

ANNOTATION
of the program of the discipline
“X-Ray diffraction studies of nanomaterials”

The name of the educational program, within the framework of which the discipline is read: “28.04.01 – Nanotechnology and microsystems engineering” (master's program “Materials Science of Nanosystems”).

- 1. Workload:** 5 credits.
- 2. The place of discipline in the structure of the educational program.** The discipline “X-Ray diffraction studies of nanomaterials” is offered to students in the 3rd semester. To study this course, it is necessary to master the disciplines: “Functional nanomaterials” / “Optical properties of nanostructures” / “Modern methods of structural analysis” and “Computer technologies in scientific research”.
- 3. The objectives** of the discipline (module): the formation of students' knowledge about the experimental methods for studying nanocrystalline systems, the development of skills to use the basic knowledge of nanosystems physics to study the properties and methods of researching materials that are promising for practical use.
- 4. Requirements for the results of mastering the discipline**

As a result of mastering the discipline, a student is to *know:*

- operating principles of experimental installations and measuring instruments;
- methods for determining the microstructural characteristics of nanomaterials;
- software products designed to process measurement data.

be able to:

- use modern software;
- apply modern research methods to measure, analyze and process experimental data.

5. The content of the discipline:

Module 1. “Modeling of X-ray diffraction patterns of nanomaterials”

Point and spatial groups. Qualitative and quantitative analysis of polycrystals. Approximation of reflexes of X-ray diffraction patterns, determination of the resolution function, determination of unit cell parameters. Methods for determining the average size of nanoparticles, microdeformations, shape of nanoparticles, size distribution of nanoparticles.

Work 1. “Functions of Gauss, Cauchy-Lorentz and pseudo-Voigt. Approximation of diffraction peaks”

Work 2. “Definitions of the instrumental function of the resolution of the diffractometer”

Work 3. “Refinement of unit cell parameters for polycrystalline and nanocrystalline samples”

Module 2. “Determination of the microstructural parameters of nanomaterials”

The main structural and microstructural parameters of nanoparticles and their physicochemical properties and characteristics. The influence of structural defects on the shape, intensity of reflexes. New methods for analyzing the shape of diffraction reflexes. High resolution diffractometers. Grazing geometry.

Work 4. “Determination of the average size of nanoparticles and microstrains by the Williamson-Hall method”

Work 5. “Analysis of the profiles of diffraction lines (harmonic analysis)”

Work 6. “Analysis of the influence of the shape and size of nanoparticles on the diffraction patterns of nanomaterials”

6. Basic educational technologies. In the framework of the discipline “X-Ray diffraction studies of nanomaterials”, classes are provided in the format of lectures and laboratory work. Active and interactive forms of conducting classes are not provided.

7. Forms of control: current control involves the performance of laboratory work, midterm control - the protection of laboratory work.