



Subject card

Subject name and code	, PG_00052084						
Field of study	Nanotechnology						
Date of commencement of studies	October 2023		Academic year of realisation of subject		2026/2027		
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	4		Language of instruction		Polish Polish		
Semester of study	7		ECTS credits		2.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. inż. Wojciech Sadowski				
	Teachers		prof. dr hab. inż. Wojciech Sadowski				
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	15.0	0.0	30
	E-learning hours included: 0.0						
	eNauczanie source addresses: Moodle ID: 7615 Wzrost kryształów https://enauczanie.pg.edu.pl/2025/course/view.php?id=7615						
	Additional information: Lecture delivered in person, accompanied by explanatory and supplementary commentary.						
	The design sessions will be preceded by a lecture outlining the principles of designing crystallization processes. Projects will be prepared in teams and presented directly by the students.						
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		2.0		18.0	50
Subject objectives	Lecture: Introduction to the growth of crystals and nanocrystals. Thermodynamic and kinetic principles of the crystallization process (phase equilibrium, diffusion). Fundamentals of nanothermodynamics. Structure of real crystals – defects. Overview of synthesis methods for bulk crystals, thin films, nanocrystals, and nanostructures. Methods for structural characterization of crystals. Project: Fundamentals of designing a crystal growth process. Selection of materials for crystallization. Selection of a crystallization method for a specific material and its technological description.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	K6_U08	The student is able to present basic facts regarding materials engineering and nanotechnology in an accessible manner.	[SU3] Assessment of ability to use knowledge gained from the subject [SU5] Assessment of ability to present the results of task
	K6_W07	The student possesses systematic knowledge regarding the physical and chemical foundations of nanotechnology, including methods for synthesizing nanostructures, types of nanostructures, their properties, and fundamental research methods.	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation
	K6_K05	The student is able to present the results of their work, convey information in a generally understandable way, communicate, and perform self-assessment as well as a constructive evaluation of the work of others.	[SK4] Assessment of communication skills, including language correctness
	K6_K04	The student is able to cooperate and work in a group.	[SK1] Assessment of group work skills [SK4] Assessment of communication skills, including language correctness
Subject contents	Course content – lecture Course content – lecture 1. Thermodynamic and kinetic foundations of the crystallization process (phase equilibrium, diffusion). 2. Fundamentals of nanothermodynamics. Specifics of the nanocrystal formation process. 3. Structure of real crystals – morphology, crystal habit, defects. 4. Overview of synthesis methods for bulk crystals, nanocrystals, and nanostructures. 5. Methods for structural analysis of crystals. 6. Elements of self-organization in nanocrystal synthesis. 7. Nanoalloys – synthesis methods. 8. Examples of crystallization in selected systems.		
	Course content – project PROJECT: Fundamentals of crystal growth process design. Selection of materials—compounds, substances, and structural systems (e.g., Si, C, GaAs, AlInSb, etc.)—for crystallization. Selection of the crystallization method for the chosen material and its technological description. Analysis of the physicochemical properties and applications of the designed crystals. Project presentation.		
Prerequisites and co-requisites	Introduction to Nanotechnology. Crystallography.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Participation in seminars and a personal project presentation	100.0%	40.0%
	Attendance at lectures and a written test based on the lecture material.	100.0%	60.0%

Recommended reading	Basic literature	1. I.V. Markov "Crystal Growth for beginners". World Scientific (2003, 2nd edition), 2. D.T.J. Hurle, ed. "Handbook of Crystal Growth", vol. 1-a North Holland (1993), 3. Handbook of Crystal Growth. Vol. I-III. Editor-in-Chief and Volume, Editor Tatsu Nishinaga. 2015, 1993 Elsevier
	Supplementary literature	A. A. Chernov. Modern Crystallography. III Crystal Growth. Springer-Verlag. Berlin Heidelberg New York Tokyo 1984, Crystal Growth Edited by Brian R. Pamplin, Copyright 1980 Elsevier, Nanocrystal. Edited by Yoshitake Masuda. Published by InTech. Copyright © 2011 InTech, Crystal growth of quantum materials: a review of selective materials and techniques. NASHRA PISTAWALA, et al. Bull. Mater. Sci. (2022) 45:10, https://doi.org/10.1007/s12034-021-02612-1 Nucleation and Crystal Growth: Recent Advances and Future Trends. by Luizmae Aspillaga, et al. Eng. Proc. 2023, 56(1), 22; https://doi.org/10.3390/ASEC2023-15281 Review of machine learning applications for crystal growth research. Kentaro Kutsukake. Journal of Crystal Growth, 630 (2024) 127598; https://doi.org/10.1016/j.jcrysgro.2024.127598 Annual Review of Chemical and Biomolecular Engineering. Modeling the Growth of Bulk, Single Crystals: Seeing What Is Hidden. Jeffrey J. Derby; Annu. Rev. Chem. Biomol. Eng. 2025, 16:217–48; https://www.annualreviews.org/content/journals/10.1146/annurev-chembioeng-082223-110559?TRACK=RSS
	eResources addresses	
Example issues/ example questions/ tasks being completed	In accordance with the course syllabus. PROJECT: Selection of materials—compounds, substances, or structural systems (e.g., Si, C, SiC, GaAs, GaP, GaN, AlInSb, etc.)—for crystallization. Selection of the crystallization method for the chosen material and a description of the associated technology (e.g., methods for growing bulk crystals, thin films, island nanostructures, or nanowires). Analysis of the physicochemical properties and applications of the designed crystals. Project presentation.	
Practical activities within the subject	Not applicable	

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