UNIWERSYTET IM. ADAMA MICKIEWICZA W POZNANIU

Fabrication and analysis of surface nanostructures II

Educational subject description sheet

Basic information

Study programme
Fizyka (Physics of Advanced Materials for Energy Processing)

Speciality
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Organizational unit
Faculty of Physics

Study level
Second-cycle programme

Study form
Full-time

Education profile
General academic

Didactic cycle
2023/24

Subject code
04FENS.24S.03267.23

Lecture languages
English

Course type
Elective

Block
specialty subjects

Subject coordinator	Mateusz Kempiński
Lecturer	Mateusz Kempiński

Period	Activities and hours	Number of ECTS points
Semester 3	• Laboratories: 15, Graded credit	2

Goals

Code	Goal
C1	Practical introduction into vacuum technology and experimental techniques utilized in fabrication and characterization of thin metallic films. Laboratory classes are planned as follow-up of the lecture “Conducting nanostructures. Methods of fabrication and analysis” and aim at application of knowledge acquired there.

Subject learning outcomes

Code	Outcomes in terms of	Learning outcomes	Examination methods
Knowledge – Student:			
W1	has basic practical knowledge on operation and maintenance of an ultra-high vacuum chamber.	FEN_K2_W01, FEN_K2_W02, FEN_K2_W07	Report
W2	has practical knowledge on deposition of thin metallic films with the use of electron-beam thermal deposition technique.	FEN_K2_W01, FEN_K2_W02, FEN_K2_W07	Report
Skills – Student:			
U1	is able to prepare samples and identify apparatus parameters for thin film deposition.	FEN_K2_U01, FEN_K2_U03	Report
U2	is able to perform basic characterization of obtained thin films with the use of AFM technique.	FEN_K2_U01, FEN_K2_U03	Report
Social competences – Student:			
K1	Is able to cooperate in the deposition process under supervision of experienced lab technician.	FEN_K2_K01, FEN_K2_K02	Report

Study content

No.	Course content	Subject learning outcomes	Activities
1.	Operation of vacuum pumps, valves and gauges–obtaining and maintaining of ultra-high vacuum.	W1, U1	Laboratories
2.	Operation of electron-beam thermal evaporation equipment and quartz balance-deposition of thin metallic films and multilayers with specific thickness.	W1, W2, U1, K1	Laboratories
3.	Imaging and determination of roughness and thickness of thin films with AFM technique.	U2	Laboratories

Additional information

Activities	Teaching and learning methods and activities
Laboratories	Laboratory method, Demonstration and observation

Activities	Credit conditions
Laboratories	Attendance during the thin-film deposition process and AFM measurements. Preparation of the report containing basic description of the deposition method and apparatus parameters and elaboration of the AFM results (processing the AFM images of thin film surface, its thickness and roughness using Gwyddion software).

Literature

Obligatory

1. Roth, A. "Vacuum technology North Holland publishing co." Amsterdam-New York-Oxford (1976).

Calculation of ECTS points

Activities	**Activity hours***
Laboratories	15
Preparation for classes	15
Report preparation	25
Student workload	**Hours** 55
Number of ECTS points	**ECTS** 2

* academic hour = 45 minutes

Efekty uczenia się dla kierunku

Kod	Treść
FEN_K2_K01	The graduate is ready to critically evaluate own knowledge and received content
FEN_K2_K02	The graduate is ready to recognize the importance of knowledge in solving cognitive and practical problems and seeking expert opinion (also from other scientific disciplines) to overcome difficulties during independent problem solving
FEN_K2_U01	The graduate can use their knowledge to formulate and solve complex and unusual problems in the field of physical sciences; select and apply appropriate methods and tools necessary to solve a given problem (including advanced IT techniques), as well as adapt existing methods and tools or develop completely new ones
FEN_K2_U03	The graduate can formulate and test hypotheses related to simple research problems in physics (plan and perform observations, experiments, theoretical calculations or computer simulations and critically evaluate and discuss the results obtained)
FEN_K2_W01	The graduate knows and understands in-depth selected facts, phenomena, concepts and theories specific to physics and complex relationships between them (constituting advanced general knowledge in the field of physical sciences and representing both key and other selected issues in the field of advanced detailed knowledge in this discipline)
FEN_K2_W02	The graduate knows and understands in-depth selected research methods and tools as well as mathematical models used in physics
FEN_K2_W07	The graduate knows and understands workplace health and safety principles to the extent that allows independent work in the research workplace