Level: bachelor

Course title: Physical methods of materials characterization

Status: elective

ECTS: 6

Requirements:

Learning objectives

Introduction to modern experimental physical methods of materials characterization.

Learning outcomes

After completing the course , students should have:

- Ability to understand the correlation between structural features and physical-chemical parameters of materials;
- Ability to use reference manuals and database for materials characterization;
- Knowledge of the possibilities to use physical methods in material characterization;
- Knowledge for performing the basic experiments for measuring the structural, optical, magnetic and dielectric properties.

Syllabus

Theoretical instruction

Monocrystalline materials. Polycrystalline and nano materials. Quasicrystals. Nano, micro and mezzo porous materials. Amorphous materials. Micro and nano composite materials. Classification of materials. Semiconductors. Metals and alloys. Ceramics. Polymers. Introduction to the basic principles in materials characterization. General classification of the materials characterization methods. Methods of characterizing the thin films and the results analysis. The structure of materials. The structural and microscopic methods of materials characterization. Diffraction methods for structural characterization of materials: roentgen diffraction, neutron diffraction, electron diffraction. Microscopic methods for investigating the morphological structure of materials (scanning electron microscopy and transmission electron microscopy) and their subatomic details (scanning tunnelling microscopy-STM and atomic force microscopy-AFM). Crystal symmetry and selection rules. Group theory analysis. Spectroscopic methods. Absorptivity and reflectivity. Infrared and Raman spectroscopy. Luminescence techniques. Optical constants and dispersal relations. Experimental determination of the dielectric function (ellipsometry). Determination of the magnetic susceptibility of weak magnetic materials. Strong magnetic materials characterization. Magnetic materials characterization by resonant methods (Nuclear magnetic resonance, Electron paramagnetic resonance, Ferromagnetic resonance). Determination of dielectric properties. Estimation of the dielectric permeability in direct electrical field regime. Measuring of the dielectric permeability in alternating electrical field regime.

Practical instruction

Experimental exercises follow the content of lectures.

Weekly teaching load				Other:
Lectures: 3	Exercises: 1	Other forms of teaching: 1	Student research:	