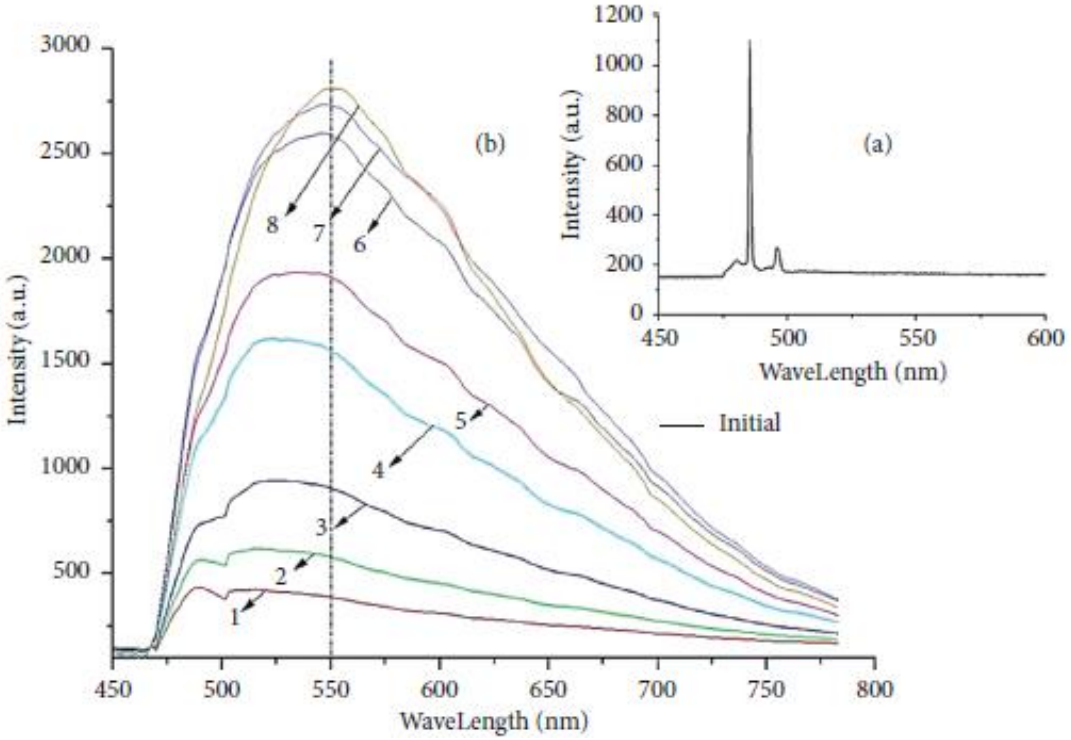
Brief information about the project

Name of the project	AP13268784 «Investigation of the Effect of Electrochemical Etching Modes on the Optical and Structural Properties of Porous Silicon»
Relevance	Porous Silicon (PS) appears to be an inexpensive and easy-to-manufacture material for use in crystalline silicon solar cell technology. In particular, the possibility of modulating the refractive index of PS layers during their fabrication by changing the current density draws the attention of researchers to its use in solar cell fabrication technology. In this work, emphasis is placed on samples that were obtained in a solution containing hydrogen hexafluorosilicate and the study of their physical properties, as well as the study of the effect of the conductivity of the crystalline silicon substrate on the physical properties of PS. Preliminary results of the study showed that the use of electrolytes based on hydrogen hexafluorosilicate improves the optical properties of PS.
Purpose	Investigation of the influence of electrochemical etching modes and conductivity of a p-n structure of single-crystal silicon on the optical and structural properties of porous silicon
Objectives	Task 1. Obtaining groups of porous silicon samples under various modes by electrochemical etching of a p-n structure from single-crystal silicon in an electrolyte containing hydrogen hexafluorosilicate. Task 2. Study of the structural, optical and electrical properties of porous silicon samples obtained in a solution containing hydrogen hexafluorosilicate. Task 3. Investigation of the influence of the conductivity of the n-layer of single-crystal silicon on the properties of porous silicon films obtained in a solution containing hydrogen hexafluorosilicate with a change in the depth of the n-layer. Task 4. Obtaining groups of samples of porous silicon under various modes by electrochemical etching of a p-n structure from single-crystal silicon in an electrolyte containing hydrofluoric acid. Task 5. Исследование структурных, оптических и электрических свойств образцов пористого кремния полученных в растворе содержащий плавиковую кислоту. Task 6. Investigation of the influence of the conductivity of the n-layer of single-crystal silicon on the properties of porous silicon films obtained in a solution containing hydrofluoric acid with a change in the depth of the n-layer.
Expected and achieved results	Expected Result 1: samples of porous silicon obtained under various etching modes in an electrolyte containing hydrogen hexafluorosilicate. Expected Result 2: results of the study of surface morphology, structure, as well as optical spectra

	(reflection, Raman spectra, photoluminescence) and current-voltage characteristics of the obtained samples of porous silicon in a solution containing hydrogen hexafluorosilicate. Expected Result 3: distribution profiles of charge carriers in samples of porous silicon obtained in a solution containing hydrogen hexafluorosilicate depending on the depth of the n-layer. Expected Result 4: samples of porous silicon obtained under various etching modes in an electrolyte containing hydrofluoric acid. Expected Result 5: results of the study of surface morphology, structure, as well as optical spectra (reflection, Raman spectra, photoluminescence) and current-voltage characteristics of the obtained samples of porous silicon in a solution containing hydrofluoric acid. Expected Result 6: distribution profiles of charge carriers in samples of porous silicon obtained in a solution containing hydrofluoric acid depending on the depth of the n-layer.
Research team members with their identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and links to relevant profiles	1. Sagidolda Ye. – LSR. Researcher ID: DNT-2266-2022; ORCID: 0000-0002-4608-7573; Scopus Author ID: 56465977800.
List of publications with links to them	1. Darmenkulova M.B., Aitzhanov M.B., Zhumatova, Sh. A., Ibraimov M.K., **Sagidolda, Ye**. Change of Optical Properties of Carbon-Doped Silicon Nanostructures under the Influence of a Pulsed Electron Beam. Journal of Nanotechnology, 2022, 2022, 1320164, **Q2, percentile: 74**; https://www.scopus.com/record/display.uri?eid=2-s2.0-85132015460&origin=resultslist&sort=plf-f 2. Khaniyev, Bakyt, Ibraimov, Margulan, **Sagidolda, Yerulan**, Tezekbay, Yerbolat, Duisebayev, Tolagay, Tileu, Ayan, Khaniyeva, Ainur. The Improved Non-Polar Gas Sensing Performance of Surface-Modified Porous Silicon-Based Gas Sensors. Coatings, Volume 13, Issue 1, January 2023, Article number 190. Q2, percentile 64; https://www.scopus.com/record/display.uri?eid=2-s2.0-85146499368&origin=resultslist&sort=plf-f
Patents	2 applications for an Innovative patent of the Republic of Kazakhstan have been filed



Photoluminescence spectra of PS samples obtained at J = 20 mA/cm^2, t = 10 min, and U = 10 V. (a) Initial PS. (b) Irradiated PS doped with carbon at different delay times of the moment of registration relative to the laser pulse maximum t_d, μs: 0 (1), 5 (2), 10 (3), 15 (4), 20 (5), 25 (6), 30 (7), and 35 (8) μs.