



Subject card

Subject name and code	, PG_00065850						
Field of study	Materials Engineering						
Date of commencement of studies	October 2024		Academic year of realisation of subject		2025/2026		
Education level	second-cycle studies		Subject group		Specialty subject group Subject group related to scientific research in the field of study		
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	general academic profile		Assessment form		assessment		
Conducting unit	Division of Electrochemistry and Surface Physical Chemistry -> Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Natalia Wójcik				
	Teachers		dr hab. inż. Natalia Wójcik				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	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	The aim of the course is to familiarize students with methods of modifying the properties of glassy materials through changes in composition, structure, manufacturing techniques, and heat treatment. Students will explore special properties of glasses, such as ionic and electronic conductivity, ferroelectricity, ferromagnetism, and chemical resistance, as well as their applications in renewable energy, environmental protection, and tissue engineering. In the laboratory part, students design and synthesize low-melting glasses doped with alkali or transition metal ions, investigate their electrical conductivity, and prepare analytical reports based on the results.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K7_W01] Has extended knowledge of the fields of science and scientific disciplines relevant to materials engineering, and their historical development and importance for the progress of exact and natural sciences, knowledge of the world and evolution of humanity.		The student has extended knowledge of the properties and modifications of glass materials and their applications in modern technologies. Understands the importance of glasses in the context of the development of natural sciences and materials engineering, especially in the areas of renewable energy and biomaterials.		[SW1] Assessment of factual knowledge		
	[K7_U03] Can formulate a research hypothesis, design an experiment needed to prove it and use properly selected measuring and laboratory methods.		The student is able to formulate a hypothesis regarding the properties of glass materials, design an appropriate experiment and conduct it using synthesis techniques, heat treatment and conductivity measurement. Is able to select and apply appropriate laboratory methods, including impedance spectroscopy, to analyze the obtained results.		[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject		
	[K7_U04] Can undertake a detailed analysis of the obtained results and develop a technical report or presentation, also in English.		The student is able to analyze the results of tests of glass properties, especially electrical conductivity, and draw conclusions based on them. Is able to develop data in the form of a technical report or presentation.		[SU2] Assessment of ability to analyse information		

Subject contents	<p>Lecture:</p> <ul style="list-style-type: none">• Methods of modifying the properties of glassy materials by changing the manufacturing technique, composition, structure and heat treatment;• Special properties of glassy materials: high electrical conductivity, ferroelectricity, ferromagnetism, chemical resistance, thermal resistance, biodegradability, recyclability;• Application of glassy materials: in renewable energy, including photovoltaic panels, new generation batteries, environmental protection, nuclear energy, tissue engineering. <p>Laboratory</p> <ul style="list-style-type: none">• Design of low-melting, silicate-borate/phosphate glass compositions doped with high content of alkali ions or transition metal ions• Glass melting and annealing• Glass grinding• Study of electrical properties using impedance spectroscopy• Conductivity analysis and report preparation		
Prerequisites and co-requisites	Basic knowledge of glass production and characteristic properties required.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	lab report	50.0%	50.0%
	lecture written test	50.0%	50.0%
Recommended reading	Basic literature	<ul style="list-style-type: none">• Shelby, J.E., <i>Introduction to Glass Science and Technology</i>, Royal Society of Chemistry, 2005.• Varshneya, A.K., Mauro, J.C., <i>Fundamentals of Inorganic Glasses</i>, Elsevier, 2019.• Bansal, N.P., Doremus, R.H., <i>Handbook of Glass Properties</i>, Academic Press, 1986.	
	Supplementary literature	n/d	
	eResources addresses	Adresy na platformie eNauczanie: Szkła specjalne - Moodle ID: 45804 https://enauczenie.pg.edu.pl/moodle/course/view.php?id=45804	
Example issues/ example questions/ tasks being completed	<ul style="list-style-type: none">• How does changing the chemical composition of glass affect its physical and chemical properties?• How does ionic conductivity differ from electronic conductivity in glass materials?• Designing the composition of low-melting borate-phosphate glass with a high ion content.• Carrying out the glass melting and annealing process in laboratory conditions.• Measurements of electrical properties of glass using impedance spectroscopy.• Analysis of Nyquist plots and determination of DC conductivity.		
Work placement	Not applicable		

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