



Subject card

Subject name and code	Identification of material structure, PG_00066094						
Field of study	Chemistry						
Date of commencement of studies	February 2026		Academic year of realisation of subject		2025/2026		
Education level	second-cycle studies		Subject group		Specialty subject group		
Mode of study	Full-time studies		Mode of delivery		at the university		
Year of study	1		Language of instruction		Polish		
Semester of study	1		ECTS credits		3.0		
Learning profile	general academic profile		Assessment form		exam		
Conducting unit	Department of Chemistry and Technology of Functional Materials -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. inż. Ewa Wagner-Wysiecka				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	30.0	0.0	0.0	45
	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	45		5.0		25.0	75
Subject objectives	To gain knowledge of methods for identifying the chemical structure, structural organization and morphology of materials and their application in explaining structure–property relationships. To develop skills in selecting complementary characterization techniques, preparing samples, performing measurements and jointly interpreting spectroscopic and microscopic results. To develop the ability to critically assess the capabilities and limitations of drawing conclusions about material structure.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K7_W05] defines the principles of sustainable development, national and European conditions for environmental management, in the field of intellectual property protection and patent law		has knowledge to explain the relevance of sustainable development principles and national and European environmental protection frameworks to materials research. Describes the principles for using structural data and patent information with regard to intellectual property protection.		[SW1] Assessment of factual knowledge		
	[K7_U01] integrates and interprets information from literature, databases and other sources		is able to integrate and interpret information from the literature, databases and measurement documentation to identify material structure using spectroscopic and microscopic results and to draw well-supported conclusions.		[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject		
	[K7_W02] identifies analytical techniques appropriate for solving specific analytical tasks – also in the production plant		has the knowledge to necessary identify spectroscopic and microscopic techniques suitable for solving problems involving the identification of the chemical structure, structural organization and morphology of materials in laboratory and industrial production settings, taking into account their complementarity, capabilities and limitations.		[SW1] Assessment of factual knowledge		

Subject contents	Course content – lecture Chemical structure, structure and morphology of materials. Hierarchical structure of materials and relationships between structure and properties of selected materials, including polymers, ceramics, metals and composites. The scope of structural information obtained using spectroscopic and microscopic methods and their complementarity. Application of FTIR/ATR and Raman spectroscopy to the identification of chemical structure, intermolecular interactions and changes occurring in materials. UV–Vis and fluorescence spectroscopy in the investigation of the local environment of chromophores and interactions in materials, including measurements of solid samples. Optical microscopy for assessing the morphology and heterogeneity of materials. Scanning electron microscopy (SEM): image formation, topographic and compositional contrast, sample preparation and the influence of measurement conditions on the observed morphology. Application of SEM to the examination of surfaces, fracture surfaces, pores, phase boundaries and the distribution of material constituents. Energy-dispersive X-ray spectroscopy (EDS) and elemental mapping as complementary tools for microstructural observation. Structural information obtained by X-ray diffraction (XRD) and thermal analysis methods as a complement to spectroscopic and microscopic investigations. Combined interpretation of results using selected materials as examples. Distinguishing between chemical and morphological changes, assessing the influence of sample preparation and measurement conditions, and evaluating the capabilities and limitations of drawing conclusions about material structure. Principles of sustainable development and selected national and European environmental protection frameworks relevant to materials research. Principles for using structural data and patent information with regard to intellectual property protection and patent law. Course content – laboratory 1. Preparation of samples for spectroscopic and microscopic investigations. Assessment of the influence of sample preparation on the results obtained. 2. Identification of the chemical structure of materials using FTIR/ATR spectroscopy. Interpretation of characteristic bands and comparison of spectra with reference data. 3. Investigation of chemical changes and interactions in materials using FTIR/ATR spectroscopy. Comparison of samples before and after a selected modification. 4. Optical microscopy in the investigation of material morphology. Observation of surfaces and heterogeneity. 5. Analysis of microscopic images. Assessment of the distribution and dimensions of constituents and the presence of pores and discontinuities. 6. Examination of material surfaces and fracture surfaces using SEM. Influence of observation conditions and contrast type on the information obtained. 7. EDS microanalysis and elemental mapping. Relating the elemental composition of selected regions to the microstructure observed using SEM. 8. Investigation of materials using UV–Vis spectroscopy, including solid-state measurements. Interpretation of spectra in relation to chemical structure and the environment of chromophores. 9. Investigation of the fluorescence properties of materials. Analysis of excitation and emission spectra and the influence of the environment and interactions on the fluorescence response. 10. Identification of material structure based on results obtained using complementary techniques. Combined interpretation of spectroscopic and microscopic data and assessment of the limitations of identification.		
Prerequisites and co-requisites	Basic knowledge of general, inorganic, organic and physical chemistry, including chemical structure and intermolecular interactions. Familiarity with the fundamentals of spectroscopy and the ability to perform basic laboratory procedures and process measurement results.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Lecture: Written exam	51.0%	50.0%
	Laboratory: To pass, students must complete all laboratory exercises, obtain at least 51% of the available points in each test, and submit all laboratory reports and receive a passing grade for each.	51.0%	50.0%
Recommended reading	Basic literature	1. Dobrzański L.A., <i>Materiały inżynierskie z podstawami technologii procesów materiałowych</i>, t. 1–4, PWN, 2026. 2. Rabek J.F., <i>Biopolimery</i>, t. 1, PWN, 2023. 3. Rabek J.F., <i>Biopolimery</i>, t. 2: <i>Metody badań strukturalnych w praktyce</i>, PWN, 2023. 4. Trykowski G., <i>Badania nanomateriałów z wykorzystaniem mikroskopii elektronowej</i>, 2022. 5. Lecture materials and laboratory exercise instructions provided by the instructors on the eNauczanie platform.	
	Supplementary literature	1. Krishnan, Kannan M. <i>Principles of materials characterization and metrology</i>. Oxford University Press, 2021 2. Pathak, Chandra Shakher, and Samir Kumar, eds. "Recent developments in atomic force microscopy and Raman spectroscopy for materials characterization." (2022).	
	eResources addresses		
Example issues/ example questions/ tasks being completed	1. Propose a set of complementary spectroscopic and microscopic techniques to address a selected problem of material structure identification in a laboratory or production facility. Justify the choice of methods and indicate their capabilities and limitations. 2. Based on microscopic images, EDS microanalysis results and elemental maps, characterize the microstructure of a material, considering the influence of sample preparation and measurement conditions on the interpretation of results. 3. Integrate spectroscopic and microscopic results with information from the literature and databases to draw well-supported conclusions about the structure of a material and its relationship to its properties. 4. Discuss the relevance of sustainable development principles and selected national and European environmental protection frameworks to materials research. Explain the principles for using structural data and patent information with regard to intellectual property protection and patent law.		

Practical activities within the subject	Not applicable
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