GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Basics of crystallography, PG_00065039		
Field of study	Nanotechnology		
Date of commencement of studies	October 2024	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	1	Language of instruction	Polish no
Semester of study	1	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Zakład ceramiki -> Instytut Nanotechnologii i Inżynierii Materiałowej -> Faculty of Applied Physics and Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Maria Gazda	
	Teachers	Martyna Czudec prof. dr hab. inż. Maria Gazda Joanna Pośpiech	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	9.0	0.0	0.0	39
	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	39	0.0	0.0	39

Subject objectives	Learn how to describe the structure of crystalline materials. Understand the relationships between chemical composition, crystal structure, structural defects, and properties.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W07] has systematic knowledge of the physical and chemical principles of nanotechnology (methods of obtaining nanostructures, types of nanostructures, their properties, basic research methods).	has systematic knowledge of crystallography, knows the types of crystal structures, understands the relationship between structure and properties, knows the basic research methods of crystallography.	[SW1] Assessment of factual knowledge
[K6_U01] can learn independently, obtain information from literature, databases and other properly selected sources	is able to learn independently, obtain information from the literature on crystallography, crystallographic databases and other appropriately selected sources.	[SU1] Assessment of task fulfilment
[K6_U04] can plan and conduct experiments, critically analyze their results, draw conclusions and formulate opinions. Has laboratory experience.	is able to plan and conduct simple experiments, e.g. XRD measurement, crystal formation from solution, critically analyze their results, draw conclusions and formulate opinions. Has basic experience in laboratory work in the XRD laboratory.	[SU1] Assessment of task fulfilment

Subject contents	Lecture:Introduction: the subject of crystallography, history, crystalline and amorphous materials;Description of three-dimensional spatial lattices, the Bravais lattice and the atomic basis. Crystallographic axes. Unit cells: primitive and non-primitive.Symbols of positions, directions and planes. A belt of planes, equivalent planes. Crystallographic formulas.Crystal symmetry (closed and open operations), symmetry transformation matrices, Point and space groups. Determination of equivalent positions.Examples of real crystal structures. Their characteristic features and some properties (packing density, surface packing density; coordination number, coordination polyhedron).Reciprocal lattice: definition, physical interpretation. Methods of studying the structure of crystals. X-ray diffractometry.Structural defects, types and their influence on the properties of crystalline bodies. Defects in ionic crystals.Surface crystallography; 2D crystalsHow crystals are formed: crystallization, crystal morphology; form and habit. Physical properties of crystals: density, anisotropy of properties, e.g. optical birefringence. Scalar and tensor properties. Examples. Influence of symmetry on anisotropy. Laboratory:Production of crystals from solution.Recognition of 2D and 3D crystal structures; determination of atomic basis; determination of packing density;Examination of crystal structure by X-ray structural method.
Prerequisites and co-requisites	no
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
lab raport	55.0%	25.0%
written test	55.0%	75.0%

Recommended reading	
Basic literature	Krystalografia, Z. Bojarski i in.
Supplementary literature	any textbook on crystallography or solid state physics
eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	1 Consider the two-dimensional structure shown in Figure 1. (a) Choose the Bravais lattice nodes. (b) Accordingly, according to your choice, determine the primitive cell and atomic basis.2. The unit cell of a certain compound is shown in the figure. Determine its summary formula (by performing appropriate calculations).3. Draw the planes (114), (003) and (310) in a crystal with a tetragonal structure with lattice constants a = 4 Å, b = 4 Å and c = 8 Å. Write the indices of the planes equivalent to the plane (001).4. List all closed symmetry operations. Describe one of them. Give its matrix.5. Define the packing density and calculate it for a centerless cubic structure.6. An X-ray diffraction study was carried out on a polycrystalline sample. What information about the tested material can be obtained from the result (with a brief explanation of the data)?7. Complete the table. The table concerns structures created by one type of atom.StructureCoordination numberPacking densityExamples of densest-packed direction indicesWhich one has higher symmetry?Example of a metal with such a structureRegular face-centeredHexagonal densely packed8. List all intrinsic and non-intrinsic defects. Explain where this division comes from.
Work placement	Not applicable

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