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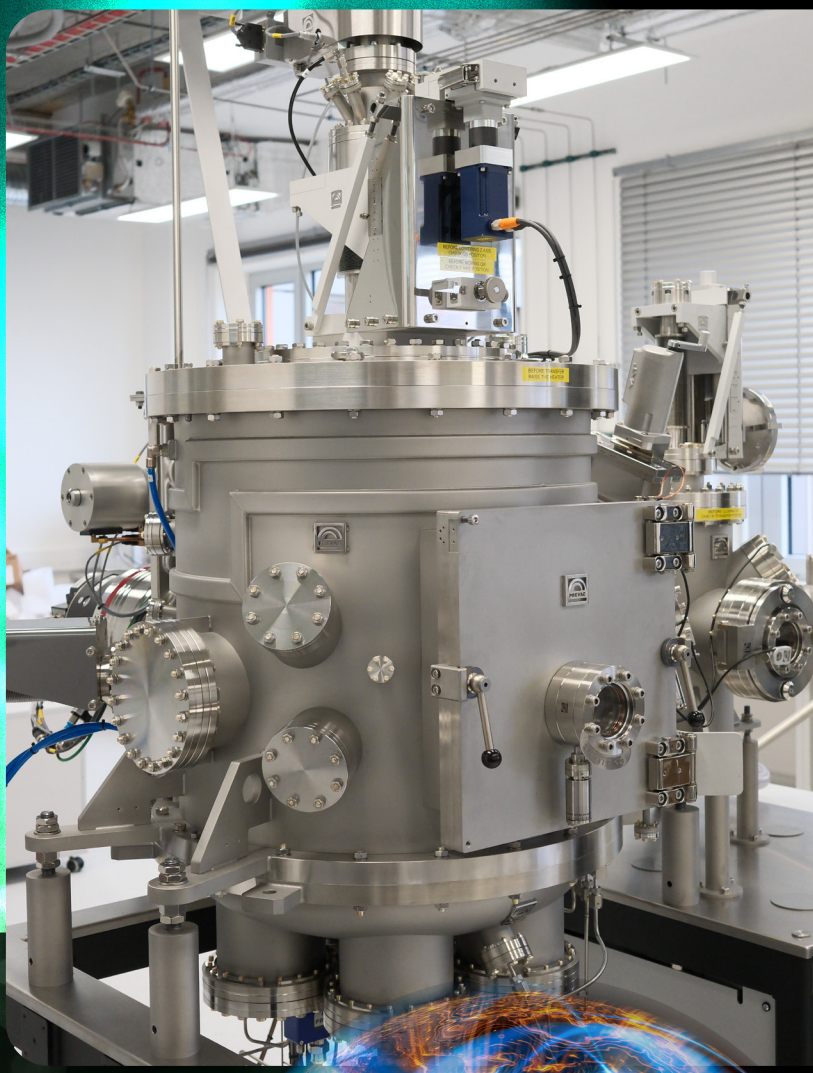
Magnetron Sputtering System

Magnetron sputtering is a versatile technique used for preparing high-quality thin films with controlled thickness, composition, and microstructure. It enables the deposition of metals, alloys, oxides, nitrides, and other functional coatings and is widely applied in materials science, surface engineering, microelectronics, and energy-related research.

The laboratory operates an ultra-high vacuum magnetron sputtering system designed for thin-film deposition on substrates up to 4 inches in diameter. The system supports DC, RF, pulsed DC, and high-power impulse magnetron sputtering (HiPIMS) modes, and allows for multi-source operation, enabling co-sputtering, reactive sputtering, and multilayer film fabrication. Motorized substrate manipulation with rotation and controlled heating ensures uniform film growth and high process reproducibility. Integrated gas dosing and in situ thickness monitoring enable precise control of deposition conditions.



Key Features

- **Ultra-high vacuum magnetron sputtering platform for high-purity thin-film deposition**
- **Multi-source configuration enabling co-sputtering and reactive sputtering processes**
- **DC, RF, pulsed DC, and HiPIMS operation for conductive and insulating materials**
- **Motorized substrate handling with rotation and controlled heating**
- **In situ monitoring of film thickness and deposition rate**
- **Computer-controlled operation with reproducible, recipe-based workflows**

Contact
Doc. Ing. Štěpán Kment, Ph.D
(stepan.kment@vsb.cz)

mel.vsb.cz

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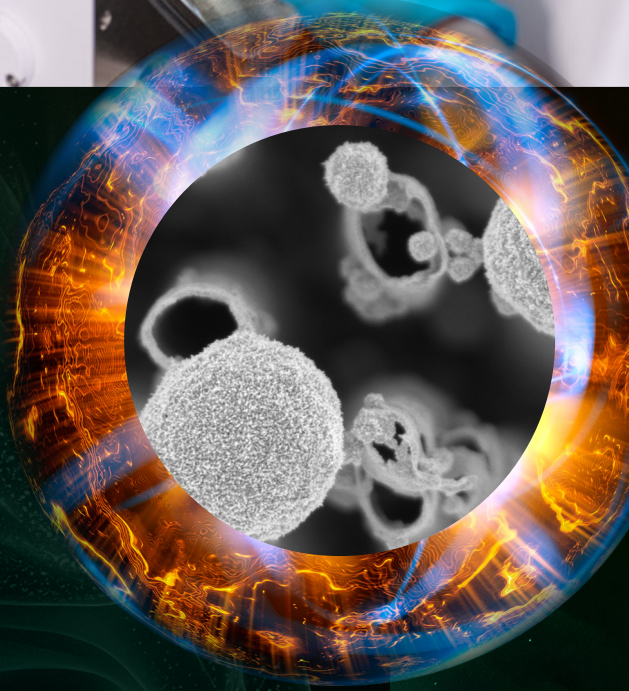
Thermo Fisher Scientific Verios 5 UC

The **Thermo Fisher Scientific Verios 5 UC** scanning electron microscope (SEM) is equipped with a Schottky field emission source and a monochromator (UC+), which enables electron energy dispersion of less than 0.2 eV and is specified to have a resolution of 0.6 nm. Sample analysis can be performed at a range of accelerating voltages from 200 V to 30 kV. The integrated in-column detection system enables simultaneous detection of topography and material contrast. Verios 5 UC allows simultaneous imaging in transmission mode using the STEM3+ detector. Chemical composition analysis can be performed using an EDX detector and Pathfinder software with optimized conditions for spectral resolution and quantitative evaluation.

Key Features

- **High-resolution imaging at low landing energies with the use of a monochromated beam**
- **Simultaneous topography (ETD, TLD) and Z-contrast (MD, ICD) imaging**
- **STEM imaging with the use of a segmentated STEM3+ detector**
- **Automated mapping of big areas with the use of MAPS SW**
- **EDS analysis with integrated ThermoFisher EDS detection system**
- **Correlation microscopy with XPS**



Contact
Dr. Jan Schäfer (jan.schafer@vsb.cz)

mel.vsb.cz

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X-ray Powder Diffraction

X-ray powder diffraction (XRD) is a fundamental, non-destructive technique for analyzing the structure of materials, enabling the precise identification and quantification of crystalline phases, determination of crystallite size and microstrain, analysis of thin films, nanostructures, and textural properties. The method supports a wide range of applications—from routine quality control to advanced research on functional materials, battery components, and thin-film systems.

Our laboratory is equipped with the Empyrean Series 3 diffractometer (Malvern Panalytical), a highly flexible, modular multi-geometry XRD platform. The system supports reflection and transmission geometries, grazing-incidence measurements, SAXS/VSAXS, and X-ray reflectivity. Thanks to its modular optical architecture, rapid component exchange, and fully motorized sample positioning, the instrument offers exceptional adaptability for both standard and highly specialized experiments.

Key Features

- **Multi-geometry XRD platform**
  Support for reflection, transmission, grazing-incidence, SAXS, and reflectivity modes for comprehensive structural characterization.
- **High-precision sample positioning**
  Motorized XYZ translation (10–10–10 mm) with rotation/tilt capabilities and micro-beam analysis down to <300 × 300 µm for localized studies.
- **Atmosphere-controlled measurements**
  Capability to operate in air, vacuum, nitrogen, and a broad range of reactive gases, including H_2, CH_4, CO_2, and other reducing or oxidizing atmospheres.
- **Operando capability for energy materials**
  Dedicated holders for coin-cell batteries and an electrochemical cell for structural monitoring during charge–discharge cycling.

Contact
Dr. S. M. Hossein Hejazi
(seyyedmohammadhossein.hejazi@vsb.cz)

mel.vsb.cz

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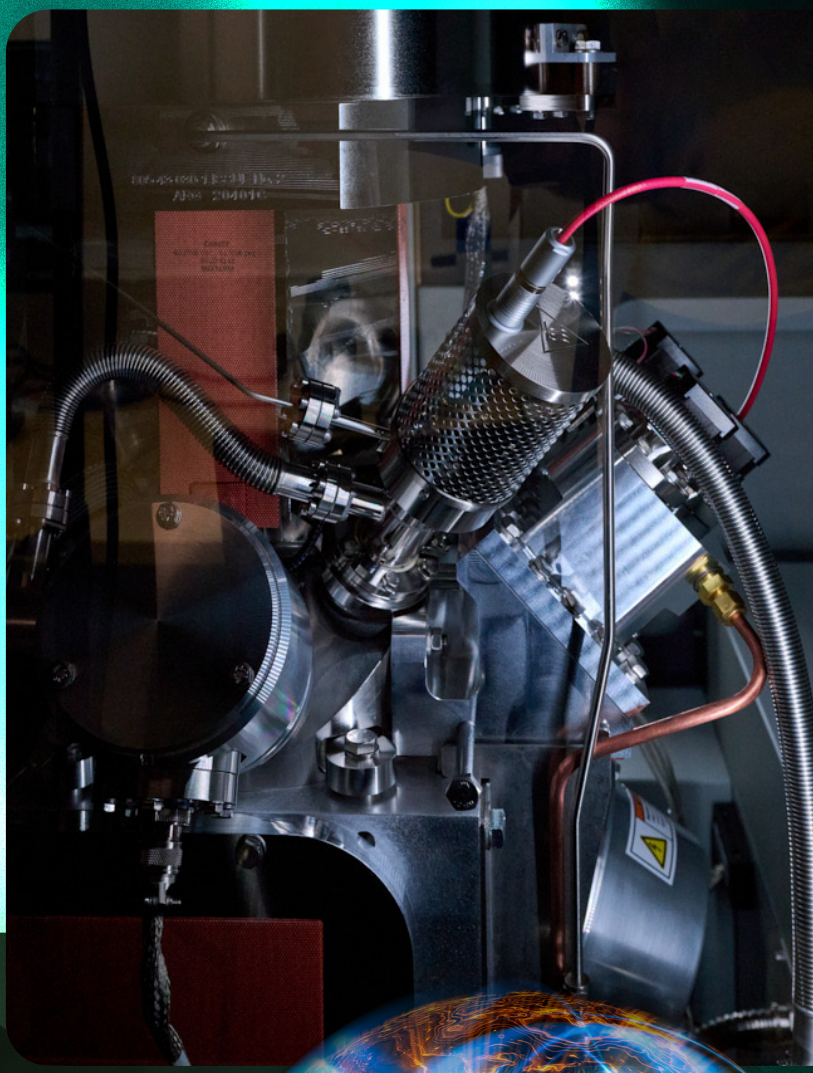
X-ray Photoelectron Spectroscopy



X-ray Photoelectron Spectroscopy (XPS) is a non-destructive analytical technique used to determine the elemental composition and chemical states of material surfaces. By probing only the topmost atomic layers, XPS provides highly surface-sensitive information, enabling the accurate quantification of surface chemistry and a detailed analysis of chemical bonding environments. This makes the technique indispensable for advanced materials research and surface characterization.

Our laboratory is equipped with a Thermo Scientific Nexsa G2 XPS system, featuring a monochromated, micro-focused Al Kα X-ray source (1486.6 eV). The instrument supports ion-beam etching for depth profiling and UPS measurements. It offers an adjustable X-ray spot size ranging from 10 to 400 µm, enabling the analysis of both small, localized features and larger heterogeneous areas. The system accommodates samples up to 20 mm in thickness.

Key Features

- **Automated multi-technique XPS platform**
  Fully automated system integrating vacuum control, acquisition, and data processing for streamlined surface analysis.
- **Monochromated micro-focused Al Kα source**
  High-stability X-ray source with adjustable spot size from 10 to 400 µm for precise analysis of small or heterogeneous areas.
- **High-resolution hemispherical analyzer**
  180° analyzer providing excellent energy resolution (<0.50 eV) for reliable chemical state identification.
- **Integrated ion source for depth profiling**
  Ion gun enabling controlled sputtering and depth-resolved chemical analysis.

Contact
Zdeněk Baďura, Ph.D.
(zdenek.badura@vsb.cz)

mel.vsb.cz

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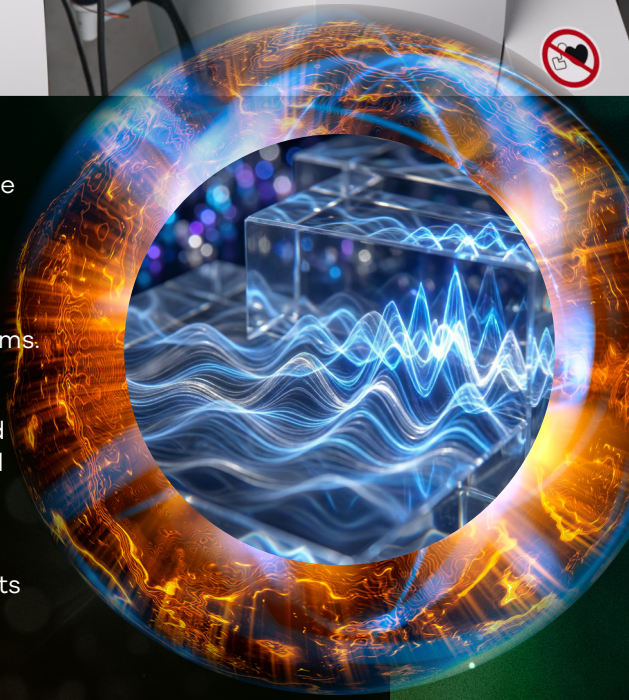
Bruker ELEXSYS E500 EPR Spectrometer

Electron paramagnetic resonance (EPR, also known as electron spin resonance, ESR) is a spectroscopic method for studying compounds—synthetic or biological—that contain unpaired electrons (radicals, metal centres, spin labels, defects, etc.). The unpaired electron spins can be excited in an applied magnetic field, producing resonance signals whose features (g-values, hyperfine splitting, line widths, relaxation behaviour) report on the local electronic environment, structure, dynamics, and interactions. Because EPR is non-invasive, it is also possible to perform in situ and even in vivo measurements (e.g. sensing O_2, NO, radicals in biological systems), as well as mechanistic monitoring of radical reactions or spin probes in chemical and biochemical systems

Key Features

- **High-sensitivity X-band CW EPR spectrometer**
  Operation in the X-band microwave region (9.0–9.9 GHz) provides highly sensitive continuous-wave EPR detection suitable for a wide range of solid and liquid samples.
- **Excellent absolute sensitivity**
  An absolute sensitivity of approximately 1×10^{15} spins / (1 G √Hz) enables reliable detection of dilute or weakly paramagnetic systems.
- **Flexible magnetic field modulation and sweep range**
  Adjustable field modulation frequency from 100 Hz to 100 kHz and magnetic field sweep up to 2.0 T (20,000 G) ensure precise control across diverse experimental regimes.
- **Variable-temperature operation**
  A variable-temperature unit using nitrogen gas allows experiments over a broad temperature range of approximately 90 K to 600 K, covering cryogenic to elevated-temperature conditions.



Contact
Zdeněk Baďura, Ph.D.
(zdenek.badura@vsb.cz)

mel.vsb.cz

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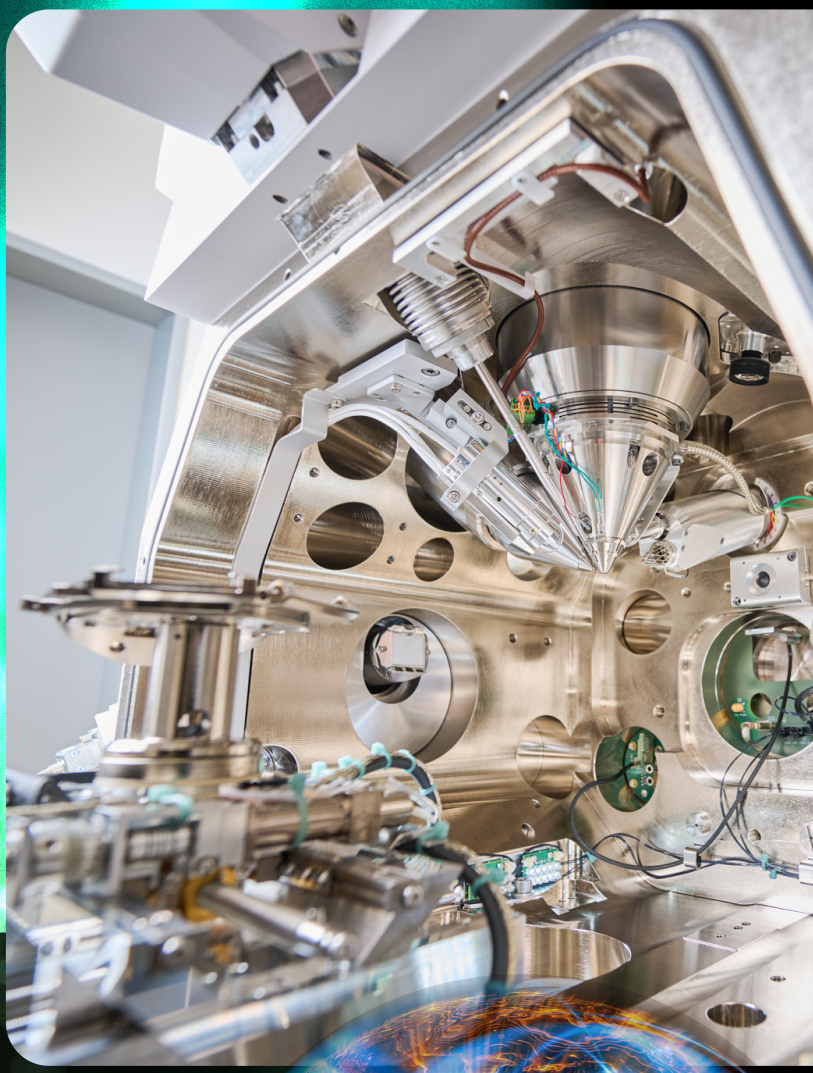
High Resolution FIB-SEM Helios 5 Dual Beam

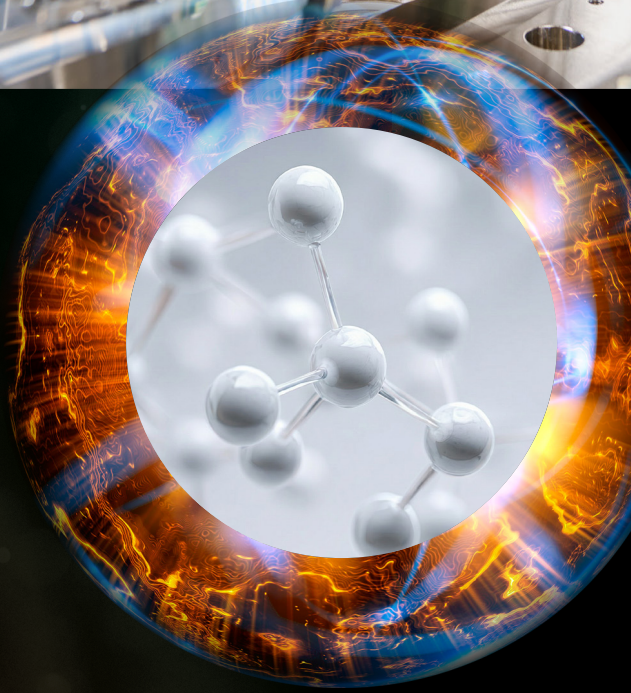
Thermo Fisher Scientific Helios 5 CX Dual Beam is a scanning electron microscope equipped with a Ga ion beam (FIB-SEM). The electron column allows imaging with a resolution of up to 0.6 nm. Sample imaging can be performed at a range of accelerating voltages from 200 V to 30 kV. An integrated in-column detection system allows simultaneous detection of topography and material contrast. Helios 5 CX enables simultaneous imaging in transmission mode using the STEM3+ detector.

Modification of samples with the use of a TomahawkTM ion column enables the high-precision preparation of lamellas for analysis in a transmission electron microscope and high-volume milling for the analysis of large areas. Chemical composition and crystallography analysis can be performed using a combination of EDS and EBSD detectors, along with Aztec software, under optimized conditions for spectral resolution and quantitative evaluation.



Key Features

- **High resolution imaging at low landing energies**
- **Simultaneous topography (ETD, TLD) and Z-contrast (MD, ICD) imaging**
- **STEM imaging with the use of a segmentated STEM3+ detector**
- **Automated mapping with the use of MAPS SW**
- **Semi-automated lamella preparation with the use of AutoTEM SW**
- **Automated 3D analysis with the use of Auto Slice & View SW**
- **Versatile Ion processing of materials with the use of Tomahawk™ HT Ga ion column**
- **Simultaneous EDS and EBSD analysis with integrated detectors from Oxford Instruments**



Contact
Dr. Jan Schäfer (jan.schafer@vsb.cz)

mel.vsb.cz

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BD FACSLyric™ Flow Cytometer

The BD FACSLyric™ is a compact, flexible and high-throughput flow cytometer equipped with up to three lasers (blue, red, violet) and capable of analysing up to 12 fluorescence channels (and 14 parameters). It is designed for both research and clinical applications (depending on configuration), offering automation options (tube & plate loading), standardized workflows and strong performance for rare / dim population detection.

Key Features

Configuration	3 lasers (blue, red, violet) – 12 fluorescence colors / 14 parameters total (A/W/H for all channels + Time)
Lasers (solid-state)	405 nm 40 mW • 488 nm 20 mW • 640 nm 40 mW
Detectors	FSC: photodiode; SSC & fluorescence: PMTs
Max acquisition rate	Up to 35,000 events/s
Sensitivity (typ.)	FITC < 85 MESF; PE < 20 MESF; fluorescence precision < 3% CV (CEN)
Fluidics – sample flow rates	Low 12 µL/min • Medium 60 µL/min • High 120 µL/min • High-sensitivity 50 µL/min

Contact
Dr. Tomáš Malina
(tomas.malina@vsb.cz)

mel.vsb.cz

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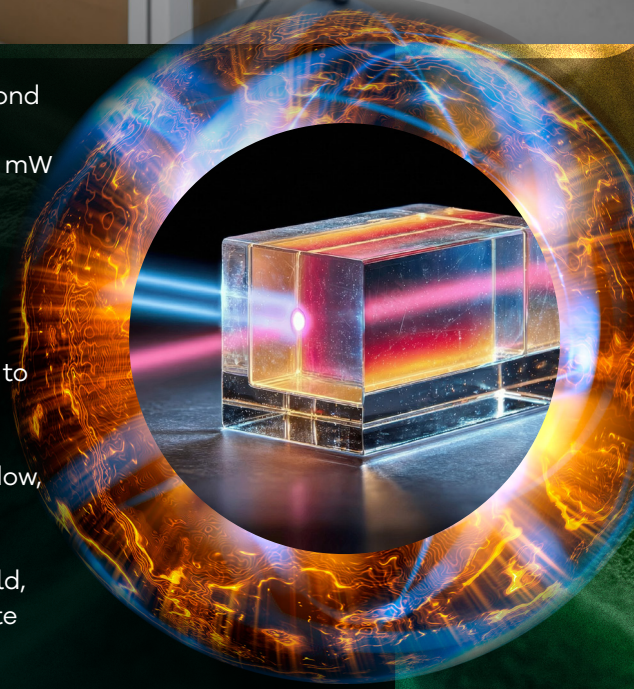
FLS1000 Research Fluorimeter

The Edinburgh Instruments FLS1000 Research Fluorimeter is a state-of-the-art modular spectrometer for steady-state and time-resolved photoluminescence (PL) measurements. It enables comprehensive characterization of emissive materials across a broad spectral range (230–1000 nm), supporting both liquid and solid samples under variable temperature conditions (77–300 K).

The system is fully computer-controlled via Fluoracle software, providing automated spectral correction, lifetime analysis, and quantum yield determination. The FLS1000 is ideal for investigating photophysical processes in nanomaterials, photocatalysts, and hybrid systems.

Key Features

Light sources	450 W xenon lamp (230–1000 nm), microsecond xenon flashlamp (0.1–100 Hz) 405 nm 40 mW • 488 nm 20 mW • 640 nm 40 mW
Excitation/ Emission Monochromators	Double Czerny-Turner configuration, f/4, 325 mm focal length, stray light suppression $>10^{10}$, 0.01 nm step size
Detection	Extended red PMT (200–980 nm), TE-cooled to –20 °C, dark count <100 cps
TCSPC electronics	Temporal resolution <25 ps, 2.5 ns–50 µs window, up to 8192 bins
Accessories	Integrating sphere for absolute quantum yield, LN_2 cryostat (77–300 K), thermostated cuvette holder, solid/powder holder



Contact
Dr. Lukáš Zdražil
(lukas.zdrazil@vsb.cz)

mel.vsb.cz

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LC-QToF System with Agilent Infinity II HPLC

The Agilent LC-QTOF 6530 is a high-resolution mass spectrometry system coupled with a high-performance liquid chromatography (HPLC) platform. This system is designed for the accurate identification of complex mixtures in various applications, including pharmaceuticals, environmental testing, and biomolecular analysis. It offers high sensitivity, fast data acquisition, and precise mass measurements, making it suitable for both qualitative and semi-quantitative analyses.

Key Features

HPLC System Model: Agilent 1290 Infinity II

- Flow Rate: 0.01–5.0 mL/min
- Maximum Pressure: up to 1200 bar
- Column Compartment Temperature Range: 4–110 °C
- Autosampler Temperature Range: 4–40 °C
- Solvent Compatibility: compatible with common organic solvents and aqueous

Mass Spectrometer Model: Agilent 6530 QTOF

- Ionization: Electrospray Ionization (ESI)
- Mass Range: 10–5000 m/z
- Mass Resolution: ~ 40,000 FWHM at m/z 922
- Mass Accuracy: <5 ppm with internal calibration
- Data Acquisition Modes: Full scan and MS/MS
- Scan Speed: up to 2 spectra/s Full scan, up to 5 spectra/s MS/MS

Typical Data Generated:

- High-resolution spectra suitable for identification of compounds in complex mixtures

Contact
Mgr. Petr Langer (petr.langer@vsb.cz)

mel.vsb.cz

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GC-QToF with GC and autosampler

The Agilent GC-QToF system is a high-resolution gas chromatography system coupled with quadrupole time-of-flight mass spectrometry, designed for the precise analysis of volatile and semi-volatile compounds. It offers superior mass accuracy, sensitivity, and resolution, making it ideal for advanced applications in environmental analysis, forensics, food safety, and chemical research. The system enables accurate identification and quantification of complex compound mixtures with high confidence.

Key Features

Gas Chromatograph (GC 8590)

- Temperature range: up to 450°C
- Fast oven ramping for quick analysis
- Equipped with high-performance HP-5ms column (non-polar, low bleed, 15 m × 0.250 mm internal diameter × 0.25 µm film thickness, max working temperature: 325 °C)

Mass Spectrometer (GC-QToF 7280) Ionization: EI (Electron Ionization)

- Mass Range: 10–1050 m/z
- Sensitivity: <2 ppm with internal reference
- Data Acquisition Mode: Full scan, MS/MS

Typical Data Generated

- Total Ion Chromatograms (TIC)
- Extracted Ion Chromatograms (EIC)
- High-resolution mass spectra with accurate mass measurements
- MS/MS fragmentation spectra for structure elucidation.

Contact
Mgr. Petr Langer (petr.langer@vsb.cz)

mel.vsb.cz