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Possibilities of laboratory and synchrotron diagnostics of crystalline materials under the external influences

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Our scientific group based on the Laboratory of X-ray Methods of Analysis and Synchrotron Radiation of FSRC "Crystallography and Photonics"RAS specializes in the research of crystalline materials under external influences of various nature and their combinations: constant, alternating and pulsed electric and magnetic fields, laser illumination and heating, mechanical and ultrasonic loading.
The objects for research are a wide range of piezoelectric, ferroelectric, photovoltaic, ferromagnetic crystals and solid solutions, as well as functional elements and systems based on them. To obtain multidimensional information, a complex of X-ray and synchrotron techniques is used, supplemented by various auxiliary studies.
For the tasks described above, a comprehensive modernization of the laboratory triple-crystal X-ray spectrometer was pursued. The upgraded setup is a unique tool for time-resolved structural diagnostics. The diffractometer scheme includes specialized equipment for applying external influences, controlling and synchronizing the experiment. It became possible to implement a wide range of techniques for in-situ diagnostics under the electric field or laser radiation action on the sample: double- and triple-crystal diffractometry in static and time-resolved regimes, reciprocal space mapping, topography, rocking curve imaging and others.
The available possibilities make it possible to study induced effects, such as the processes of migration of charge carriers of ionic, vacancy, and polaron types in a crystal lattice, photoinduced processes, magnetoelastic interactions, deformation behavior, etc. Precision measurements of piezoelectric constants are conducted.
The mechanisms of the formation of defects in the crystal lattice, in particular, as a result of thermal annealing under various conditions, are determined. Techniques for the rearrangement, organization and control of charged defects by means of external electric fields are developed. The action of external influences is studied to establish the relationship between the growth and synthesis technology, structural features and the defect structure with the physical properties of crystals.

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