Course syllabus

Svepspetsmikroskopi
Scanning Probe Microscopy

FAFN30, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED F/Pi
Date of Decision: 2023-04-18

General Information

Main field: Nanoscience.
Elective for: F4, N4-nf
Language of instruction: The course will be given in English

Aim

The course deals with the field of high-resolution microscopy using scanning probe methods. Today these techniques have found their use in a wide range of research areas – from advanced physics and chemistry with atomic precision to applications in biology, such as studies of single cells and viruses. The course will encompass both theoretical and practical aspects of handling and possible applications of SPM. The techniques of STM (Scanning Tunneling Microscopy) and AFM (Atomic Force Microscopy) will be given particular attention.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- be able to describe the common principle and experimental realization of all Scanning Probe Microscopes
- be able to explain the physical interaction between sample and probe for a Scanning Tunneling Microscope and an Atomic Force Microscope
- be able to critically interpret images and spectra obtained by Scanning Probe Microscopy

Competences and skills
For a passing grade the student must

- be able to independently acquire the details about a specific Scanning Probe Microscopy technique from literature
- be able to evaluate the strengths and limitations of different Scanning Probe Microscopy techniques and compare the images obtained by these microscopes.

Contents

Introduction to scanning probe microscopy. Instrumentation: positioning devices, probes, data acquisition/electronics, ultrahigh vacuum environment, and vibration isolation concepts. STM: principle and practical applications, methods for imaging and spectroscopy, structural, electronic, and chemical contrast mechanisms, sample and probe preparation, atomic resolution on metals and semiconductors. AFM: principle and practical applications, methods for imaging, force curves, applications. Optical SPM techniques: principles and practical applications. Examples of more advanced SPM techniques and combined methods. Applications of SPM in: condensed matter, chemistry, and nanotechnology.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: The assessment of the course consists of short exercises, a project, and an oral exam. The results of the project are presented in a written report and an oral presentation on a seminar. The final grade of the student is based on the exercises (20%), the project (30%), and the oral exam (50%).

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Admission

Assumed prior knowledge: FFFF05 Solid State Physics or FFFF01 Electronic Materials.
The number of participants is limited to: No
The course overlaps following course/s: FAF085

Reading list

- Lecture scripts & complementary literature handed out at the lectures.

Contact and other information

Course coordinator: Jan Knudsen, jan.knudsen@sljus.lu.se
Course coordinator: Rainer Timm, rainer.timm@sljus.lu.se
Course homepage: https://canvas.education.lu.se/courses/4284
Further information: The course is given by the Faculty of Science and does not follow the study period structure.