Laboratory of applied microscopy

The department is equipped with stereo SZX7 Olympus, Zeiss STEMI 2000C, polarizing microscope Zeiss Axio Scope A1 POL, and atomic force microscope Agilent 5420 AFM / SPMv in combination with a vector network analyzer N5230A PNA. It represents a high-precision modular system allowing to examine in detail the surface structure of materials with atomic resolution on the basis of mutual force interaction gauge tip and the studied material.

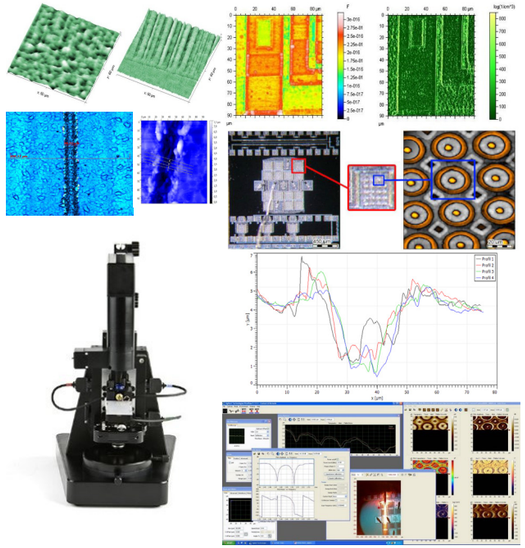
The microscope allows measurements in the following modes: contact AFM, tapping AFM (AAC, MAC), electric force microscopy (EFM), force modulation microscopy (FMM), Kelvin force microscopy (KFM), lateral force microscopy (LFM), magnetic force microscopy (MFM), scanning microwave microscopy (SMM), scanning tunneling microscopy (STM).

Application possibilities of microscopy mainly include research and materials characterization:

- material properties of surfaces - adhesion, elasticity, friction;
- electrical properties - complex impedance, calibrated capacitance, calibrated dopant density measurements (with no need for the oxide layer);
- semiconductors;
- polymers;
- nanolithography.

Parameters:

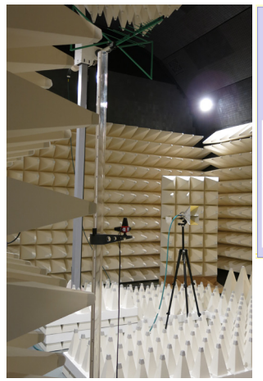
- atomic resolution;
- sample size up to 70 x 70 mm;
- temperature control up to 250 ° C.

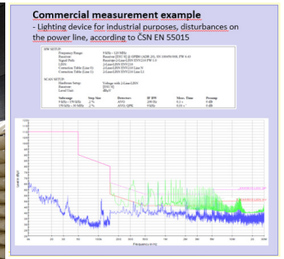


Laboratory of electromagnetic compatibility

The workplace is able to perform measurements according to the following standards (and many others):

- ČSN EN 61000-3-2 Electromagnetic compatibility – limits of harmonic currents for appliances with supply current lower than 16 A;
- ČSN EN 61000-3-3 Electromagnetic compatibility – voltage flicker and fluctuations in power lines for appliances with supply current lower than 16 A;
- ČSN EN 55011 Limits and methods of electromagnetic disturbance measurements for industrial, science and medical high frequency appliances;
- ČSN EN 55013 Limits and methods of measurement of electromagnetic disturbances emitted by radio and TV receivers and associated devices;
- ČSN EN 55014 Limits and methods of measurement of electromagnetic disturbances emitted by devices with electric propulsion, heating household devices, electric tools and similar electric appliances;
- ČSN EN 55015 Limits and methods of measurement of electromagnetic disturbances emitted by lighting equipment and similar devices;
- ČSN EN 55022 Limits and methods of measurement of electromagnetic disturbances emitted by IT devices;
- ČSN CISPR 23 Limits for industrial, science and medical devices;
- ČSN EN 61000-4-1 List of electromagnetic susceptibility tests;
- ČSN EN 61000-4-2 Electrostatic discharge immunity test;
- ČSN EN 61000-4-3 High frequency electromagnetic field immunity test;
- ČSN EN 61000-4-4 Fast transients and pulses immunity test;
- ČSN EN 61000-4-6 Disturbances induced into electrical lines – immunity test;
- ČSN EN 61000-4-14 Voltage flickering immunity test.





Tomas Bata University in Zlín
Faculty of Applied Informatics

CEBIA-Tech
Centre for Security, Information and Advanced Technologies

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Faculty of Applied Informatics
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760 05 Zlín
Czech Republic

GPS: 49°13'50.991"N, 17°39'26.257"E

RESEARCH PROGRAMME 2: „SECURITY RESEARCH“

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We are looking forward to future cooperation!

www.cebia.utb.cz

Tomas Bata University in Zlín
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EUROPEAN UNION
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2007-13
OP Research and Development for Innovation

R&D orientation

Regional research centre for security, information and advanced technologies (RRC CEBIA-Tech) was established under the OP Research and Development for Innovation. It represents a dynamic opportunity for further development of R&D in the Zlín region in the field of applied informatics, security technologies and alternative energy sources. RRC CEBIA-Tech is part of the Faculty of Applied Informatics, Tomas Bata University in Zlín. One of the primary goals was to build a top-ranking workplace with quality instrumentation and laboratory equipment. Scientific and research activities of the Centre are focused on the following areas:

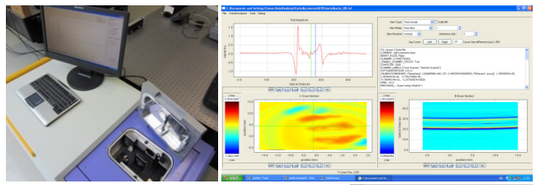
- grid computing and application of artificial intelligence;
- intelligent production systems;
- intelligent buildings;
- embedded systems;
- **development of small mobile data and telecommunication networks for emergency units;**
- **development of systems for the detection and analysis of hazardous substances using THz frequencies;**
- **development of techniques for the protection of electronic systems against interference by external and internal electromagnetic fields (EMC);**
- alternative energy sources.

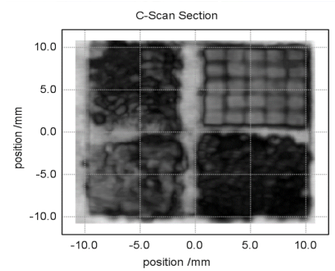
The information contained in the leaflet refers the research programme “Security Research”. In this area, we specialize in:

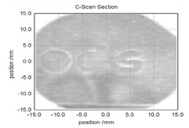
- **Applied optics in forensic sciences;**
- **Electromagnetic compatibility of the security systems.**

For more details, please visit:

www.utb.cz/fai-en/structure/regional-research-centre-cebia-tech





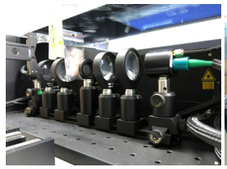


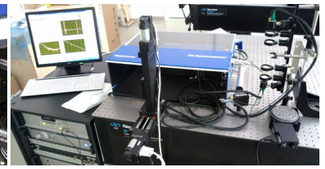
Laboratory of the terahertz optics

The workplace has two terahertz spectrometers: Tera OSCAT from German manufacturer MenloSystems, GmbH, and TPS Spectra 3000 from the TeraView, Ltd. (UK). Top-class equipment of the laboratory enables terahertz spectroscopy of the studied substances in time period and displaying 2D scans of the measured objects. The analysis is focused mainly on the evaluation of two basic parameters - refractive index and absorption coefficient in the terahertz region of the electromagnetic spectrum. The device is mainly used for scientific research; so far, measurements of optical parameters have been carried out for various polymer materials, samples of gunpowder, edible oils and a freeze-dried meat, and also studies on recrystallization kinetics of polybutenes, crosslinking reaction of adhesives and analysis of the atomic layer of tungsten on a slide. The systems are also used for experiments in the context of students‘ theses; examples could be studies on artworks (paintings) in the terahertz region of the spectrum and evaluation of their authenticity, 2D imaging of gunpowder samples, imaging of the layer of pharmaceuticals, or text hidden in the envelope. The laboratory is focused primarily on security and forensic applications, but on the basis of demand and pilot experiments with biological material (eg. samples of meat) it is under consideration to extend the current research also to biomedical and biotechnological direction.

Tera OSCAT:

- two measuring modes: step scan and rapid scan;
- frequency range: > 3 THz in step scan, > 1 THz in rapid scan;
- rapid scanning speed: > 200/s;
- spectral resolution: < 5 GHz;
- SNR: > 60 dB;
- 2D scanning based on the passage of the radiation through the sample (transmission geometry);
- the system is not closed and allows variable adjustment of the lenses for measurements of e.g. bulky objects.





TPS Spectra 3000:

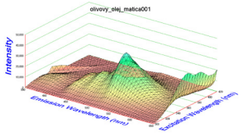
- one measuring mode: rapid scan;
- frequency range: 0.06–3 THz;
- rapid scanning rate: 30/s;
- spectral resolution: 32 GHz;
- SNR: > 150 dB;
- 2D scanning based on the reflective geometry;
- creation of a nitrogen atmosphere or vacuum (higher precision).

Laboratory of luminescence microscopy

For measuring of the luminescent properties of materials the workplace is equipped with **Spectrofluorometer ISS® pc1 ™**. This ultra-sensitive spectrofluorometric device allows measurements of adjusted excitation and fluorescence emission spectra in the steady state. The device has been used e.g. for the measuring the emission spectra of edible oils and mixtures thereof, determination of riboflavin content and monitoring of thermal degradation of oils; moreover, luminescence of banknotes and postage stamps has been also studied.

Spectrofluorimeter ISS® pc1™:

- light source: xenon high-pressure lamp (300 W), range 250-1000 nm (UV / VIS / IR);
- detected by a photomultiplier;
- sensitivity: SNR> 2000: 1 at room temperature, up to 6000: 1 while cooling by PMT;
- dynamic range: linear up to 4 million counts per second;
- automated control.



Laboratory of Raman spectroscopy

Raman spectroscopy is a modern analytical method providing specific information on the molecular level. In recent years, it is an increasingly sought-after method for quick identification of materials and evaluation of structural changes, and is becoming part of the equipment of leading research laboratories.

Raman spectroscopy is non-destructive, non-invasive and fast method that allows measuring of all states and forms (crystals, fibers, solutions, etc.) even through conventional packaging materials. The method provides specific chemical characteristics. Raman microscopy brings the advantages of optical microscopy, measuring of samples of µm sizes and trace amounts of substances. Measurement options: Raman spectrum, mapping, depth scanning and time series.

Application possibilities of Raman microscopy include security, material and technical disciplines:

- evaluation of the authenticity of Czech banknotes and works of art, identification of inks, explosives, etc.;
- determination of methanol content in alcoholic beverages;
- identification of polymer materials and their properties after radiation crosslinking, quasi-real-time monitoring of the cross-linking reaction kinetics in epoxy resins, etc.;
- analysis and identification of edible oils, meat, vitamins;
- identification of drugs through blisters;
- identification of minerals and precious stones;
- identification of unknown substances.

The **inVia Basis** Raman microscope from the Renishaw company is equipped with two lasers (VIS Ar^+ 514 nm and NIR diode 785 nm), inbuilt confocal microscope Leica with lenses with of up to 50x magnification and motorized table for precise manipulation with the samples. The spectral range of the instrument is 100–3200 cm^{-1}, spectral resolution is 1 µm.