

**Report on the proposal for the opening of the subproject**  
**“Investigations of Functional Materials and Nanosystems Using Neutron Scattering”**  
(Theme Leader(s): D.P.Kozlenko, V.L.Aksenov, A.M.Balagurov)

Understanding the connection between matter's structure and its physical and chemical properties at the microscopic and atomic scale is crucial in various scientific disciplines such as condensed matter physics, materials science, chemistry, geophysics, engineering, biology, and pharmacology. Neutron scattering methods, among other experimental techniques, offer undeniable advantages in investigating the characteristics of functional materials and nanosystems that consist of light atoms, isotopically enriched nanomaterials, magnetic orderings, biological entities, and polymers. The research results obtained from the beginning of 2021 on the theme 04-4-1142-2021/2025 "Research of functional materials and nanosystems using neutron scattering" demonstrated the high efficiency of neutron scattering for the successful solution of the above-described problems and resulted in more than 300 research papers and one patent. The high research quality was also recognized by 5 JINR awards.

The research activities within the given theme are planned to continue within the implementation of the 7-year plan of JINR development for 2024-2030. Therefore, it is proposed to include the theme 04-4-1142-2021/ "Research of functional materials and nanosystems using neutron scattering" with the first priority in the JINR problem-thematic plan from 2024. The activities will include a new project “A study of structure and dynamics of functional materials and nanosystems at the IBR-2 spectrometer complex” and a prolonged project “Development of an inelastic neutron scattering spectrometer in inverse geometry at the IBR-2 reactor”. The proposed theme with two projects will be realized mainly by the highly recognized and experienced staff of the Department of Neutron Scattering Investigations of Condensed Matter of FLNP.

The first new project will focus on addressing current issues in condensed matter physics, materials science, chemistry, biophysics, and geophysics. The primary experimental base for this project is the IBR-2 high flux pulsed reactor spectrometer complex, as well as available laboratory equipment. The collaboration will take place with multiple organizations from JINR Member States, other countries, and other JINR Laboratories during the project implementation. Apart from the fundamental studies, several applied topics will be addressed, including texture analysis, residual stress determination, neutron radiography, and tomography studies on various materials.

The second project aims to construct an advanced spectrometer for inelastic neutron scattering. This spectrometer will have a wide range of scientific applications, focusing on the study of atomic and molecular dynamics in functional materials. The initial phase of the project, conducted from 2021 to 2023, involved numerical modeling, technical design, and the development of a model element for the focusing analyzer. Additionally, materials, including highly oriented pyrolytic graphite single crystals, were purchased and tested for the project. Over the next five years, the plan is to further develop the main components of the spectrometer and begin its assembly on the 2nd experimental channel of the IBR-2 reactor.

In conclusion, I support the initiation of the theme "Investigations of Functional Materials and Nanosystems Using Neutron Scattering" with the two above-mentioned projects and recommend implementing this theme at JINR with the first priority during the 7-year plan of JINR development from 2024 to 2030.

Dr. phys.  
Head of the EXAFS Spectroscopy Laboratory  
Institute of Solid State Physics, University of Latvia  
Riga, Latvia  
12.06.2023

Alexei Kuzmin

