Level: PhD

Course title: Physicochemical parameters of materials

Status: elective

ECTS: 15

Requirements:

Learning objectives

The acquisition of modern knowledge related to the material structure and physicochemical properties.

Learning outcomes

After mastering course, students should have the ability of scientifically based understanding of the material structure and its impact on the physicochemical parameters. In addition, students should possess the ability to use the scientific literature and prepare the scientific presentations.

Syllabus

Theoretical instruction

Primal parameters. Fundamental types of chemical bonds form solid (Primary - ion, covalent, metallic bonds: Secondary - Van der Waals, hydrogen bond, coordination bond). The influence of chemical bonding on the creation of the fundamental types of crystals (ionic, covalent, metallic, and molecular crystals with hydrogen bonding, complex compounds).
Phases and phase transitions. Gibbs phase rule. Phase transitions of first and second order. Phase diagrams. Phase diagrams of one component systems. Binary systems.
The processes and methods of crystallization (crystallization from solution, melt, vapour phase, reaction crystallization, electrolysis crystallization and devitrification). Crystal growth rate.
Secondary parameters. Electronic conductivity and material types. Conductors (metals, weak and strong metals, theory of operation). Semiconductors (intrinsic conductivity; extrinsic conductivity; induced conductivity: thermal excitation, photoconductivity Dielectrics: paraelectrics, ferroelectrics, piezo- and pyroelectrics; dielectric breakdown (avalanche breakdown, Zener breakdown, dielectric strength, etc.); ion and proton conductivity. Ion and proton conductivity. Behaviour of materials in the field of direct and alternating current. Superconducting materials. Thermal conductivity. Material behaviour in a magnetic field and magnetics division. Diamagnetism and diamagnetic materials. Paramagnetism and paramagnetic materials. Ferromagnetism, antiferromagnetism and ferrimagnetism. Magnetically soft and hard magnetic materials. The interaction of electromagnetic radiation with the material. Mirror and diffuse reflection. Transmission of radiation. Index of refraction. Absorption of radiation. Photoeffect. Electronic transitions. Photoconductivity. Exciton states.

Practical instruction

Computational exercises that follow the content of lectures; preparing and presenting the seminar papers.

Weekly teaching load				Other:
Lectures: 6	Exercises:	Other forms of teaching:	Student research: 4	