GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Technologies of receiving nanomaterials, PG_00028253		
Field of study	Nanotechnology		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2024/2025
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study 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	4	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Division of Nanomaterials Physics -> Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Wojciech Sadowski	
	Teachers	dr inż. Marta Prześniak-Welenc prof. dr hab. inż. Wojciech Sadowski dr inż. Michał Winiarski dr hab. inż. Natalia Wójcik Daniel Jaworski	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	15.0	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	50.0	100

Subject objectives	Review of technologies used to produce and study nanomaterials and nanostructures.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_U10	The student is able to predict and assess potential negative biological and ecological effects of producing nanostructures on an industrial scale and their practical applications.	[SU2] Assessment of ability to analyse information
K6_U09	The student has the ability to design and implement processes for producing nanostructured materials.	[SU3] Assessment of ability to use knowledge gained from the subject
K6_W05	The student has basic knowledge of inorganic and organic chemistry, physical chemistry and chemical thermodynamics	[SW1] Assessment of factual knowledge
K6_U06	The student is able to present in a simple and accurate way technological and scientific problems related to the production and application of nanostructures to specialists in related sciences and to initiate and coordinate interdisciplinary cooperation.	[SU1] Assessment of task fulfilment
K6_W06	The student has basic knowledge of the science of the structure of materials and their physico-chemical properties.	[SW1] Assessment of factual knowledge

Subject contents

Materials in modern technology. The scale of physical phenomena. Research tools used in nanotechnology. Methods of producing nanoparticles in the liquid, gas and solid phases. Methods of producing nanofibers. Carbon nanomaterials. Synthesis of fullerenes, carbon nanotubes, graphene. Methods of obtaining nanolayers. CVD vapor deposition methods, Vapor phase epitaxy (VPE) and its application to obtain nanostructures. Physical vapor deposition (PVD methods). Vacuum vaporization. Cathodic sputtering. Pulsed laser deposition (PLAD) technique. MBE molecular beam epitaxy. Sol-gel technology. Nanoceramics technology. Nanopowders and nanosinters. Mechanical synthesis. Forming and sintering of nanopowders. Nanometal technology. Rapid cooling and crystallization of amorphous materials. Nanocomposites technology. Methods of imaging the structure of nanomaterials using atomic force microscopy and electron microscopy. Application of the X-ray diffraction method to determine the size of crystallites and study the size distribution of nanocrystallites. Tomographic methods, nanoindentation. Theoretical, technical and economic limits of miniaturization. Examples of the use of nanotechnology in everyday life.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Written exam - sets of 3 questions	50.0%	50.0%
Laboratory	100.0%	50.0%

Recommended reading

Basic literature	1. Michael F. Ashby, Paulo J. Ferreira and Daniel L. Schodek; Nanomaterials, Nanotechnologies and Design; Elsevier, 2009 2. Donglu Shi, Zizheng Guo and Nicholas Bedford; Nanomaterials and Devices; Elsevier, 2015 3. Bangwei Hang; Physical Fundamentals of Nanomaterials; Elsevier, 2018 4. Kelsall R.W., Haley J.W., Geghegan M (Eds.), Nanoscale Science and Technology, John Wiley & Sons Ltd
Supplementary literature	1. Dobrzański L.A.: Podstawy nauki o materiałach i metaloznawstwo. Materiały inżynierskie i podstawy projektowania materiałowego. WNT. 2002. 2. M.Ashby, H.Shercliff, D.Cebon, Inżynieria materiałowa, T1, T2, Wydawnictwo Galaktyka, Łódź, 2010 3. Blicharski M., Wstęp do inżynierii materiałowej, Wydawnictwo Naukowo Techniczne, Warszawa 2001
eResources addresses	Adresy na platformie eNauczanie: Technologie otrzymywania nanomateriałów - Moodle ID: 44723 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=44723

Example issues/ example questions/ tasks being completed

1. Knowledge of basic concepts in the field of nanotechnology.
2. Knowledge of the principles of operation of devices and instruments used in nanotechnology.
3. Characteristics of the "top-down" and "bottom-up" methods
4. Ability to select nanostructured technology.
5. Knowledge of the basic properties of selected nanostructured materials.

Work placement

Not applicable

Document generated electronically. Does not require a seal or signature.