

Physics of Functional Nanomaterials

This Master of Science Program implements the new paradigm of interdisciplinary education at the crossroad of physics, chemistry and molecular biology. Special attention is paid to fundamental-to-applied research streamline in the field of "smart" materials. Students and graduates of this Master Program will participate in the novel materials development and related high-technological applications, such as sensors, fuel cells and selective purification systems.

Program organizer: Chair of Physics of Polymers and Crystals

Full-time, 2 years

Entrance examination: Physics

PROGRAM DESCRIPTION

Rapid development of natural science at the meeting point of various disciplines in the beginning in XXI century had led to the development of novel educational programs. It became clear that the basis of many complex phenomena is essential due to the simple physical principles. This fact appears in a particularly striking way on nanoscale, where surface and quantum effects lead to new properties even for simple and thoroughly studied materials.



The courses of the "Physics of Functional Nanomaterials" program cover the modern techniques for obtaining and property studies of nanomaterials, nanosystems and nanodevices. The experimental techniques for analysis of various physicochemical materials will be described. Students will also learn the modern theoretical approaches and computer simulations of applied nanomaterials and related systems. Special attention is paid to biotechnology, bioinformatics and biomimetic approach to the development of novel synthetic nanomaterials.

Graduates will be prepared as self-sufficient specialists highly demanded in the field of advanced materials physics and related applications. All graduates will have an opportunity to continue their education in MSU PhD programs and to develop a successful career as scientists.



CAREER PROSPECTS

Graduates of the program will be able to continue their scientific researcher career in MSU and other research institutes, as well as to apply their knowledge in advanced technology companies as researchers, developers, engineers in the following fields:

- Technologies for novel materials production
- Physical chemistry of polymers and biopolymers
- Computer simulations
- Biomedical technologies
- IT technologies



PROGRAM OF STUDIES

Head of the program Alexey R. Khokhlov, Member of Russian Academy of Sciences, Full Professor, Doctor of Science.

Lectures of the program are given by leading researchers. All practical courses take place in modern scientific laboratories.

Basic disciplines

- Condensed Matter Physics
- Physical Principles of Nanotechnology
- Fundamentals of Physics and Chemistry of Polymers
- Molecular Basis of Life
- Statistical Physics of Macromolecules
- Introduction to Organic Electronics
- Physics of Nanocarbon Materials
- Crystal Physics
- Methods of High-resolution Microscopy in Nanomaterials Research
- Methods of Computer Simulation in Statistical Physics
- Polyelectrolytes in Solution and Near Surfaces

Additional disciplines (for students choice)

- Optics of Anisotropic Media
- Introduction to Liquids Theory and Phase Transitions
- Introduction to Chemical Informatics
- Crystal Growth
- Modern Trends in Soft Matter Physics
- Computer Simulation of Polymer Systems
- Methods of Polymer Research
- Crystallization of Polymers
- Bionanoscapy
- Physics of Crystal Surfaces
- Models of Contemporary Nonequilibrium Statistical Mechanics
- Functional Materials for Electrochemical Power Generation
- Colloidal Systems
- Self-assembly as a Method of Preparation of New Molecular Systems
- Materials for Organic Electronics
- Methods of The Phase Transitions Theory in The Physics of Polymer Nanostructures
- Biomimetic Systems and Materials
- Principles and Perspectives of The Development of Biotechnological Nanomaterials and Nanodevices
- Self-assembly in Thin Polymer Films
- Diffusion in Polymers
- Luminescence and Light Scattering in Solutions and Suspensions of Nanoparticles

LABORATORY PRACTICE

Master of Science program includes workshops in laboratories together with the lectures and seminars. It allows students to learn primary experimental methods for synthesis and analysis of the nanomaterials.

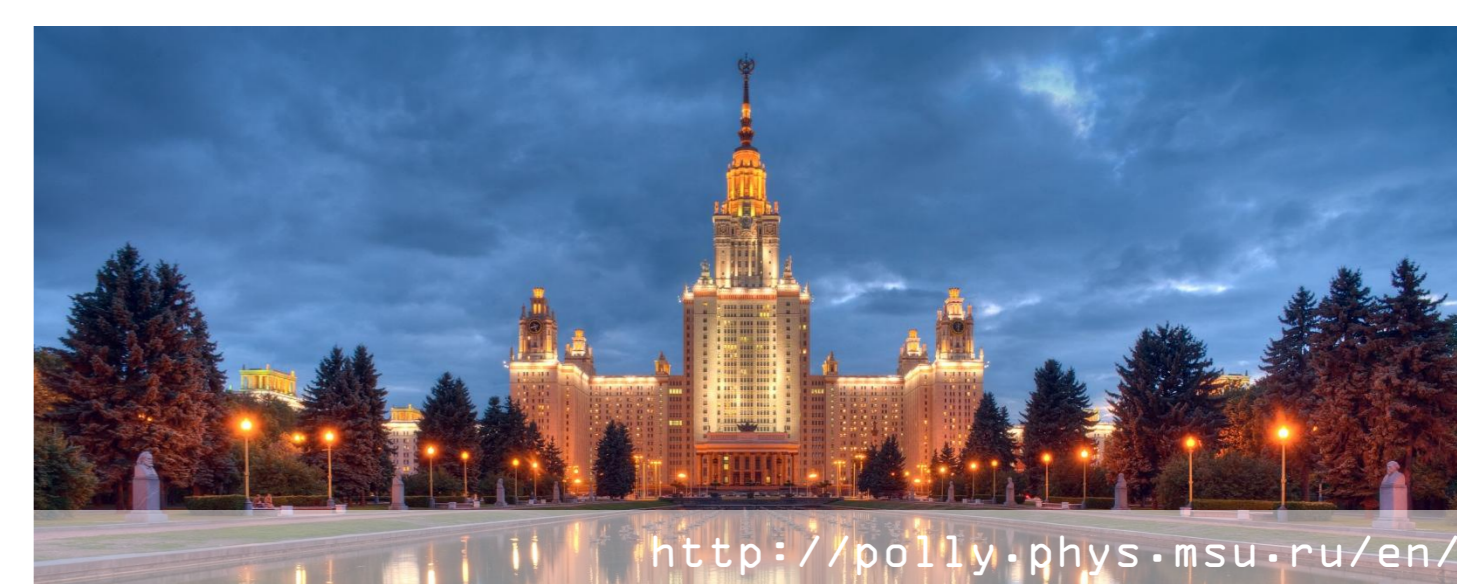


RESEARCH

Students will participate in scientific projects. The best of them will present their scientific results at the international conferences and exhibitions.

Research activity takes place at Faculty of Physics as well as in the other research institutes:

- A.N. Nesmeyanov Institute of Organoelement Compounds of Russian Academy of Sciences
- A.V. Shubnikov Institute of Crystallography of Russian Academy of Sciences
- A.N. Frumkin Institute of Physical Chemistry and Electrochemistry of Russian Academy of Sciences
- N.S. Enkolopov Institute of Synthetic Polymeric Materials of the Russian Academy of Sciences
- Skolkovo Institute of Science and Technology



<http://polly.phys.msu.ru/en/>

PROFESSORS



Yaminsky Igor Vladimirovich, Professor Specialist in atomic force microscopy and scanning tunnel microscopy Teaches the courses "Methods of high-resolution microscopy in nanomaterials research" and "Bionanoscapy"



Potemkin Igor Ivanovich, Professor Specialist in the field of polymer systems self-assembly Teaches the courses "Modern Trends in Soft Matter Physics" and "Self-assembly in thin polymer films"



Kramarenko Elena Yul'evna, Professor Specialist in polyelectrolyte-based systems and polymer composites Teaches the courses "Statistical physics of macromolecules" and "Polyelectrolytes in solution and near surfaces"



Philippova Olga Evgen'evna, Professor Specialist in polymer gels Teaches the course "Self-assembly as a method of preparation of new molecular systems"



Makhaeva Elena Evgen'evna, Professor Specialist in physical chemistry of polymers Teaches the courses "Methods of Polymer Research" and "Fundamentals of physics and chemistry of polymers"



Obraztsov Alexander Nikolaevitch, Professor Specialist in synthesis and analysis of novel carbon materials Teaches the courses "Physical Principles of Nanotechnology", "Physics of nanocarbon materials" and "Physics of the crystal surface"



Vinogradova Olga Igorevna, Professor Specialist in micro- and nanofluidics, and chemical physics Teaches the course "Colloidal systems"

DORMITORY

Foreign students are provided with a dormitory in the Main Building of MSU

CONTACTS

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You can also contact the Chair of Physics of Polymers and Crystals, Faculty of Physics, MSU for additional information:
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