COURSE DESCRIPTION CARD - SYLLABUS

Course name
Chemistry of Solid State

Course

Field of study
Chemical Technology

Year/Semester
3/7

Area of study (specialization)

Profile of study
general academic

Level of study
First-cycle studies

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
20

Laboratory classes
20

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

4

Lecturers

Responsible for the course/lecturer:
dr hab. inż. Dominik Paukszta

Responsible for the course/lecturer:
dr inż. Aleksandra Grząbka-Zasadzińska

Prerequisites

The student should have a basic knowledge of inorganic and organic chemistry, mathematics and physics. Student should also be able to search for information from literature, databases and other properly selected sources.

Course objective

Providing knowledge in the field of solid structure, reactions and transition phases in solids as well as learning the methods of morphological and structural research. Understanding the relationship between the structure of a solid and its physicochemical properties. Acquiring an ability to identify solids based on diffractometric investigations.

Course-related learning outcomes

Knowledge

1. Student has the necessary knowledge of chemistry to enable understanding of chemical reactions occurring in the solid state as well as phase and polymorphic transformations occurring in the condensed phase [K_W03]

2. Student has the necessary knowledge of chemistry to enable understanding of the principles and laws of symmetry when describing the structure of solids, including defects and molecular orientation [K_W03]

3. The student has the necessary knowledge in the field of identification and characterization of the molecular structure and morphology of chemical substances in the condensed phase using diffractometric and microscopic techniques [K_W11]

Skills

1. Student has the skills to search information from literature and modern databases enabling identification and determination of the structure of solids [K_U01]

2. The student uses computer programs to understand issues related to the correlation of solids properties with their structure [K_U07]

3. Student is able to determine the structure of chemical compounds using diffractometric and microscopic techniques, and is able to describe structure based on knowledge of symmetry elements and the ability to apply the laws of symmetry [K_U19]

Social competences

1. The student understands the need for further training and for improving their professional competencies [K_K01]

2. The student is able to work in a group and cooperate in completing practical tasks [K_K03]

3. Student is able to define priorities for the implementation of assigned tasks [K_K04]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures:

Exam in an on-site system: the knowledge acquired during the lecture is verified in the form of a written exam at the end of the lecture cycle.

Remote exam: closed-ended question test with twenty questions at the end of the lecture cycle.

Laboratory:

The skills in the laboratory classes are verified on the basis of a test of theoretical issues, consisting of 3-5 questions. Theoretical topics for all exercises are passed on during the organizational meeting. Passing threshold: 50% of points. In addition, reports containing a description of the experiment and calculations are evaluated.

Programme content

The essence of solid state. Definition of crystal structure and crystal. Classifications of solids. Ionic, covalent, molecular and metallic crystals. Assumptions of the simplified crystal lattice model.

Definition of a unit cell, crystallographic systems, elements of symmetry, crystallographic classes, Bravais lattices, space groups. Miller index, interplanar distances.

Defects in crystals, types of defects. Water in crystals - importance on the physicochemical properties of solids. Solid phase reactions, reaction mechanism between solids. Diffusion in condensed phase. Polymorphism. Methods of monocrystal crystallization: growth of single crystals from aqueous solutions, growth of single crystals from flux, hydrothermal method, Bridgman-Stockbarger process, Czochralski method, monocrystallization by the Verneuil method, increase of monocrystals from the gas phase, crystallization from solution.

Liquid crystal materials - basic concepts, definition. Structure of a liquid crystal compound - thermotropic and lyotropic mesophase, types of mesogens. The degree of order in liquid crystals. Interaction of liquid crystal compounds in an electric field. The use of liquid crystal materials in many industries. Presentation on selected examples of the realtionships between the structure and properties of the condensed phase.

X-ray diffraction on the crystal structure, Bragg diffraction conditions. X-ray diffraction methods. Position and intensity of diffraction reflections. Construction and operation of a horizontal diffractometer. The use of x-ray techniques. Identification and quantitative analysis by X-ray diffraction in wide angles, the use of the PDF-4 database in identification analysis. Studies of morphology and topography of solid surfaces by microscopic techniques.

As part of the laboratory classes, the following exercises are performed:

1. Crystallization processes

2. Elements of closed symmetry

3. Identification analysis of solids using X-ray diffraction method

4. Qualitative analysis using the PDF-4 database

Teaching methods

1. Lecture: multimedia presentation

2. Laboratory: practical classes using chemical reagents and research equipment

Bibliography

Basic

1. J.Dereń, J.Haber, R.Pampuch, Chemia ciała stałego, PWN,1975.

2. P.Luger, Rentgenografia strukturalna monokryształów, PWN, 1989

3. Z. Bojarski, M. Gigla, K.Stróż,M. Surowiec, Krystalografia, podręcznik wspomagany komputerowo", PWN, 2007.

4. Ch. A. Wert, R. M. Thomson, Fizyka ciała stałego, PWN 1974.

Additional

1. International Tables for Crystallography, The International Union of Crystallography, Kluwer Academic Publishers - Dordrecht/Boston/London 1992

2. Von Meerssche, J.Feneau-Dupont, Krystalografia i chemia strukturalna, PWN, 1984

Breakdown of average student's workload

	Hours	ECTS
Total workload	80	4,0
Classes requiring direct contact with the teacher	40	2,0
Student's own work (literature studies, preparation for laboratory classes, preparation for tests, preparation for exam, preparation of reports from laboratory classes)[1]	40	2,0

[1] delete or add other activities as appropriate