

Functional nanomaterials and photocatalysis Educational subject description sheet

Basic information

Study programme Fizyka (Physics of Advanced Processing) Speciality - Organizational unit Faculty of Physics Study level Second-cycle programme Study form Full-time Education profile General academic	Materials for Energy	Didactic cycle 2023/24 Subject code 04FENS.21S.03239.23 Lecture languages English Course type Elective Block specialty subjects	
Subject coordinator	lgor latsunskyi		
Lecturer	lgor latsunskyi		
Period Semester 1	Activities and hours • Lecture: 30, Graded credit		Number of ECTS points 3

Goals

Code	Goal
C1	The course will be devoted to the main principles of photocatalysis and the photocatalytic materials. The mechanism and kinetic analysis of photocatalytic reactions; evaluation methods of photocatalytic activity; typical fabrication methods of common photocatalysts and the factors for improving photocatalytic activity will be studied. Examples of various practical applications of the photocatalysis and the photocatalysts will be presented.

Subject learning outcomes

Code	Outcomes in terms of	Learning outcomes	Examination methods
Knowledge	e - Student:		
W1	On successful completion of this course, a student will be able to describe the basic principles of photocatalysis (thermodynamics, kinetics, mass transfer, electron transfer and reactionmechanisms); give examples of photocatalytic reactions and its applications	FEN_K2_W01, FEN_K2_W06	Oral colloquium, Test
W2	On successful completion of this course, a student will be able to explain the basic characteristics of semiconductor / electrolyte interfaces and processes related to photocatalysis	FEN_K2_W01	Oral colloquium, Test
W3	On successful completion of this course, a student will be able to describe and compare energy efficiencies of the semiconductor nanomaterials and plasmon-based nanocomposites in photocatalysis	FEN_K2_W01, FEN_K2_W03	Oral colloquium
W4	On successful completion of this course, a student will be able to be acquainted with experimental techniques for investigation of semiconductor / electrolyte interfaces under light irradiation as well as be able to explain one of these techniques in detail	FEN_K2_W03, FEN_K2_W05	Oral colloquium
Skills - Student:			
U1	On successful completion of this course, a student will be able to explain the basic characteristics of semiconductor / electrolyte interfaces and processes related to photocatalysis	FEN_K2_U04	Test

Study content

No.	Course content	Subject learning outcomes	Activities
1.	Principles of semiconductors and semiconductor surfaces	W1	Lecture
2.	Principles of solid state photoelectrochemistry and photocatalysis	W1	Lecture
3.	Semiconductor / electrolyte interface; mechanism of surface reactions and charge carrier transfer mechanisms at surfaces	W2, U1	Lecture
4.	Emerging photocatalytic nanomaterials and nanocomposites. Fabrication of practical photocatalysts	W3	Lecture
5.	The role of co-catalysts and the plasmon resonant photocatalysis	W3	Lecture
6.	Experimental techniques to study semiconductor / electrolyte interfaces under light irradiation	W4, U1	Lecture
7.	Applications of photocatalysts	W1	Lecture

Additional information

Activities	Teaching and learning methods and activities	
Lecture	Lecture with a multimedia presentation of selected issues, Conversation lecture, Discussion	

Activities	Credit conditions
Lecture	At the final written test, the student will receive 3 questions drawn from 3 groups of different complexity (one question from each group). The full answer for each question gives a score 1 point (pt). It is possible to improve the final score with an additional oral exam. Very good (bdb; 5,0): 3 pts Good plus (+db; 4,5): 2.5 pts Good (db; 4,0): 2 pts Satisfactory plus (+dst; 3,5): 1.5 pts Satisfactory (dst; 3,0): 1 pt Unsatisfactory (ndst; 2,0): <1 pt

Literature

Obligatory

- 1. H. Kisch, "Semiconductor Photocatalysis. Principles and Applications", Wiley-VCH, 2015
- 2. R. Ameta, S. Ameta, "Photocatalysis. Principles and Applications", Taylor and Francis Group, 2017
- 3. P. Pichat (ed.), "Photocatalysis and Water Purification", Wiley-VCH, 2013
- 4. R. Memming (ed.), "Semiconductor Electrochemistry", Wiley-VCH, 2015.
- 5. M. Kaneko, I. Okura (ed.), "Photocatalysis. Science and Technology", Springer, 2003
- 6. C. Hussain, A. Mishra (ed.), "Handbook of Smart Photocatalytic Materials", Elsevier, 2020

Calculation of ECTS points

Activities	Activity hours*	
Lecture	30	
Preparation for the exam	30	
Preparation of a multimedia presentation	30	
Student workload	Hours 90	
Number of ECTS points	ECTS 3	

* academic hour = 45 minutes

Efekty uczenia się dla kierunku

Kod	Treść
FEN_K2_U04	The graduate can prepare, for various audiences, oral presentations and written studies presenting specialized topics in the field of physical sciences in a communicative way, as well as debate on such topics
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_W03	The graduate knows and understands in-depth selected computational methods and information technology tools and techniques used to solve complex problems in physics
FEN_K2_W05	The graduate knows and understands the role of physical sciences in the context of fundamental dilemmas and challenges of modern civilization
FEN_K2_W06	The graduate knows and understands basic concepts and principles in the area of industrial property protection and copyright