

Brief information about the project

Name of the project	AP26103225 Preparation and comprehensive study of phase-change indium selenide thin films promising for nanophotonics and optoelectronics
Relevance	Modern technology of active electronic devices, designed to implement neuromorphic computing circuits and fabricate programmable antennas, requires the search for new materials with the ability to reversibly change both electrical and optical properties. In this regard, chalcogenide glassy compounds are the best candidates, as most of them possess the property of phase transition 'amorphous state - crystal' with a significant contrast of electronic properties in these two states. It is important that modern technologies have made it possible to reversibly change the phase of such materials and already today there are devices designed to record information, functioning on the basis of phase-change ternary chalcogenide compounds of germanium (Ge), antimony (Sb) and tellurium (Te). However, the use of ternary compositions in future devices is not always optimal due to the complexity of the chemical composition and difficult control of device stability. Therefore, in this project it is planned to perform a comprehensive research on little-studied two-component phase-change chalcogenides based on indium selenide compounds in order to identify their potential capabilities in nanophotonics and optoelectronics.
Purpose	Preparation of phase-change indium selenide thin films and comprehensive study of the transformation of their structural, optical, electrical and photovoltaic properties in order to evaluate their practical significance in nanophotonics and optoelectronics.
Objectives	1. Obtain phase-change indium selenide thin films in two modifications InSe and In₂Se₃ with significant contrast in physical properties in amorphous and crystalline states; 2. Reveal the crystallisation temperature of the mentioned films and to determine the optical constants of the films in amorphous and crystalline states to assess their significance in active photonic devices; 3. Obtain spectral dependences of photoconductivity of the films to assess the possibility of manufacturing photodetectors based on them; 5. Reveal the conditions of local crystallisation of amorphous films by laser beam for laser engraving technology, which will allow to create diffraction gratings, metasurfaces and two-dimensional photonic crystals; 6. Reveal the conditions of reversible phase switching of InSe and In₂Se₃ thin films by electric pulse
Expected and achieved results	- at least 3 (three) articles and (or) reviews in peer-reviewed scientific publications in the scientific area of the project, indexed in Science Citation Index Expanded and included in the 1st (first), 2nd (second) and (or) 3rd (third) quartile by impact factor in the Web of Science database and (or) having a CiteScore percentile in the Scopus database of at least 60 (sixty); - at least 2 (two) articles or reviews in a peer-reviewed foreign or domestic publication recommended by the KOKNVO; One of the articles will be categorised as multidisciplinary (multidisciplinary or interdisciplinary practical application). - At least one (1) Doctor of Philosophy (PhD) will be trained
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Usage	-
Priority compared to real-world alternatives	-
List of publications with links to them	1. Oman Z., Nurlybekov N., Karibaeva K., Zhylysbayev U., Huang M., Markhabaeva A., Nemkaeva R., Mukhametkarimov E. Crystallization of amorphous thin films of indium selenide // KBTU Bulletin, accepted for publication on March 11, 2026.
Patents	-