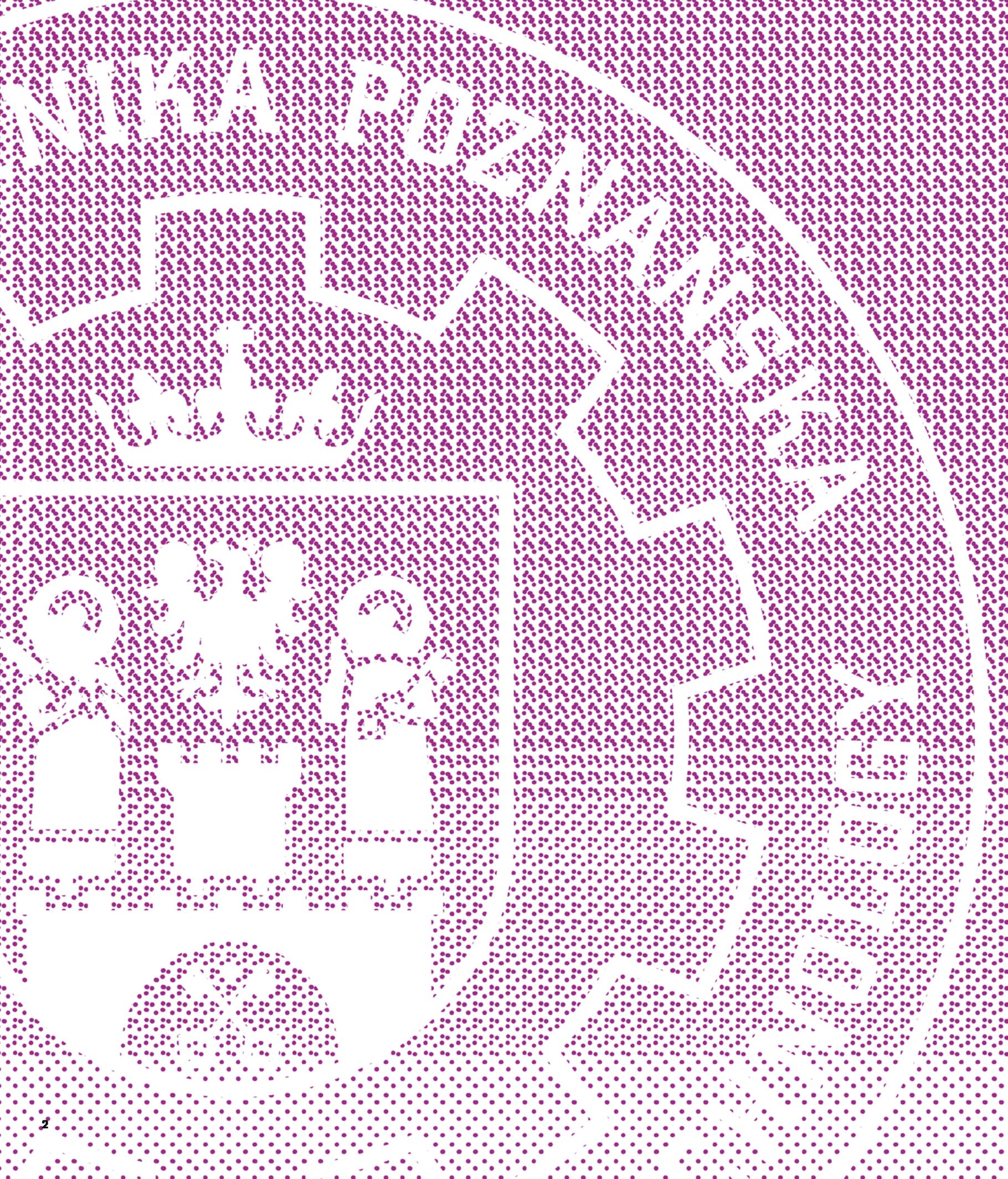


## FACULTY OF TECHNICAL PHYSICS

Information on the selected test equipment  
at the Faculty of Technical Physics, Poznan University of Technology





The Faculty of Technical Physics (WFT) is one of the youngest faculties at Poznan University of Technology, possessing full academic rights since 2008. Two fields of study – Technical Physics and Education in Technology and Informatics - offer students the university curriculum within the scope of functional materials and nanotechnology, making use of computer simulations and ability to build research apparatus.

The faculty is particularly interested in establishing cooperation with developing businesses which apply the latest technologies, mainly in the field of biotechnology, nanotechnology or optoelectronics. Thanks to highly-qualified teaching and research staff as well as unique, specialist research equipment and actively-maintained contacts with leading national and international scientific and research centers, we are able to meet challenges posed. Please note our offer of research apparatus and our invitation of cooperation that we extend to all businesses which wish to control matter at the level of particles, thus giving their products a competitive edge

**Professor Ryszard Czajka, DSc PhD**

Dean of the Faculty of Technical Physics



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# Zeiss LSM 710 laser scanning confocal microscope

## TECHNICAL SPECIFICATIONS:

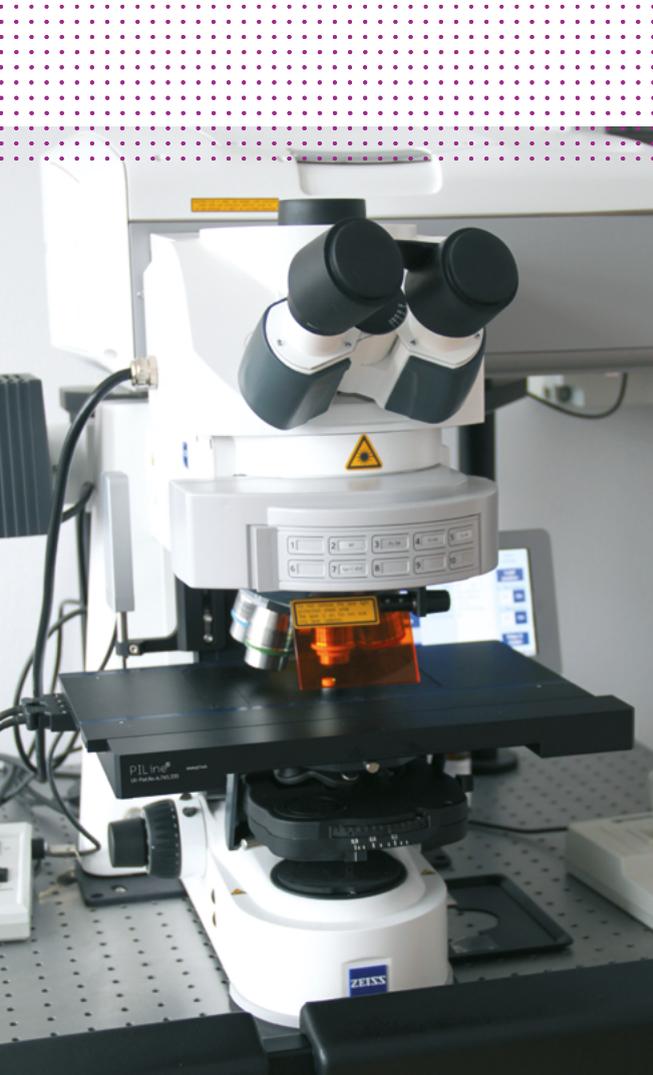
- excitation beams: laser Ar 458, 488 and 514 nm, laser He-Ne 543 nm, laser He-Ne 633 nm, HXP and halogen lamps
- detection in the wavelength range 400-800 nm, possible spectral detection in the wavelength range 200-1100 nm using external spectrometer (BlackComet StellarNet or QE65000 OceanOptics)
- automatic table - range of motion 130x85 mm, 9 kg maximum load of the table, positioning accuracy in the Z axis - 10 nm
- lenses for observation in the bright and the dark field and in Nomarski contrast C-DIC (circularly polarized light):
  - EC Epiplan-Neofluar 5 x/0.13 HD DIC, working distance 14.5 mm
  - EC Epiplan-Neofluar 10 x/0.25 HD DIC, working distance 9.0 mm
  - EC Epiplan-Neofluar 20 x/0.50 HD DIC, working distance 2.2 mm
  - EC Epiplan-Neofluar 50 x/0.80 HD DIC, working distance 0.6 mm
  - EC Epiplan-Neofluar 100 x/0.90 HD DIC, working distance 0.28 mm
  - EC Plan-Neofluar 40 x/1.30 Oil DIC, working distance 0.21 mm
- microscope equipped with an interferometer for thickness measurement

## APPLICATION:

- surface imaging of surface morphology and topography measurement
- measurement of fluorescence, map of fluorescence

## KEYWORDS

- confocal microscope
- thickness measurements
- 2D and 3D imaging
- fluorescence microscope



**TECHNICAL SPECIFICATIONS:****Cary 4000 Varian Spectrophotometer**

- absorption and transmission measurements, two light sources
  - deuterium lamp for the UV range, and halogen lamp for Vis; spectral range 200-900 nm, absorbance range 0.001 to 10; additional equipment: temperature controller, Ulbricht sphere to measure the scattering of light

**QE65000 Ocean Optics Spectrometer**

- absorption and transmission measurements of light 200-950 nm

**Black-Comet BLK-CXR-SR Spectrometer**

- deuterium and halogen light sources
- absorption and transmission measurements of light, spectral range 215-1100 nm

**FT/IR Spectrometer**

- measurements in the mid and near infrared range, wavenumbers range 15000-350  $\text{cm}^{-1}$
- single beam
- measuring chamber (200x260x185  $\text{m}^3$ )

**APPLICATION:**

- transmission, scattering and absorption measurements in the UV-Vis and IR ranges of liquids and solids
- characterization and analysis of highly scattering materials i.e. powders, metals, amorphous compounds (glass), gels, organic systems (bacteria, algae, tissue, proteins), lubricants

# Absorption spectroscopy setup

**KEYWORDS**

- absorbance
- reflectance
- transmittance
- absorption coefficient

# Emission spectroscopy setup

## TECHNICAL SPECIFICATIONS:

- light source – xenon lamp, spectral range 200-900 nm
- excitation range: 280-670 nm
- type of excitation: LEDs
- three excitation wavelengths available 280, 405 and 633 nm
- detection: strobe technique
- photomultiplier with spectral range from 185 to 900 nm
- range of lifetime measurements: 100 ps-3  $\mu$ s
- sensitivity of the setup: concentration up to  $4 \cdot 10^{-10}$  M of fluorescein
- analysis of multi-exponential decay



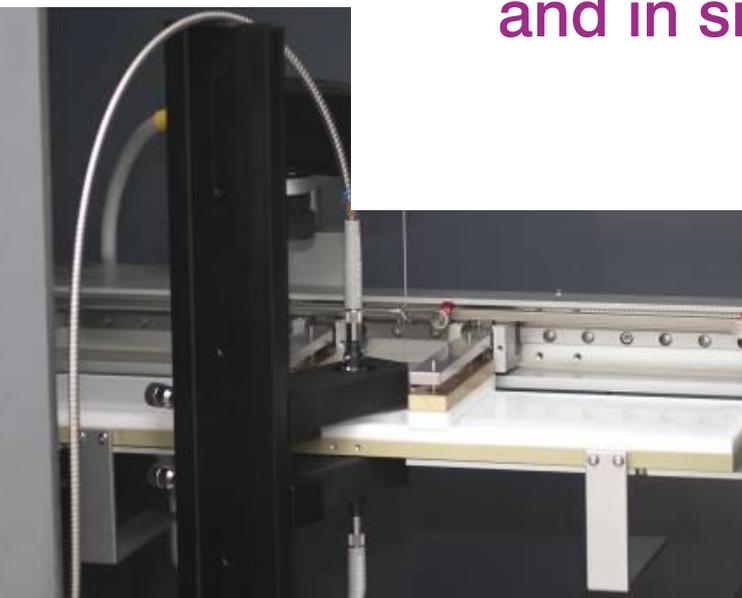
## KEYWORDS

- fluorescence
- luminescence
- decay time
- decay times

## APPLICATION:

- fluorescence and phosphorescence measurements (also at low temperature studies)
- luminescence life time measurements

# Setups for Langmuir, Langmuir-Blodgett, Langmuir-Shaefer layer preparation and in situ absorption measurements of Langmuir layers

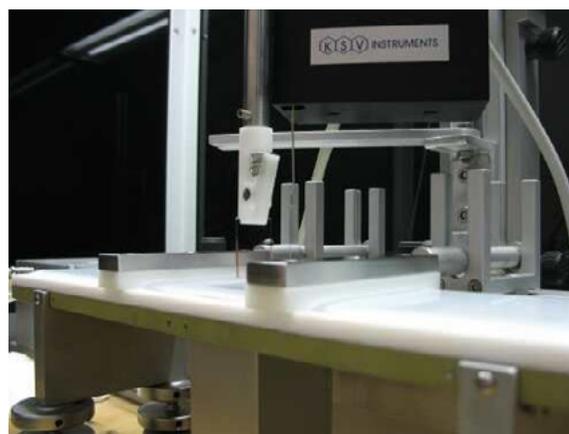


## TECHNICAL SPECIFICATIONS:

- additional device for surface potential measurement (method based on the oscillating capacitor)
- spectrometer (QE65000) spectral range 200-950 nm

## APPLICATION:

- setup for Langmuir molecular layer preparation (at air-water interface) and Langmuir-Blodgett, Langmuir-Shaefer (transferred on solid substrate)
- setup for Langmuir monolayer absorption spectra measurements based on QE65000 Ocean Optics spectrometer and DH200 BAL Mikropack UV-Vis light source (monolayer is illuminated and absorption signal is collected using optical fibers)



## KEYWORDS

- molecular layers
- in situ absorption

# Setup for photovoltaic cell testing

## APPLICATION:

- photovoltaic devices testing compatible with the IEC, ASTM, JIS standards



## TECHNICAL SPECIFICATIONS:

ABET Technologies Sun 3000 solar simulator:

- Xe Arc lamp - 550 W
- AM 1.5 filter
- testing area – 55 mm x 55 mm in AAA class and 100mm x 100 mm in ACA class
- KEITHLEY 2440 SourceMeter
- maximum current source/measure range 1A with resolution 10 pA
- direct measurement of  $V_{oc}$ ,  $I_{sc}$ ,  $V_{mpp}$ ,  $I_{mpp}$ , FF and  $E_{ta}$  parameters

## KEYWORDS

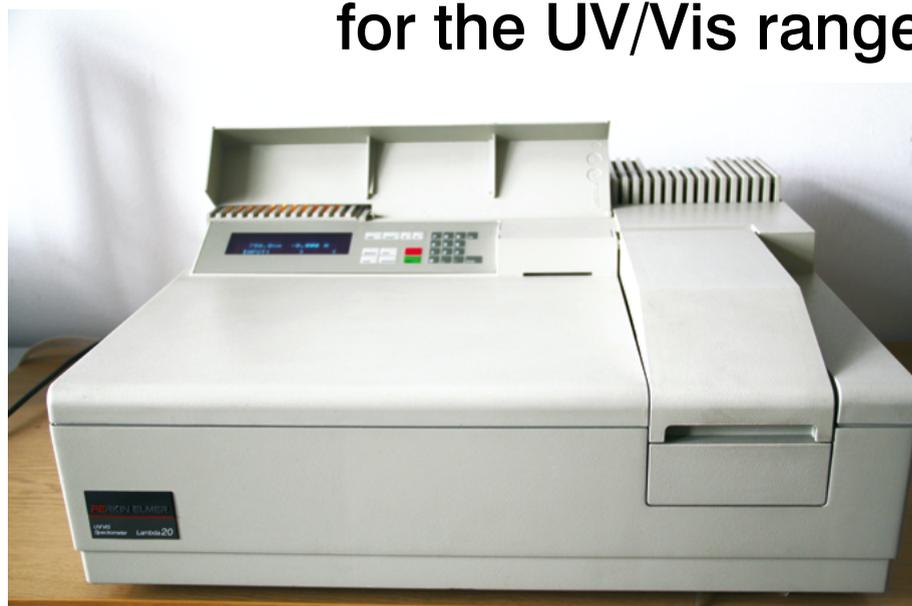
- solar simulator
- photovoltaic cell
- I(V) characteristic

# PerkinElmer LAMBDA

## 20 spectrometer for the UV/Vis range

### APPLICATION:

- double-beam spectrometric scanning
- polarized and unpolarized absorption spectra
- time drive method
- differential analysis or absorption ratio detection for different wavelength
- concentration analysis
- absorption spectra scanning of powder samples



### TECHNICAL SPECIFICATIONS:

- wavelength range: 190 nm to 1100 nm
- photometric range: transmission 0% to 100%; absorbance  $\pm 6,000$
- spectral bandwidth: 1 nm or 2 nm (fixed slit)
- scan speeds: 7.5; 15; 30; 60; 120; 240; 480; 960; 1920 and 2880 nm/min

#### Adapters for spectrometer:

- attachment PTP-1 - temperature range: 273-373 K
- integrating sphere for light scattered sample measurement

### KEYWORDS

- absorption spectra
- kinetics for photochemical reactions
- temperature absorption spectra
- absorption spectra of powder samples
- polarized absorption spectra

# PerkinElmer LS 55

## luminescence spectrometer

### APPLICATION:

Capability to measure:

- fluorescence
- phosphorescence
- chemiluminescence and bioluminescence in natural and polarized light

### KEYWORDS

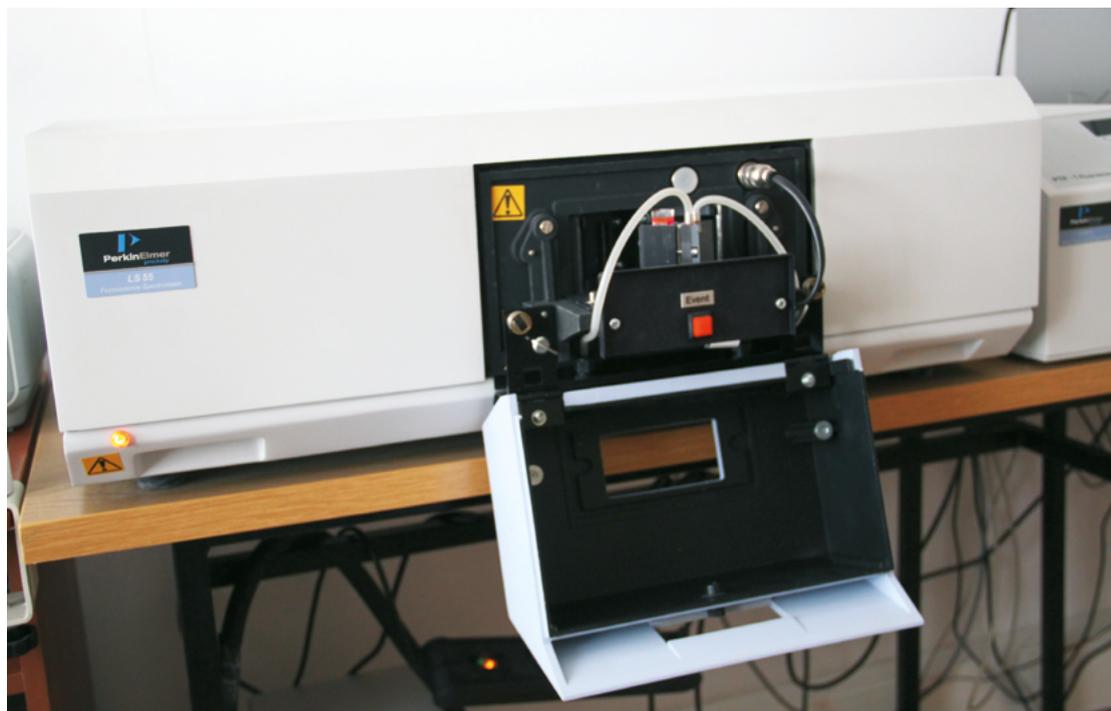
- fluorescence spectra
- phosphorescence spectra
- chemiluminescence spectra
- bioluminescence spectra

### TECHNICAL SPECIFICATIONS:

- excitation wavelength range: 200 to 800 nm; emission wavelength range: 200 to 900 nm – photomultiplier R928
- excitation slits: 2.5-15.0 nm
- emission slits: 2.5-20.0 nm
- scanning speed: 10-1500 nm/min
- xenon discharge lamp, equivalent to 20 kW for 8  $\mu$ s duration.

Adapters for spectrometer:

- temperature attachment:
  - PTP-1-FL – temperature range: 273-373 K
  - PCB-150 temperature range: 293-333 K ( $\pm 0.1$  K) up to around 77 K
- adapter for powder and polymer samples measurements
- fiber-optic cable technique for sample detection out of spectrometer compartment



# UHV ATM/AFM microscope + LEED spectrometer including AES

## TECHNICAL SPECIFICATIONS:

- sample size max.  $4 \cdot 10 \text{ mm}^2$ , investigations on the conductive materials
- vacuum base level  $1 \cdot 10^{-10} \text{ mbar}$
- room temperature measurements
- thermal treatment of samples up to  $1200^\circ\text{C}$  temperature

## SPM UHV:

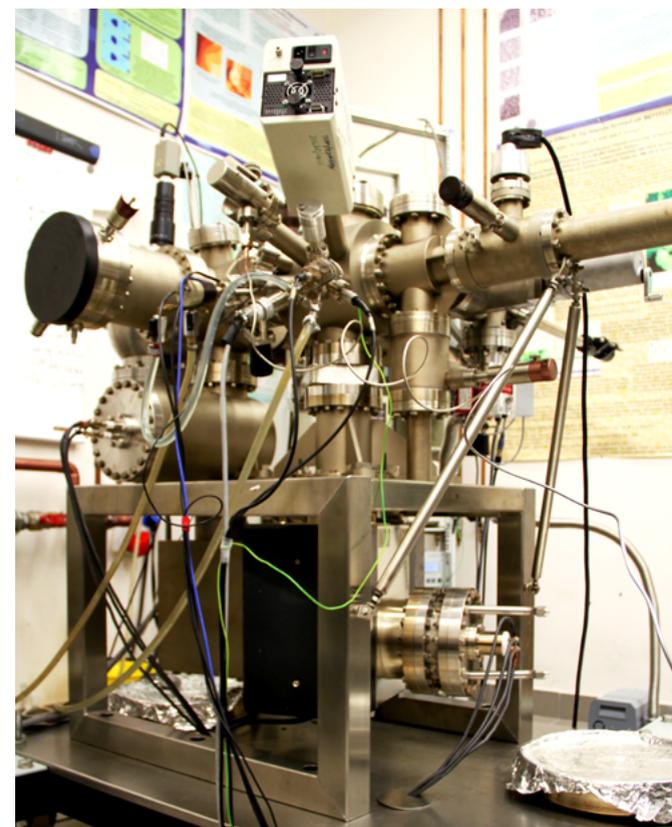
- lateral resolution  $< 1 \text{ nm}$
- investigation strongly restricted as regards sample compositions due to possible chamber contaminations

## AES i LEED UHV:

- effective measurement area  $\sim$  microns in range
- measurement of the surface atomic structure, electron energy up to  $250 \text{ eV}$  (LEED)
- qualitative information about the chemical composition, AES electron energy up to  $3 \text{ keV}$  (AES)

## APPLICATION:

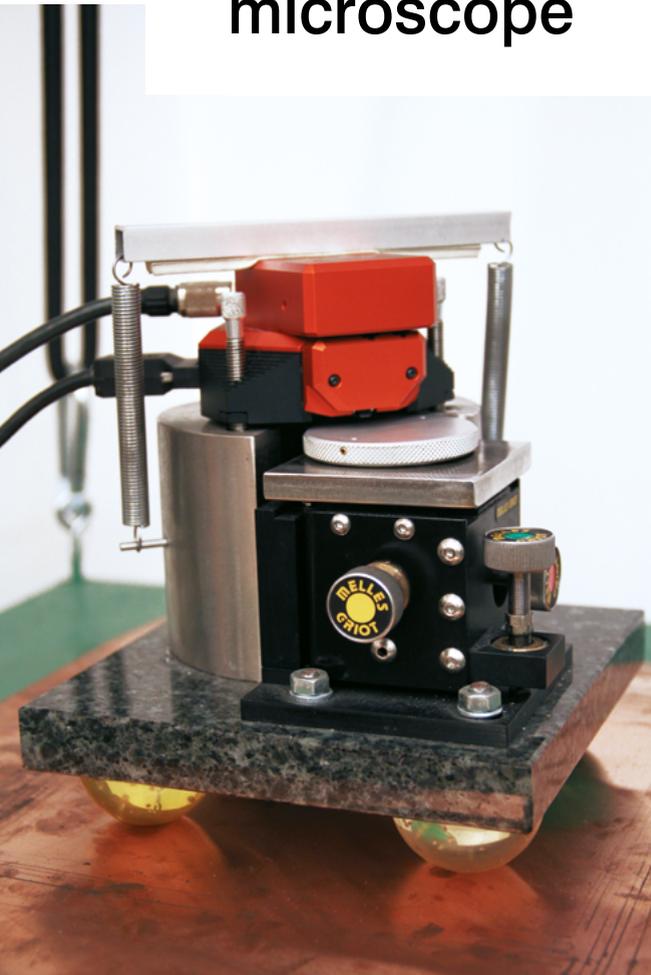
The experimental system is equipped with wide preparation possibilities (including: molecular and atomic evaporation sources, sample thermal treatments, and both ion, electron guns). The setup allows the fabrication of the innovative nano-systems with a wide application range. The nanostructures formed on the reconstructed conductive and semiconductor substrates are imaged with an atomic resolution using ultra high vacuum scanning probe microscopy (UHV SPM) techniques. Auger electron spectrometer (AES) coupled with a low-energy electron diffractometer (LEED) leads to global chemical and structural samples characterization.



## KEYWORDS

- fabrication, modification and characterization of clean semiconductor and metallic substrates

# Nanosurf EasyScan 2 AFM atomic force microscope



## APPLICATION :

- imaging the topography of the investigated materials
- investigating physical and chemical parameters of the surface layer
- locating and characterizing individual phases in composite materials with the grain size at nanometer level

The research includes, among others:

- investigation of the impact of UV radiation on the structure and mechanical properties of polymers and polymer composites (PMMA, PPS, PS, PAA, PP, PLA, PET, PVC)
- nanomechanical testing of materials such as molecularly imprinted polymer films
- investigation of thin films, coatings and very small grains of material
- research of light-curing fillings

## TECHNICAL SPECIFICATIONS :

- maximum scan area - 11 x 11  $\mu\text{m}^2$
- maximum range in the direction of the Z axis - 2 microns
- resolution in the Z direction – 0.027 nm
- resolution of the XY plane - 0.15 nm

Measurement modes:

- static measurements: Constant Height mode, Constant Force mode, Conductive AFM mode, force spectroscopy mode
- dynamic measurements: Intermittent Contact Mode imaging with Phase Contrast, Magnetic Forces and Force Modulation

## KEYWORDS

- atomic force microscope (AFM)
- surface topography

## TECHNICAL SPECIFICATIONS:

The inVia Raman microscope is an outstanding sensitivity measurement system that allows to perform the following measurements:

- using three laser wavelengths: 488, 514.5 and 785 nm
- in the spectral range 100-10000  $\text{cm}^{-1}$
- low-frequency from 10  $\text{cm}^{-1}$  using NExT filter
- with spectral resolution 2  $\text{cm}^{-1}$
- in the temperature range 77-875K
- polarized Raman spectra
- confocal depth profiling with resolution of 2  $\mu\text{m}$
- topography of the materials with spatial resolution of 1  $\mu\text{m}$
- with accumulation of spectra in the case of very weak signals (extremely small quantity of sample)

Materials investigated (samples) do not require special preparation.

# Renishaw inVia Raman microscope

## KEYWORDS

- Raman microscopy
- Raman mapping of the materials surface
- temperature measurements



## APPLICATION:

- investigation of crystalline, thin film, semiconductor, biological, pharmaceutical, polymer materials and hetero- and nanostructures using a non-invasive method allows, among others, to perform:
  - spectroscopic characterization of materials
  - identification of mixtures, impurities and defects
  - determination of chemical composition and stress level of thin film structures
- investigation of Raman maps and confocal profiles of materials

The following materials were commissioned to be investigated:

- polymeric compounds used for the fabrication of LCD protective foils
- chemical compounds used in pharmaceuticals and dentistry
- alloys used for the fabrication of sewage containers
- carbon compounds used in the electrical industry



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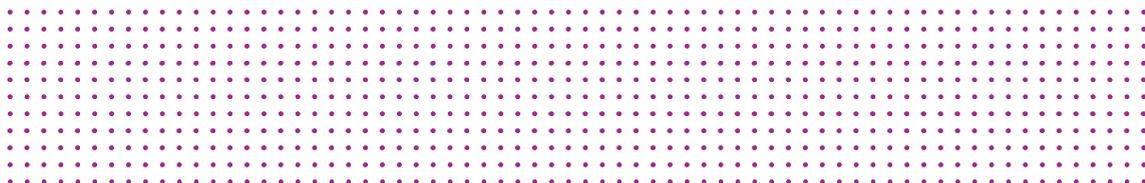
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**13** Renishaw inVia Raman microscope

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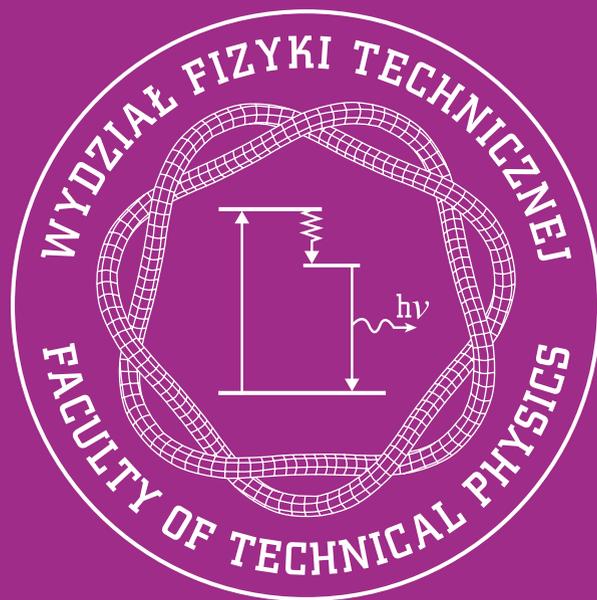
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