University of Gdańsk

Subject card

Subject name and code	Monographic lecture - Advanced electrochemical methods, PG_00082431		
Field of study	Chemical Business		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2025/2026
Education level	Master's studies	Subject group	Obligatory subject group in the field of study Optional subject group
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish
Semester of study	3	ECTS credits	3.0
Learning profile	academic	Assessment form	credit
Conducting unit	Department of Analytical Chemistry -> Faculty of Chemistry -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Paweł Niedziałkowski	
	Teachers	prof. dr hab. inż. Tadeusz Ossowski dr Anna Wcisło dr hab. Paweł Niedziałkowski	

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	0.0	0.0	30
	E-learning hours included: 0.0						

Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
	Number of study hours	30	5.0	40.0	75

Subject objectives

- introduction to the development and application of electrochemical methods,
- introduction to the theoretical foundations and measurement principles of electroanalytical methods,
- introduction to the methodology of modification and imaging of various surfaces using electrochemical and optical methods and combined methods,
- presentation of the application of electroanalytical methods to solve complex analytical problems,
- developing the ability to search for applications of electroanalytical methods in the scientific literature

Learning outcomes

Course outcome	Subject outcome	Method of verification
[BCHMU2_W01] Knows and understands complex physicochemical processes and is able to analyse their course in connection with other fields of science.	- explains complex physicochemical processes for a given research method - combines the possibilities of applying analytical chemistry in other fields of science	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion
[BCHMU2_U02] Is able to define her/his interests, develop them within the chosen direction and in connection with the subject of her/ his master's thesis by implementing the process of self-education and planning her/his professional career.	- plans his/her self-education process - plans a professional career path	[SU1] oral statement/conversation/ discussion [SU8] observation of student's independent or team work
[BCHMU2_U01] Is able to, on the basis of her/his knowledge, propose a solution to problems in chemistry, taking into account the economic aspect by using advanced measurement techniques.	- correctly selects advanced analytical methods for the research problem - takes into account economic conditions	[SU4] test/exam - oral or written
[BCHMU2_W05] Knows and understands the main trends in the development of chemistry combined with economics as two interpenetrating scientific disciplines.	- lists and describes modern measurement methods - combines economic conditions with individual research methods	[SW4] test/exam - oral or written
[BCHMU2_K04] Is willing to properly assess the acquired knowledge, respect and disseminate it in order to solve specific cognitive and practical issues.	- self-assesses his/her current knowledge - identifies the challenges facing the chemical sciences	[SK1] oral statement/conversation/ discussion [SK8] observation of student's independent or team work

Subject contents

Course contents

(1)Theoretical concepts of electroanalytical methods: interfacial phenomena, the description of the diffusion of substances to the surface of the electrodes, the reversibility of electrode process, Fick's law, the Cotrells law, modeling of electrodes processes, electrodes kinetics, mechanisms of electrodes processes. Electrochemical measurements in aqueous, non-aqueous and mixed environments.

(2)Voltammetric methods: chronoamperometry, cyclic voltammetry and normal pulse voltammetry. Electrochemical impedance spectroscopy. Voltammetric stripping.

(3)Surface modification: Langmuir-Blodgett, self-organized film on the metal surface (SAM).

(4)Techniques used to characterize monolayers: Raman spectroscopy, confocal and SERS. Spectroelectrochemical measurements. The use of an atomic force microscope (AFM). Automation and computerization of analytical methods.

Prerequisites and co-requisites

finished course on "instrumental analysis"

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
final test/exam	51.0%	100.0%

Recommended reading

Basic literature	1. A. J. Bard, L. R. Faulkner - Electrochemical methods, Wiley 2. F. Scholz Electroanalytical methods, Guide to Experiments and Applications, Springer 3. C. Z. Zoski - Handbook of electrochemistry Elsevier 4. Z. Galus Elektrochemiczne metody wyznaczania stałych fizykochemicznych, PWN, Warszawa 5. A. Kisza Elektrochemia cz. I i II, WNT, Warszawa
Supplementary literature	1. W. Szczepaniak Metody instrumentalne w analizie chemicznej, PWN, Warszawa
eResources addresses	

Example issues/ example questions/ tasks being completed

Electrochemical measurements in aqueous, mixed and non-aqueous environments. Voltammetric methods: chronoamperometry, cyclic and normal pulse voltammetry. Electrochemical impedance spectroscopy. Voltametric stripping.

Work placement

Not applicable

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