Project name, IRN	**AP08855672 –** Direct impact on the radiative relaxation of electronic excitations in order to improve the luminescent characteristics of functional materials based on alkali halide crystals
Completion date	04.10.2020-31.12.2022
Project supervisor	Shunkeyev Kuanyshbek Shunkeyevich
Report	The project proposes an original method of influencing on the radiative relaxation of electronic excitations (EEs) (excitons, holes, electron-hole pairs) in alkali halide crystals (AHCs) by lowering the lattice symmetry via a uniaxial elastic deformation or a local deformation caused by light homologous impurity cations. The existing sientific background of the team allows to suggest that a uniaxial elastic deformation increases the probability of the self-trapping of electronic excitations at regular lattice sites due to a decrease of the mean free path of excitons, while a local deformation enchance s the efficiency of electron-hole recombination of pairs in a field of a light homologous cation. An original experimental method of a low-temperature (90 K) elastic deformation of crystals in combination with highly sensitiive luminescent and thermoactivation spectroscopy is implemented.
Relevance	To improve the scintillation characteristics of the detectors, it is possible to use the recombination effect of electron-hole pairs in AHCs activated by small-radius cation homologues. At the same time, there should be an increase in the intensity of the impurity glow at temperatures when its own glow has already been extinguished. This effect is achieved by increasing the free path of the hole with increasing temperature. Thus, one of the urgent issues is the development of technology for manufacturing scintillators based on AHCs, where electron-hole recombination is the main mechanism of luminescence.
Purpose	The aim – is to improve the luminescent characteristics of AHCs by the direct influence of deformation, on the radiative decay states of EEs. Uniaxial deformation is carried out mechanically along directions <100>/<110>; local deformation of the lattice is performed by the introducing of point structural defects into the matrix
Expected results	Modernization of the SDL-2 spectral complex with a Hamamatsu EQ-99X LDLS laser source emitting a highly stabilized and intense light flux in the spectral range of 170-2100 nm, to ensure high-precision registration of the luminescent characteristics of crystals (excitation and emission spectra). Development of an experimental method for studying the effect of elastic deformation on the efficiency of radiative relaxation of electronic excitations by recording the luminescent characteristics of NaCl, NaBr, KCl, KBr, KI, RbI, CsBr and CsI crystals. Development of an experimental method for studying the effect of light homologous cations on the luminescence efficiency at the recombination of electron-hole pairs by recording the luminescent characteristics of NaCl-Li, KCl-Li, KCl-Na,KCl-Sr, KCl-NO2 crystals .

	Development of an experimental method for studying the complex effect of elastic deformation and doping with homologous light cations on the efficiency of recombination luminescence of electron-hole pairs by recording the luminescent characteristics in NaCl-Li, KCl-Li, KCl-Na, KCl-Sr, KCl-NO2 crystals. Systematization/generalization of the original experimental results on improving the luminescent characteristics of AHCs under the directed action of elastic and/or local deformation on the efficiency of radiative relaxation of electronic excitations, as well as the development of the scientific basis describing the action on the radiative/non-radiative channels of electronic excitation relaxation in scintillation materials.
Research group	Supervisor – Main researcher: Shunkeyev Kuanyshbek, d.ph.-m.s., professor, H index=9 (Author ID in Scopus – 57211063006; Researcher ID - O-8849-2017; ORCID - 0000-0002-3860-397X). https://www.scopus.com/authid/detail.uri?authorId=57211063006 Lushchik Alexander, d.ph.-m.s., professor, H index =30 (Author ID in Scopus – 7006987094; Researcher ID - F-9130-2013; ORCID - 0000-0001-4568-8967). https://www.scopus.com/authid/detail.uri?authorId=7006987094 Ogorodnikov Igor, d.ph.-m.s., professor, H index =17 (Author ID in Scopus – 7005409381; Researcher ID - O-7689-2014; ORCID - 0000-0002-4700-2340). https://www.scopus.com/authid/detail.uri?authorId=7005409381 Popov Anatoli, d.ph.-m.s., professor H index=33 (Author ID in Scopus – 57205266521; Researcher ID - O-6751-2013; ORCID - 0000-0003-2795-9361). https://www.scopus.com/authid/detail.uri?authorId=57205266521 Myasnikova Lyudmila, c.ph.-m.s., associated professor, H index=5 (Author ID in Scopus – 16481268100; Researcher ID - O-9697-2017; ORCID - 0000-0003-3326-7206). https://www.scopus.com/authid/detail.uri?authorId=16481268100 Sagimbaeva Shynar, c.ph.-m.s., associated professor, H index=6 (Author ID in Scopus – 6602130267; ORCID - 0000-0002-1234-3030). https://www.scopus.com/authid/detail.uri?authorId=6602130267 Zhanturina Nurgul, PhD, associated professor H index =6 (Author ID in Scopus – 55588115900; ORCID - 0000-0001-9540-6334). https://www.scopus.com/authid/detail.uri?authorId=55588115900 Aimaganbetova Zukhra, PhD, H index=5 (Author ID in Scopus – 56305678700). https://www.scopus.com/authid/detail.uri?authorId=56305678700 Ubaev Zhiger, master, H index =2 (Author ID in Scopus – 57211061571; ORCID - 0000-0002-8862-3506). https://www.scopus.com/authid/detail.uri?authorId=57211061571 Maratova Aida, master, H index =0 (Author ID in Scopus – 57220785727; ORCID - 0000-0002-0083-3219). https://www.scopus.com/authid/detail.uri?authorId=57220785727
Publications in scientific publications	***Web of Science, Scopus*** 1. Zhanturina N., Myasnikova L., Shunkeyev K., Maratova A.,

	Popov A. Efficiency of H-center stabilization in alkali halide crystals at low-temperature uniaxial deformation // Fizika Nizkikh Temperatur. – 2020. – Vol. 46, No. 12. – P. 1371-1376. https://doi.org/10.1063/10.0002469 2. Shunkeyev K., Ubaev Zh., Lushchik A., Myasnikova L. Radiation defects in NaCl matrix with lowered lattice symmetry due to light cation doping and elastic uniaxial deformation //Lithuanian Journal of Physics. – 2021. – Vol.61, No.3, pp. 151-160. https://doi.org/10.3952/physics.v61i3.4514 3. Shunkeyev K., Maratova A., Myasnikova L., Sh.Sagimbayeva, N. Zhanturina. The specificity intrinsic luminescence of a CsI crystal under the influence of low-temperature elastic deformation // Nuclear Inst. and Methods in Physics Research, B. – 2021. – Vol. 509. – P. 1-6. https://doi.org/10.1016/j.nimb.2021.10.009 4. Shunkeyev K., Z. Aimagambetova, L. Myasnikova, A. Maratova, Zh. Ubayev. Mechanisms of radiation defect formation in KCl crystals under the influence of local and plastic deformation// Nuclear Inst. and Methods in Physics Research, B. – 2021. – Vol. 509. – P. 7-11. https://doi.org/10.1016/j.nimb.2021.10.010 5. Shunkeyev K., Maratova A., Lushchik A., Myasnikova L. Effect of a low-temperature deformation on Ex - luminescence of KI single crystals // Integrated Ferroelectrics. – 2021. – Vol. 220. – P. 140-146. https://doi.org/10.1080/10584587.2021.1921543 6. Ogorodnikov I.N. Influence of lattice fluctuation disorder on the thermally induced electron-excitation energy transfer // Journal of Experimental and Theoretical Physics. -2021. – 160(3). ¬ P. 332-339. https://doi.org/10.1134/S1063776121080070 ***CCSpES*** 1. Убаев Ж.К., Шункеев К.Ш., Мясникова Л.Н., Сагимбаева Ш.Ж. Люминесценция матрицы NaCl при локальной и упругой деформации // Вестник ЕНУ им. Л.Н. Гумилева. Серия Физика. Астрономия. – 2020 - №4 (133). – С. 49-54. 2. А.Г. Маратова, Ж.К. Убаев, К.Ш. Шункеев, Л.Н. Мясникова. Цифровая технология сканирования люминесцентных характеристик щелочногалоидных кристаллов // Вестник Национальной инженерной академии. 2021. – № 2 (80). – С. 55-61. 3. Ж.К. Убаев, К.Ш. Шункеев. Оптическое создание и рекомбинационное формирование околонатриевых электронных возбуждений в кристалле KCl-Na// Вестник КазНИТУ. – 2021. - №2 (143) – С. 77–84.
Security documents	1. Маратова А.Г., Убаев Ж.К., Шункеев К.Ш., Мясникова Л.Н., Цифровая технология регистрации спектров фотолюминесценции, рентгенолюминесценции, туннельной люминесценции и термостимулированной люминесценции щелочногалоидных кристаллов //

	Авторское свидетельство № 12826, 26.10.2020. 2. Убаев Ж.К., Маратова А.Г., Шункеев К.Ш., Мясникова Л.Н. Цифровая технология сканирования интегральной туннельной люминесценции и термостимулированной люминесценции щелочногалоидных кристаллов // Авторское свидетельство № 12980, 03.11.2020. 3. Shunkeyev K, Myasnikova L, Sagimbayeva Sh., Ubayev Zh., Herman A., Litskevich A., Registratition method for spectra of thermally stimulated luminescence of alkhali halide crystals// Patent for inventions № 34978, 02.04.2021. 4. Shunkeyev K, Myasnikova L., Zhanturina N., Sagimbayeva Sh., Aimaganbetova Z., Ubayev Zh., Maratova A., The method of influence on the free path length of excitons in alkali halide crystals// Patent for untility model № 5978, 09.04.2021. 5. Maratova A., Shunkeyev K., Sagimbayeva Sh., Myasnikova L. The method of synchronous registration of the time and spectral dependence of the intensity of tunnel luminescence of alkali-halide crystals// Patent for untility model № 6563, 22.10.2021.
Participation in the 2020 conference on the topic of research	Functional Materials and Nanotechnologies November 23th – 26th 2020. Vilnius, Lithuania
Participation in the 2021 conference on the topic of research	1. European Materials Research Society (E-MRS) – Spring Meeting 2021, May 31st – June 3rd 2021. 2. 11th International Conference on Luminescent Detectors and Transformers of Ionizing Radiation, September 12th -17th 2021, Bydgoszcz, Poland.