GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Crystallography, PG_00061905		
Field of study	Materials Engineering		
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	3	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Institute of Nanotechnology and Materials Engineering -> 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	

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	40.0	75

Subject objectives

The aim of the course is to familiarize students with the basic concepts of crystallography, such as crystal lattice, unit cell, symmetry, packing density, structural defects, etc., and to link them with the chemical composition and properties of materials. The aim of the course is also to learn and acquire skills in the field of experimental methods of crystallography.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W04] Knows selected aspects of construction and operation of scientific equipment in materials engineering.	Knows the structure and operation of scales, optical microscopes and X-ray diffractometers	[SW3] Assessment of knowledge contained in written work and projects
[K6_U01] Can properly use selected analytical, simulation and experimental methods, as well as devices for measuring the fundamental properties of materials and technological processes.	Is able to use methods to develop X-ray diffractometry results and can use various tools to visualize crystal structures.	[SU1] Assessment of task fulfilment
[K6_W02] has knowledge of physics and chemistry, useful for formulating and solving simple problems within the scope of materials science	Has knowledge of physics and chemistry enabling simple crystallographic calculations	[SW1] Assessment of factual knowledge
[K6_U05] can learn independently	can independently develop their skills and knowledge in the field of crystallography	[SU1] Assessment of task fulfilment
[K6_U02] Can operate typical laboratory equipment and analyze material tests	is able to operate a scale, an optical microscope and, under supervision, an X-ray diffractometer	[SU4] Assessment of ability to use methods and tools

Subject contents	**Lecture:**Introduction: the subject of crystallography, history, crystalline and amorphous materials;Description of three-dimensional spatial networks, Bravais network and atomic basis. Crystallographic axes. Symbols for positions, directions and planes. Crystallographic patterns. Crystal symmetry (closed and open operations). Symmetry groups. Examples of real crystal structures. Their characteristic features and some properties (packing density, coordination number, coordination polyhedron).Inverse network: definition, physical interpretation. Methods of examining the structure of crystals. X-ray diffractometry.Structure defects, types and their impact on the properties of crystalline bodies.How crystals are formed: crystallization, crystal morphology.Physical properties of crystals: density, anisotropy properties, e.g. optical birefringence. **Lab:** The laboratory includes exercises: producing crystals from solution; building 3- and 2-dimensional models of periodic structures; symmetry study; determining packing density; density measurement; tests using an X-ray diffractometer; examination of two-dimensional structures using optical diffraction methods; testing of optically anisotropic materials.
Prerequisites and co-requisites	none

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Lab assesement	55.0%	30.0%
Written test	55.0%	70.0%

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: Krystalografia 1 - Moodle ID: 336 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=336

Example issues/ example questions/ tasks being completed

1. Consider the two-dimensional structure shown in Figure 1. (a) Select the nodes of the Bravais network. (b) Determine the primitive cell and the atomic basis according to your choice.2. The unit cell (cube) of a certain intermetallic compound is shown in the figure below. Name this structure and determine the summary formula of the compound.3. Draw the (314), (010) and (111) planes in a crystal with an orthorhombic structure with lattice constants a = 4 Å, b = 6 Å and c = 8 Å. Write the indicators of the directions in which the closest atoms meet.4. Define the packing density and calculate it (find the expression, without numerical calculations) for the regular structure shown in the figure (the one for question 1), if it is known that the radius of Au is equal to 1.1 of the radius of Cu.5. State and explain the Bragg/Laue condition6. What defects in the crystal structure have the greatest impact on:a) mechanical properties of metals?b) color of ionic crystals?What is the impact? Justify your answers briefly.7. What is crystal anisotropy?

Work placement	Not applicable

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