

Center of Excellence for Advanced Material Research and Technologies, Latvia

**Research activities:**

- studies of electronic and ionic processes in wide-gap materials with different degree of structural ordering;
- development of new inorganic materials (single crystals, glasses, ceramics, thin films) for optics and electronics;
- vision research, development of new technologies for psycho-physical testing and primary vision care;
- design and manufacturing of scientific instruments and instruments for analytical tasks and environmental monitoring.

The interdisciplinary nature of research at the ISSP is reflected by its highly qualified staff. At present there are 180 employees working at the Institute, 28 of 87 members of the research staff hold Dr. habil. degrees, 45 hold Dr. or PhD. At the end of 2005 there were 10 PhD students and 46 undergraduate and graduate students in physics and optometry programmes working at the ISSP. Educational activities of the Institute were continued and extended in 2005.

Some of the new scientific equipments available were purchased by EU Structural fund. Two of them are described below.

**The Scanning Electron Microscope** is of Carl Zeiss brand, model. Main characteristics:

- Possibility to inspect samples in both: Low and High vacuum modes; (possibility to inspect insulating and gassing samples), with easy vacuum mode changeover, LV mode pressure range 1-750 Pa and HV mode pressure better than  $10^{-4}$  Pa; and with LaB6 better than  $10^{-7}$  Pa
- Resolution of 3 nm (in LV mode 4.5 nm) for W filament, and 2 nm for LaB6 filament, compatibility to both filament types
- Magnification from 5x – 1.000.000x
- Additional detectors: infrared camera, probe current and specimen current detector (SCM)



"Scanning Electron Microscope (SEM) with energy dispersive detector for X-rays (EDX) and with an option of Electron Beam Lithography (EBL).

- Specimen stage: motorized in 5 axis (X – 100 mm, Y – 125 mm, Z – 61 mm (35 motorized), tilt 90° rotation 360° continuous compucentric), computer controlled, positioning precision of 1.5-2 micrometer and good stability (gives possibility for long EBL exposures without substantial change in the sample position)

**The EDX** is of Oxford instruments brand, model INCA 350. Main characteristics:

- 10mm<sup>2</sup> area, INCA SATW Window (for detection of elements from Be upwards.);
- Detector resolution guaranteed at 2,500cps provides reliable and accurate results over entire spectral range at typical microscope operating conditions: At C: 66eV or better At F: 70eV or better At Mn: 133eV or better;
- Guaranteed peak resolution change by <1eV at Mn K $\alpha$  between 1,000 and 10,000cps ensures accuracy of results and speed of analysis whilst delivering greater user productivity and quality of information.
- Sensitivity of 1 Wt% for light elements and 0.1% for heavier elements;
- A micrometer resolution.

**The EBL** is of Raith brand, model ELPHY Quantum. Main characteristics:

- Good quality pattern generator: 2.5 MHz writing speed with < 2 ns dwelltime
- high speed image acquisition & mark registration (400 ns Video ADC)
- Should give possibility to obtain structures below 50 nm.

**Application example:** Simultaneous / Multifunctional Analysis and nanostructures formation:

- SEM imaging (different modes);
  - Local composition Measurements with EDX;
  - Creation of nano-structures using EBL;
- The system is proving indispensable to researchers in material analysis (semiconductors, insulators, metals), life sciences, healthcare, nanoscience.

**Responsible:**

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**"Nanofinder S" 3D Scanning Confocal Microscope with Spectrometer**

**Technical details:** The "Nanofinder S" is a versatile system to carry out multifunctional analysis of micro-structures in 3 dimensions. It combines excellently the advanced features of conventional high-resolution optical microscopy and laser scanning confocal spectroscopy. The heart of the system is a confocal microscope coupled to a spectroscopy system enabling 3D-imaging with a spatial resolution of 200 nm.

- High spatial resolution: 200 nm (X-Y axes); 500 nm (Z-axis);
- Quick analysis in imaging mode: 4  $\mu$ s per point;
- Raman shift measurements from low wavelengths: 300  $\text{cm}^{-1}$  (441.6 nm);
- Modular, upgradable;
- High thermal and mechanical stability;
- Polarization measurements;
- Fully automated;
- High spectral resolution: 0.008 nm (Echelle grating, 500 nm wavelength); 0.025 nm (1200 l/mm grating);
- High-efficiency imaging spectrograph;
- Multiple laser input;
- Excitation laser wavelengths: 350 nm to 850 nm;
- Low power excitation ( $\mu$ W to mW): non-destructive analysis;
- Optimized optics for your applications in VIS: 450 - 900 nm.

**Application example:** Simultaneous / Multifunctional Analysis: • Raman Measurements; • Luminescence Measurements; • Laser Reflection & Transmission Measurements;

The "Nanofinder S" is proving indispensable to researchers in nanoscience, semiconductors, carbon nanotubes, liquid crystals, polymers, optical wave guides.

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