



Adam Mickiewicz University in Poznań

Doctoral School of Exact Sciences AMU

Scanning probe microscopy

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Scientific lecture

Field of science	Physical sciences
Teaching method	Lecture, problem-based learning, laboratory method
Language	English
Numbers of hours	10 h lecture, 10 h laboratory
Aims of the course	The course aims to give students a comprehensive understanding of the principles, techniques, and applications of scanning probe microscopy (SPM). It covers key types of SPM such as atomic force microscopy (AFM) and scanning tunneling microscopy (STM), emphasizing their role in nanoscale imaging, surface analysis, and manipulation. The course equips students with theoretical knowledge and practical skills to apply SPM techniques in nanotechnology, materials science, and biology.
Course contents	<ol style="list-style-type: none"> 1. Introduction to Scanning Probe Microscopy. 2. Basic Principles of SPM, working mechanism, and different SPM modes. 3. Types of scanning probe microscopy, scanning tunneling microscopy (STM), atomic force microscopy (AFM), near-field scanning optical microscopy (SNOM), and magnetic force microscopy (MFM). 4. Key components of an SPM system. 5. Selected applications of scanning probe microscopy in nanotechnology, materials science, biology, and semiconductor industry. 6. Advantages and limitations of SPM, and future trends in scanning probe microscopy (multimodal SPM, High-Speed SPM).
Prerequisites and co-requisites	-
Learning outcomes	
On completion of the course PhD candidates will be able to:	Assessment mode
understand the fundamental principles of SPM and differentiate between its key types, such as AFM, STM, and SNOM (E_W01, E_W02)	Written test, report
describe the working mechanisms of different SPM modes (contact, non-contact, tapping) (E_W01, E_W02)	Written test, report
perform basic AFM experiments, including sample preparation, probe operation, and image acquisition, and analyze obtained data to extract nanoscale topography and material properties (E_U01, E_U02, E_U06)	Written test, report
critically evaluate acquired knowledge and results, collaborate effectively in a team setting to design, conduct, and report on SPM-based experiments (E_K01, E_K05)	Written test, report

Literature	<ol style="list-style-type: none">1. Meyer, E.; Bennewitz, R.; Hug, H.-J. Scanning Probe Microscopy: The Lab on a Tip; Graduate texts in physics; Second edition.; Springer: Cham, Switzerland, 2021; ISBN 978-3-030-37089-3.2. Haugstad, G. Atomic Force Microscopy: Exploring Basic Modes and Advanced Applications; John Wiley & Sons: Hoboken, N.J, 2012; ISBN 978-0-470-63882-8.
Additional information	