

# Solid-State Electronics, Radio-Electronic Components, Micro- And Nanoelectronics, Devices Based On Quantum Effects

National Research Nuclear University MEPhI (Moscow Engineering Physics Institute)

Degree or qualification is awarded: **Researcher. Lecturer-researcher**

Language of study: **Russian, English**

Mode of study: **full-time**

Duration: **4 years**

Availability of free education: **yes**

Price: **155 000 rubles per semester**

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**Basic department:** Condensed Matter Physics (№ 67)

## Goals of the Program

A targeted training for the organizations: SC Rosatom, institutes of RAC, NRC "Kurchatov Institute", companies, which manufacture and develop electronic components of micro- and nanoelectronics, specialized and radiation-resistant electronics, including microwave electronics based on heterostructures, such as companies of holding company OJSC "Russian electronics", personnel and research support to the FTP "Development of electronic component base and radio electronics."

## Characteristics of the scope and objects of professional activity of future graduates:

- research and development of new semiconductor heterostructure materials based on A<sub>3</sub>B<sub>5</sub>, SiC, graphite and diamond;
- research and development in the field of modern nanotechnology of electronics for creation electronic components, including planar technology of formation of multilayer metallization, plasma chemical deposition and etching technologies of dielectric coatings, nanolithography, atomic layer deposition, cluster planarization;
- research and development in the field of current transport and radiative processes in the organic semiconductor structures;
- realization of experimental research in the field of promising micro- and nanoelectronic devices, functional electronics, including based on the new principles - spintronics, single-electronics, functional electronics;
- development of mathematical functional models and parameters of electronic devices, taking into account the scattering and ballistic processes in the short-channel nanotransistors;
- quantum design of semiconductor heterostructures and devices of microwave electronics - nanotransistors, resonant tunneling diodes, etc .;
- development of epitaxial growth technologies of heterostructures for microwave, functional and optoelectronics, magnetic field sensors, temperature;
- research in the physics of radiation exposure and the effects of heavy charged particles on the materials and electronic devices;
- simulation and design of radiation-resistant electronic components of silicon, silicon-on-insulator and heterostructure electronics;
- the design of specialized microcontrollers.

## Objects of the professional activity

Microwave, functional and optoelectronic materials: heterostructures A<sub>3</sub>B<sub>5</sub>, nanomaterials, organic semiconductor structures.

Schottky field-effect transistors with high electron mobility based on heterostructures, optoelectronic devices,

electronic component base of THz (terahertz) wavelength range.  
Monolithic microwave integrated circuits.  
Technologies of producing electronic components.  
Technologies for designing of electronic components.  
Element base terahertz electronics - emitters and detectors.

### **Brief description of the curriculum**

The ideological foundations:

1. Physics, technology and tools underlying in the creation of a modern electronic components are one of the most modern and high-tech areas of development, including the level of development of the state, are responsible for defense and security.
2. Development of scientific and human potential, their own high technologies in the field of materials and devices of modern electronics with the use of nanotechnology is an important priority for meeting the critical technologies of the Russian Federation, catching up the domestic technologies of world level.
3. In the Centre of nanostructured electronics a unique research-scale production line is formed for the creation of materials, technology development and pilot production prototypes of microwave devices, power and functional electronics based on non-silicon heterostructure materials, equipped with the latest technology and research equipment that provides the formation of a unique educational process with practical competence of graduates, conducting scientific research on the best world level.
4. Comprehensive training school for graduates, based on knowledges of the fundamental solid state physics, semiconductor structures, knowledge and skills to use modern nanotechnology in the production of electronic components, design skills and modeling studies of the properties of microwave devices, power and functional electronics is based.

The structure of the courses:

- basic courses of the educational standard,
- special general course in physical electronics,
- implementation of practical, laboratory and research work, the performance of the experimental part of final qualifying works at the Center of nanostructured electronics MEPhI and other practical training in accordance with the themes of post-graduate work.

### **The base of industrial and/or scientific practice and employment**

Post-graduate students do the scientific trainings, carry out the scientific research works and prepare the graduate qualification works at:

- organization of ROSATOM: the center "Nanostructured electronics" in NRNU MEPhI, the National Research Center "Kurchatov Institute", Federal State Unitary Enterprise "Yu.E. Sedakov Research Institute of Measuring Systems";
- institutes of Russian Academy of Sciences: P.N. Lebedev Physical Institute of the Russian Academy of Sciences, The Institute of Radioengineering and Electronics (IRE), Physical Technological Institute, The Institute of SHF Semiconductive Electronics, The Ioffe Institute, Scientific Research Institute of System Analysis (department 3).
- industrial organizations in electronics: Radio Engineering Corporation "Vega", OKB "Planeta", Scientific Research Institute "Pulsar", Research Institute for Molecular Electronics, manufacturing facility "Mikron".

### **Specializations within this programme**