**Laboratory of spectroscopy (Optical characterization)**

**Equipment:** Laboratory of spectroscopy (Horiba Raman spectrometer, WITec Raman spectrometer, Horiba photoluminescence spectrometer)

**No. of Equipment: UFCH27**

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**Equipment Description**

**Horiba Raman (LabRAM HR,** **HORIBA Jobin-Yvon)**

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. Here are the key features-

* Excitation wavelengths
  + Ar-Kr (Coherent Innova 70C Spectrum): 457, 476, 488, 514, 531, 568, 647 nm - He-Ne (integrated): 633 nm
* Olympus BX microscope, 10x, 50x and 100x visible long working distance lenses, 50x IR LWD lens, 100x short working distance lenses
* Piezo XYZ stage (PI 730.3CD)
* Manual / motorized XY stages, manual / piezo Z axis
* DuoScan
* Peltier-cooled CCD / liquid nitrogen cooled InGaAs detector for IR range
* Linkam heating stage (RT to 1500°C)
* Diamond-anvil cell
* Available gratings: 600, 1200, 1800 l/mm
* Electrochemical cell(s) for in-situ spectroelectrochemical measurements; controlled by µAutolab (Ecochemie/Metrohm)
* Cantilever beam bending apparatus for in-situ spectromechanical studies
* Photodetection with Keithley 2400 electrometer integrated with oscilloscope.

**WITec Raman (alpha300R)**

Our WITec microscope system has an exceptional optical throughput, unparalleled signal sensitivity, and outstanding imaging capabilities. From advanced microscopes to high-end instruments at the very cutting edge of available technology, its specifications include-

* 532 and 633 (RayShield Coupler) nm excitation wavelength
* Confocal microscope, 10x, 50x, and 100x vis. long working distance lenses
* 50x, 100x vis. short working distance lens
* Raman spectra measurements at extremely low wavenumbers down to below 10 rel. cm-1
* Provides access to additional information from Stokes and anti-Stokes Raman signals close to the Rayleigh line
* Piezo XYZ stage (250x250x20 μm)
* Peltier-cooled EMCCD
* Available gratings: 600, 1200, 1800 l/mm

**Fluorescence spectrometer Fluorolog 3 (HORIBA Jobin-Yvon)**

Fluorolog 3 system is a state-of-the-art system for measuring excitation and emission spectra of thin-film and liquid samples. Key feature includes -

* 450-W light source (Xe lamp)
* Fiber-coupled Ar-Kr laser excitation (Coherent Innova 70C Spectrum): 457, 476, 488, 514, 531, 568, 647 nm
* Double-grating excitation monochromator
* Single-grating emission monochromator
* Automatic slits
* Room-temperature PMT detectors
* Inverted optical microscope
* Liquid and thin-film sample holders

**Specification of expertise relevant to NanoEnviCz workpackages:**

**WP3 a-h**

**Detailed description of expertise**

**Please, specify the main research topics connected with equipment**:

Using the confocal LabRAM Raman system, a wide range of samples can be characterized in situ under different experimental conditions, for example, for solid samples temperature-dependent Raman and photoluminescence measurement up to 800 K; for both solid and liquid samples, spectro-electrochemical performance can be studied [1].

Using WITec Raman (alpha300R), spatially resolved Raman and PL spectroscopic measurement of solid, liquid, and powder samples can be performed. In addition to fluorescence and Raman imaging, the low-frequency measurement facility is very useful in proteins and DNA analysis. [2]

Fluorescence spectrometer Fluorolog 3 is a unique system for measuring spectral responses of thin films, powder, and liquid samples. [3]

**Please, specify the secondary research topics connected with equipment**:

Second, the spectroscopy Laboratory is dedicated to the optoelectronic characterization of semiconducting nanomaterials, thin films, and liquid samples.

**Keywords describing research area:**

Raman, Photoluminescence, excitation and emission spectra, spectroelectrochemistry, graphene devices

**Competence**

**Relevance for applied and industrial research:**

Raman and PL measurement of low-dimensional semiconducting materials are of utmost importance in applied and industrial research to stand out chemical compositions and optoelectronic performance of the studied materials.

**Relevance for fundamental studies:**

Raman and PL measurement in a wide range of experimental conditions is essential for the fundamental understanding of the studied materials

**Comments**

The spectroscopy laboratory is designed for the essential characterization of nanomaterials of different dimensionality for fundamental and application-based research.

**References**

[1] M. Kalbac , A. Reina-Cecco , H. Farhat , J. Kong , L. Kavan and M. S. Dresselhaus, ***ACS Nano***, 2010, 4 , 6055 —6063.

[2] G. Haider, K. Sampathkumar, T. Verhagen, L. Nádvorník, F. J Sonia, V. Valeš, J. Sýkora, P. Kapusta, P. Němec, M. Hof, O. Frank, Y.‐F. Chen, J. Vejpravová, M. Kalbáč, ***Adv. Funct. Mat.*** 2021, 2102196

[3] V. L. P. Guerra, P. Kovaříček, V. Valeš, K. Drogowska, T. Verhagen, J. Vejpravova, L. Horák, A. Listorti, S. Colella and M. Kalbáč, ***Nanoscale***, 2018, 10, 3189.

