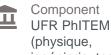


UE Physical measurements at nanoscale by local probes





ECTS 3 credits



mécanique)

UFR PhITEM (physique, ingénierie, terre, environnement,

Semester Printemps

> Teaching language(s): English

> Open to exchange students: Yes

> Code d'export Apogée: PAX8NQAE

Presentation

Description

Goal: Introduction to local probes techniques in the field of nanosciences and nanotechnologies.

Content

1. Introduction to Scanning Probes Microscopy (1h30)

- · Comparison between surface analysis techniques: SEM/TEM, SFA
- Presentation of the SPM sub-families: STM / SFM / SNOM via examples of applications
- 2. The Scanning Tunneling Microscope (7h)
- · The tunneling effect
 - STM relevant parameters
 - · Expression of the tunneling current
- · The STM instrument
 - · Tip fabrication methods
 - Electronic and instrumental chain to measure and control tunnelling current in the pico/nano-ampere range ADC/DAC, I/V converter, lock-in amplifier





- · Source of noises and detection limit
- · Vibration isolation (tutorial on transfer function and damping)
- · Measurement at low temperature : how to operate an STM in a cryostat>
- · Operating STM modes and associated measurements
 - · Local density of states (LDOS) and I/V spectroscopy
 - · Constant current mode versus constant height mode

3. The Atomic Force Microscope (12h)

- · Why mechanical oscillators
 - · Introduction and history
 - · Mechanical susceptibility
 - · Limits of sensitivity (readout noise and Brownian motion)
 - · Working at resonance, decrease the size/mass
- · How to build an AFM
 - · Micro fabrication of cantilever and tips
 - Nano positioning (piezo material and issues with them as hysteresis...)
 - Precision position measurements (optical and capacitive)
 - Signal analysis (Homodyne detection, PLL and PID)
- · Operating AFMs
 - Calibration process (cantilever stiffness, position detection)
 - What physical values are accessible (van der Waals, electrical, magnetic, friction forces)
 - · Different modes of operation
- · Maps analysis and image processing
 - · Surface analysis parameters: rms, ra, skewness, kurtosis, etc
 - · Artefacts, tip dilation effect
 - · Tilt correction via polynomial subtraction and color scale
 - · Tutorial on processing of the images and spectroscopy curves obtained in PW via Gwyddion software

Course parts

CM Lectures (CM) 22h

UE Physical measurements at nanoscale by local probes - Practical work (TP)

Period: Semester 8

Useful info

Campus

> Grenoble - University campus



8h