the-art system for measuring excitation and emission spectra of thin-film and liquid samples	learn more	27/03/2026
Mass Spectrometer with inductively coupled plasma ICP-MS (TUL8)	ICP-MS NexIOn300D (Perkin Elmer) with autosampler and possible combination with HPLC (Flexar - Perkin Elmer)	learn more	27/03/2026

Microplate spectrophotometer (UJEP19)	Universal 96-well microplate UV-VIS spectrophotometer with PathCheck technology for correction of sample volume variations.	learn more	27/03/2026
Sciex X500R QTOF HR mass spectrometer - new (TUL14) -Pro-NanoEnviCz II	A QTOF type HRMS mass spectrometer coupled to an HPLC chromatograph. Suitable for screening and trace determination of pollutants (e. g. pesticides) and their metabolites, pharmaceuticals and biomolecules. Use of libraries and in silico fragmentation software allows for the identification of unknowns.	learn more	27/03/2026
Solid State NMR Spectrometer Jeol (TUL15)	Classic solid state nuclear magnetic resonance instrument for chemical analysis. The instrument produces a high intensity magnetic field and studies its interaction with magnetic nuclei of the exposed sample. It finds application in basic characterization of chemical structure of synthesized nanomaterials and composites.	learn more	27/03/2026
Spectrophotometer Cary 50 (UJEP13)	UV/Vis spectrophotometer Cary 50 with wavelength 190-1100nm	learn more	27/03/2026
Thermo Nicolet - FTIR (UACH8)	Mid-infrared Fourier transform spectrometer (FTIR) for determination of the molecular structure of the chemical compounds and in-situ observation of the adsorption, surface chemical and photochemical reactions.	learn more	27/03/2026
Thermoanalytical Complet (UACH15)	System SETARAM for thermal analysis is using sophisticated system of QMS module connection so-called SuperSonic System in which gas molecules are accelerated and directed to the mass spectrometer.	learn more	27/03/2026
Thermogravimeter STA449F1(Netzsch) connected with Mass Spectrometer (Anamet) (UFCH14)	Thermogravimeter STA449F1 (Netzsch) allows is devoted to measure: thermogravimetry (TG) and differential scanning calorimetry (DSC). TG determine sample mass loss during the thermal treatment and DSC determines the heat capacity of the sample.	learn more	27/03/2026
Thermogravimetric analyser with FTIR spectrometer (TUL2)	Thermogravimetric analyzer Q500 is suitable for studying material thermal stability from ambient to 1000 °C. T Evolved gases can be online studied by FTIR spectrometer Nicolet iS10 with MCTA (nitrogen cooled) detector in spectral range 4000 – 650 cm-1 and maximum spectral resolution 1 cm-1.	learn more	27/03/2026

X-Ray Photoelectron Spectroscopy (UPOL3)	Acquired Information are determination and quantification of chemical composition of surfaces (max. depth 10 nm), determination of valence states of atoms, chemical composition depending on the depth (depth chemical concentration).	learn more	27/03/2026
XPS/ESCA and Auger electron spectroscopy (UJEP3)	The instrument is an electron spectrometer SPECS with an X-Ray source of achromatic (Al/Mg) and monochromatized (Al/Ag) photons for electron spectroscopy (XPS/ESCA) analyses with electron source-based charge compensation. The system also is equipped with an electron source (50 eV – 3000 eV) for Auger electron spectroscopy (AES) with scanning options and an SE detector (SEM/SAM). The detection unit is 5 channel channeltron. The base pressure is about 4x10-9 mbar. The solid samples and powder samples can be analyzed. The limitation is mainly in the sample stability under the measurement conditions. A depth profiling of elemental composition is possible by Argon ions sputtering from an external ion source.	learn more	27/03/2026

Surface characterization techniques

Instrument	Description	Link	Available until:
Apparatus for the determination of the texture features and adsorption properties of solid materials - Pro-NanoEnviCz (UFCH19)	A device for determining the surface area, pore size distribution and pore volume by the physical gas sorption	learn more	27/03/2026
BET (TUL10)	Surface area and pore size analyzer. The analysis is based on physisorption of either nitrogen or argon on the surface of a sample.	learn more	27/03/2026
Nanoindentor (UFCH24) - new Pro-NanoEnviCz II	The Hysitron TI 980 nanoindenter provides rapid, multi-sample, and multi-technique automated testing capabilities for high-throughput characterization. It includes quantitative nanoscale-to-microscale indentation, nano-scratch, nano-wear, high-resolution in-situ scanning probe microscopy (SPM) imaging, dynamic nanoindentation, and high-speed mechanical property mapping; providing a comprehensive understanding of material behavior at the nanoscale. The equipment enables: 1. quantitative determination of localized mechanical properties such as elastic modulus, hardness, creep, stress relaxation, and fracture toughness for a wide variety of materials, 2. continuous measurement of elastic-plastic and viscoelastic properties as a function of indentation depth, frequency, and time, 3. to obtain comprehensive nanomechanical property maps and property distribution statistics in a record amount of time.	learn more	27/03/2026
Sensor characterization laboratory (UFCH 26)	The laboratory for characterization of sensors equipped by gas system, electrical parameter measurement unit, and optical excitation unit.	learn more	27/03/2026
Surface Area and Pore Size Analyzer (BET) (UACH5)	The Surface Area and Pore Size Analyzer, which uses the static dosing method.	learn more	27/03/2026

Surface Characterization System (UFCH32)	Combined ultra-high vacuum apparatus for complex study of thin films, interfaces and surface nanostructures (SPECSR) encompassing: - X-ray photoelectron spectroscopy (XPS) with microfocused (200 μm) monochromatic X-ray source (hυ=1486.6 eV) - ultraviolet photoelectron spectroscopy with excitation of electrons by monochromatized He I (21.2 eV) and He II (40.8 eV) radiation - hemispherical electron energy analyzer with two-dimensional electron and ion detector and sample manipulator allowing measurement of high resolution spectra from room temperature down to liquid Helium temperature at different polar and azimutal detection angles, band structure mapping by angle-resolved photoemission spectroscopy (ARPES) technique using scanning angle lens - low-energy electron diffraction (LEED) technique for the determination of the surface structure and accurate surface atomic positions of materials - ion gun for cleaning of surfaces - scanning probe microscopy (SPM) for investigations at atomic scale of a wide variety of materials	learn more	27/03/2026

XRD techniques

Instrument	Description	Link	Available until:
Multipurpose X-ray powder diffractometer PANalytical XPertPRO MPD (UACH14)	Multipurpose X-ray powder diffractometer PANalytical XPertPRO MPD equipped with Cu Kα or Co Kα X-ray tube allows analyzing powdered or solid samples and/or micro-samples in reflection or transmission mode. This diffractometer is equipped with programmable divergence slit, focusing mirror and fast linear PSD detector. It allows in-situ analyses at elevated temperatures up to 1200 °C.	learn more	27/03/2026
Multipurpose X-ray powder diffractometer (Co tube), Empyrean, series 3 (UACH17)	Non-destructive analysis, qualitative and quantitative phase analysis of crystalline solids, determination of amorphous content by indirect method using an internal standard addition are available. It enables studies of changes in materials connected with their applications, usage, functionality and caused by ageing, fatigue at operation conditions.	learn more	27/03/2026
WDRF spectrometer Rigaku Primus IV (UJEP 37)	Tube-above wavelength dispersive X-ray spectrometer for fast elemental analysis of powders, liquids and bulk materials in range F-U. This spectrometer is equipped with micro-mapping utility for analysis of defects and for mapping of chemical composition. It also enables thin layer analysis and analysis of defects.	learn more	27/03/2026
X-ray Powder Diffraction (UPOL7)	The instrument is used for identification of crystalline phases, quantitative phase analysis, determination of amorphous phase content, structural analysis of powder samples, determination of particle size, determination of Mean X-ray Coherence Length (MCL), determination of residual stress in (nano)material samples, monitoring and determination of structural/phase transformations in non-ambient conditions, and determination of temperature dependent dilatation.	learn more	27/03/2026
X-ray difractometer Panalytical X (UJEP5)	Universal XRD powder diffractometer, with Cu Kα x-ray tube. Measurements could be done in reflection and transmission mode. The device is equipped with smart detector, collimator, Göbbel mirror and Euler stage. Identification of unknown crystalline phase	learn more	27/03/2026

	and qualitative and quantitative phase analysis of polycrystalline materials are provided.		
X-ray powder diffractometer with optics for nanolayers and nanosurfaces Panalytical X Pert PRO (UJEP33)	X-ray diffractometer equipped with Co tube is usually used in Bragg-Brentano geometry with linear X´Celerator detector. The goniometer is vertical, the sample is placed horizontally. It is designed for measuring powder, bulk and thin layer polycrystal samples. X-ray diffractometer equipped with optics for structure analysis of polycrystalline thin films and nano-surfaces.	learn more	27/03/2026