GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Conductive Polymers, PG_00039677		
Field of study	Materials Engineering, Materials Engineering, Materials Engineering		
Date of commencement of studies	February 2023	Academic year of realisation of subject	2023/2024
Education level	second-cycle studies	Subject group	Optional 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	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Chemistry and Technology of Functional Materials -> Faculty of Chemistry		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. Anna Lisowska-Oleksiak	
	Teachers		

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	15.0	50

Subject objectives

The aim of the course is to familiarize students with the current state of knowledge and technology about the properties and applicability of high-molecular organic compounds (polymers), which are conductors of electric current. Topics include both ion and electronic conductors.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K7_W07	223/5000 The student has knowledge about new achievements in the field of polymeric conductors:solid polymer electrolytes, ionic polymers such as ionomers, polyelectrolytes, so-called electroactive polymers - synthetic metals, redox polymers.	[SW1] Assessment of factual knowledge
K7_U06	The student is able to assess the suitability of polymeric materials showing the ability to conduct electricity. Is able to assess the impact of macromolecule structure on physicochemical properties. Is able to assess the usefulness of a conducting material in a variety of applications of new technologies, knowing the advantages and limitations of conductive polymers.	[SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment

Subject contents	A) Lecture: Introduction to solid state electrochemistry. Solid (E) electrolytes, Electrical properties of ionic current conductors. Polymer solid electrolytes. Gel electrolytes, hydrogels and gel electrolytes with aprotic solvents. Polyelectrolytes, ionomers, ion-selective membranes (Nafion other) Phase boundary electrode (type 1 conductor) - electrolyte, phase boundary polyconductor / electrolyte. Electrode materials (MA) Electroactive polymers synthetic metals polyaniline, polypyrrole, polythiophene, methods of preparation, electrical and mechanical properties. Low molecular weight PM conductors. Applications of the SAM layer at the liquid-gas interface. Langmuir Blodgett layers. Integral electrodes, transition metal chalcogenides, porphyrins, phthalocyanines, transition metal hexacyanometalates. The mechanism of charge transport in ion-electron conductors with transition metal atoms in the structure Molecular luminescent layers. Applications of organic compounds in light emitting devices. Carbon materials with graphene surfaces; nanomaterials. B) Laboratory • Synthesis and properties of the so-called polymer synthetic metal (polypyrrole, polythiophene). - pdf manual • Determining the material's electric charge capacity by means of impedance spectroscopy pdf instruction • Electrochromic properties of polyaniline. Investigation of color changes of the polymer layer under the influence of the electric field. • Construction of amodified electrode containing with redox centers of transition metal atoms for electrocatalysis. • Gel type electrolyte - EIS method for conductivity measurements.
Prerequisites and co-requisites	Basic knowledge in general chemistry, physical chemistry

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
lecture - tests	51.0%	60.0%
laboratoria -reports and tests	100.0%	40.0%

Recommended reading

Basic literature	1. Materiały do wykładu. 2. A. Lisowska-Oleksiak, A.P. Nowak , Przewodzące Materiały Organiczne, Gdańsk, 2005. 3. Instrukcje do ćwiczeń. 4.R.W. Kelsall, I.W. Hamley, M. Geoghegan, Nanotechnologie Rozdz. 8, PWN 2012. 5. A. Franky So Organic Electronics, CRC Press 2010. 6. W. Bogusz. F. Krok, Elektrolity stałe, WNT 1998.
Supplementary literature	1. M.F. Gray Polymer Electrolytes 2. G. Inzlet, Conducting Polymers 3. P.G. Bruce, Solid State Electrochemistry, Cambridge University press 2000 4. A. Lasia, Electrochemical Impedance spectroscopy and its applications, Springer 2014
eResources addresses	

Example issues/ example questions/ tasks being completed	1. The mechanism of charge transport in amorphous poly (oxyethylene electrolytes containing lithium salts 2. Methods for obtaining conjugated polymers of so-called synthetic metals 3. Theory of hard and soft acids and HSAB bases used to describe coordination in polymer solid electrolyte systems. 4. Polyaniline as example of an electrochromic compound 5.Electric replacement model for Impedance of a polymer electrode.? 6. What physicochemical quantities can be determined by measuring the impedance of electroactive polymer layers?
Work placement	Not applicable