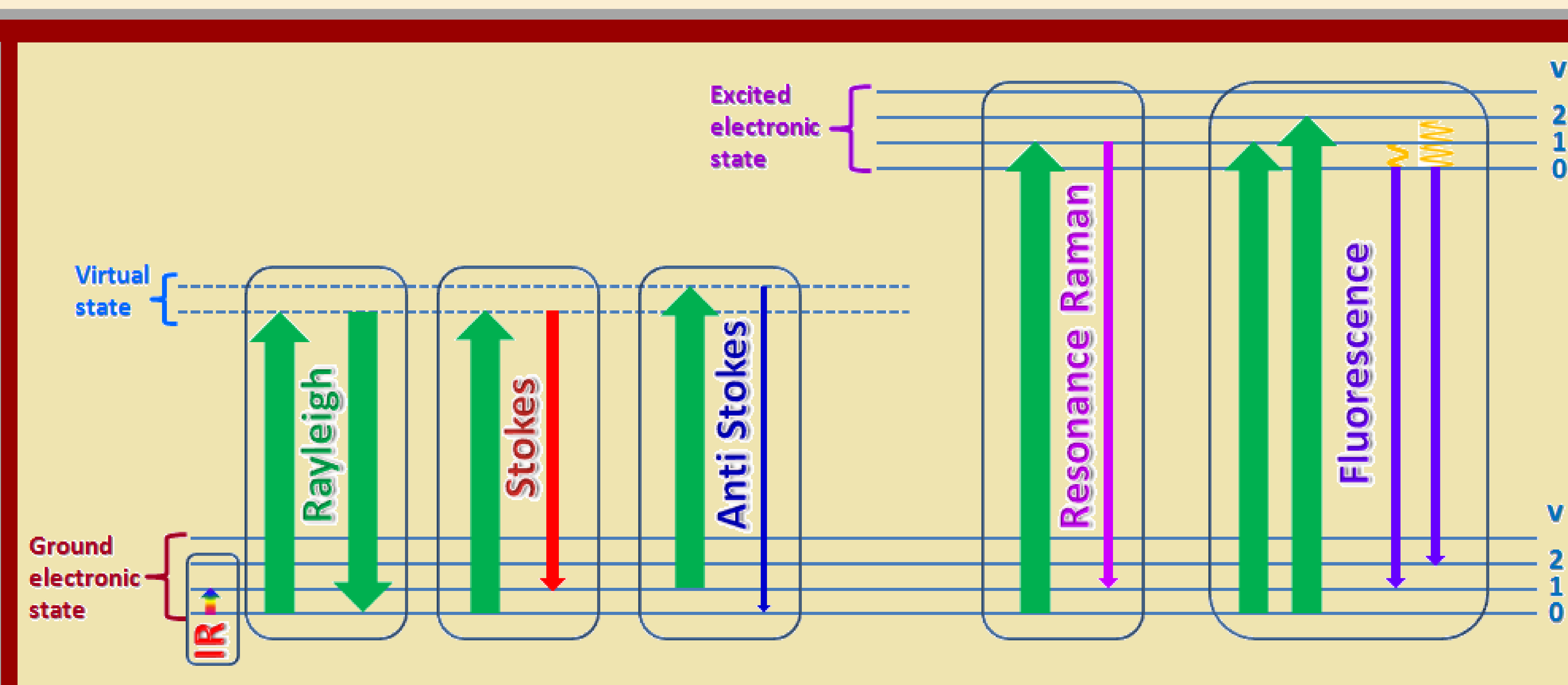
Babeş-Bolyai University
Ioan Ursu Institute
Biomolecular Physics Center
Raman-SPM Laboratory

www.phys.ubbcluj.ro/raman

Raman spectroscopy

Raman spectroscopy is based on the phenomenon of inelastic scattering of light, first observed by C.V. Raman in 1928. It involves illuminating a sample with intense monochromatic laser light and analyzing the resulting Raman (inelastically) scattered photons. Such photons carry information about the identity of the material and its physical and chemical state. In Raman spectroscopy, the difference between the wavelengths of the incident and scattered radiation is measured.



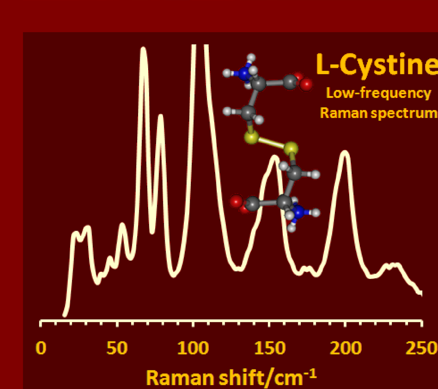
Applications of Raman spectroscopy

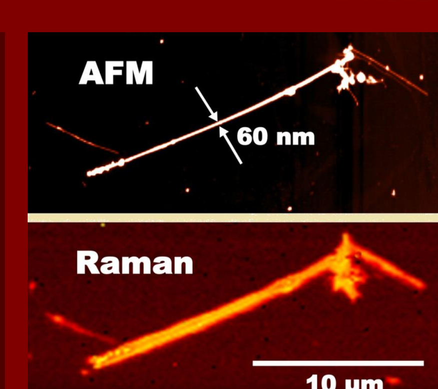
Raman spectroscopy is used in a wide variety of research fields, with in applications in physics, chemistry, biology, pharmacology geology, forensics, materials science, etc.

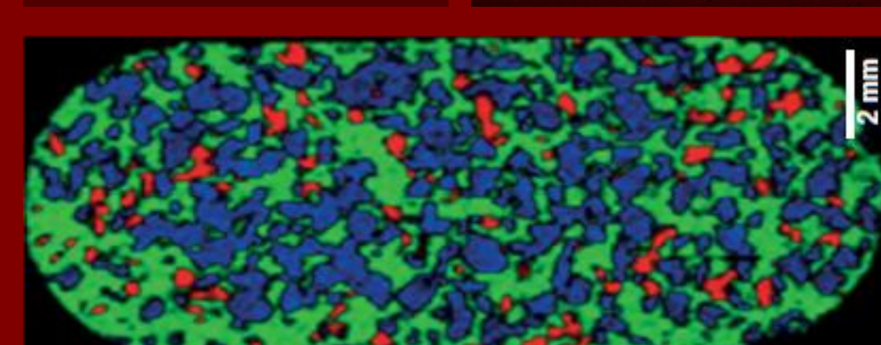
Our Renishaw inVia Reflex Raman spectrometer allows specialized applications like: Raman imaging, polarized Raman, resonant Raman, low-frequency Raman, photo-luminescence, simultaneous Raman/AFM imaging.

Renishaw inVia Reflex Raman Spectrometer

Focal length:	250 mm
Spectral resolution:	0.5 cm^{-1} in visible; 1 cm^{-1} in NUV and IR
Spatial resolution:	< 1 µm (lateral), <2 µm (depth)
Dispersion:	<0.5 cm^{-1}/pixel







Lasers lines
1. He-Cd - 325 nm (20mW) and 442 nm (80 mW)
2. Cobolt DPSS 532 nm (200 mW) 3. He-Ne 633 nm (17mW)
4. Diode 785 nm (300 mW) 5. Diode 830 nm (300 mW)

Diffraction gratings
600, 1200, 1800 and 2400 lines/mm

Detectors
RenCam CCD , 1024x256 pixels (200-1060 nm) and InGAs (800-1660 nm)

Edge filters
< 100 cm^{-1} in Vis and NIR and <200 cm^{-1} in UV

Photoluminescence filters
325 nm and 442 nm excitation lines

Near-Excitation Tunable (NExT) Filters
532 and 633 nm laser lines

Optical objectives
Vis/NIR 5X (NA 0.12 WD 13.2 mm), 20X (NA 0.35, WD 20 mm), 50X (NA 0.75, WD 0.37 mm) and 100X (NA 0.9, WD 3.4 mm)
NUV: 15X (NA 0.32 WD 8.5 mm) and 40X (NA 0.5, WD 1 mm)

Kits
Polarization kits and analyzers for 785 and 532 laser lines
Macro sampling kit for measuring solids, powders and liquids

Stage
XYZ Mapping Stage

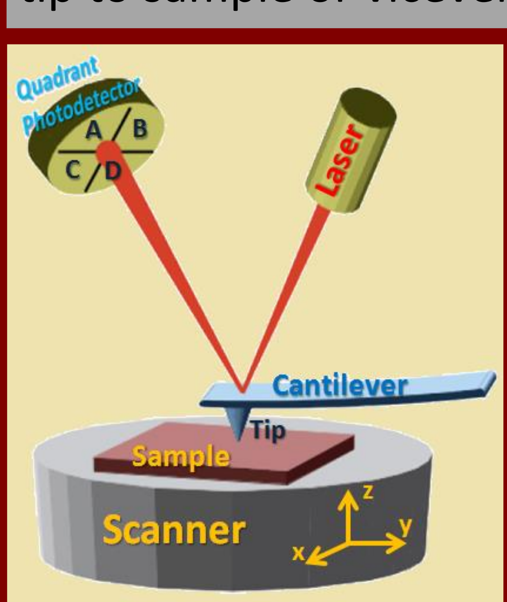
Databases
forensic, polymers and minerals

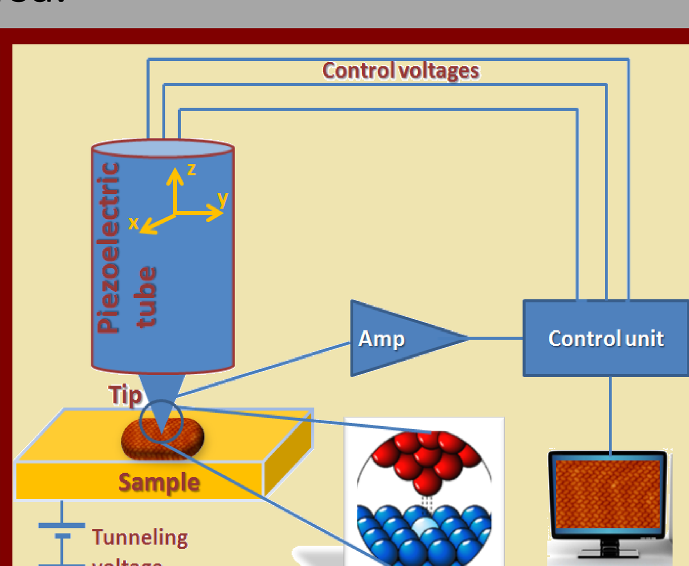
NT-MDT NTEGRA Spectra Microscope

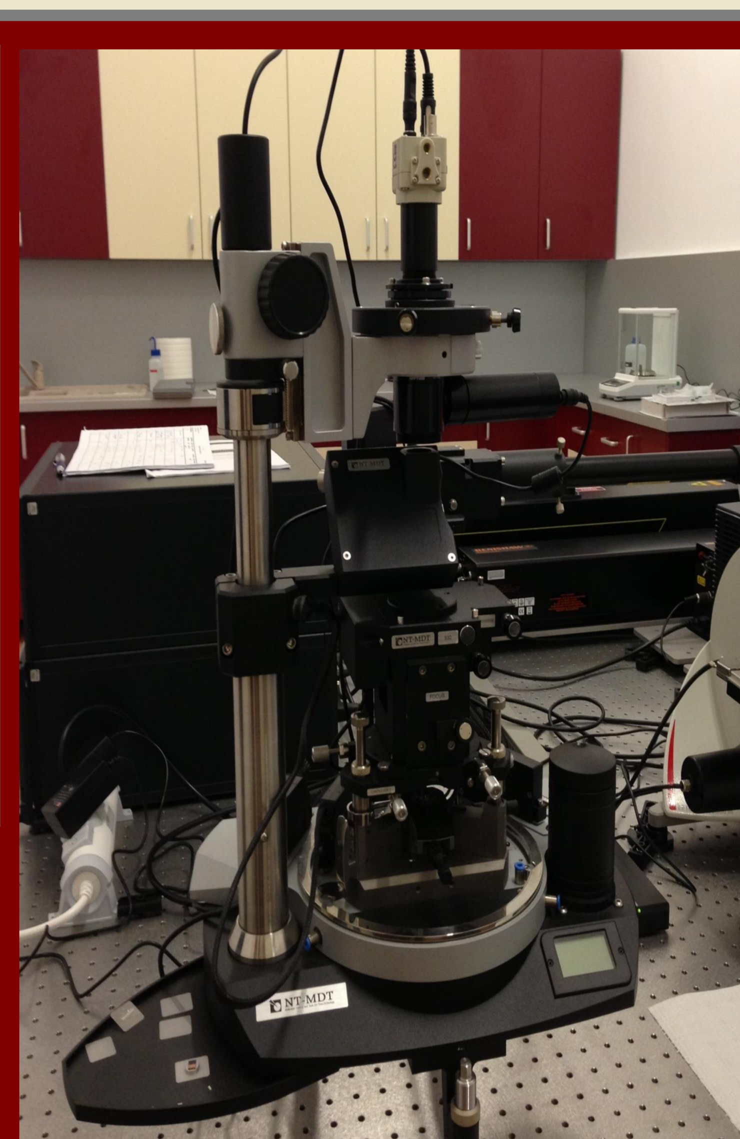
Scanning Probe microscopy

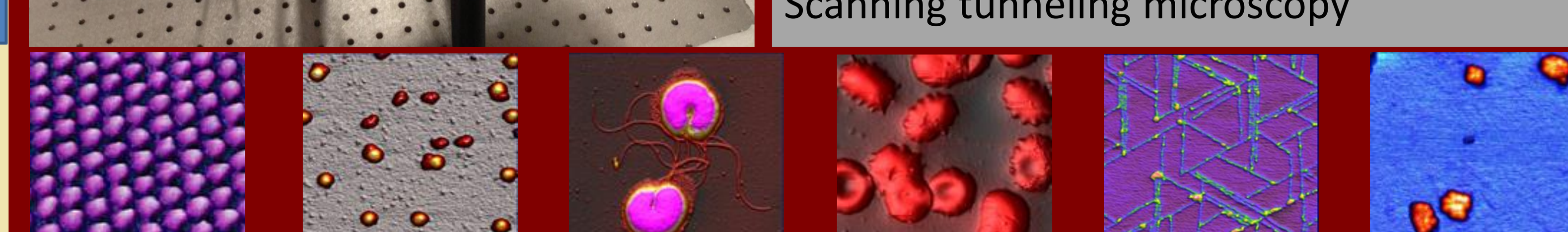
Atomic force microscopy (AFM) is a technique used to obtain 3D images and other information from a wide variety of samples, at nanometer resolution. AFM works by scanning a probe along the sample surface.

Scanning tunneling microscopy (STM) offers the opportunity to image conducting and semiconducting surfaces and to perform tunneling spectroscopy with atomic scale spatial resolution. STM works by bringing a sharp metal tip into close proximity of a conducting sample and applying a bias. The electrons tunnel from tip to sample or viceversa.









Features

Laser: 830 nm
Objective: 100x, NA=0.7
Scanners: 100 µm and 1 µm
Simultan AFM and Raman acquisition
Atomic resolution on HOPG

Operating modes
Contact, Non-contact, Semi-contact
Lateral Force Microscopy, Phase Imaging
Force Modulation Microscopy
Adhesion Force Microscopy
AFM Lithography and Nano-manipulation
Magnetic force microscopy
Electrostatic force microscopy
Scanning Capacitance Microscopy
Kelvin Probe Microscopy
Spreading Resistance Imaging
Force distance curves
Conductive Probe AFM
Scanning tunneling microscopy

Applications of SPM techniques

3D images with high magnification, magnetic domains on the sample surface (MFM), contact potential difference across the sample (KPM), forces between molecules, I(V) curves, hardness or softness of the sample, thermal parameters, nanolithography, identification of contaminants and mapping of different components in composite materials (Phase imaging), manipulating single atoms or molecules, carrying well controlled nano-scale structures into the surface, imaging the molecular orbitals.

The SPM microscope is directly coupled to the Raman spectrometer for co-localized AFM and Raman imaging simultaneously on the same pixel on non-transparent samples (upright configuration).