

Pr – Ce ENERGY TRANSFER IN $\text{LiPr}_{1-x}\text{Ce}_x\text{P}_4\text{O}_{12}$ SYSTEMT. Shalapska¹, G. Stryganyuk², P. Demchenko¹, A. Voloshinovskii¹¹Ivan Franko National University of Lviv, Lviv, Ukraine²Institute for Scintillation Materials NAS of Ukraine, Kharkiv, Ukraine

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The luminescence of Pr^{3+} ions was studied mainly for the purpose to reveal the upconversion or downconversion processes. Recently, the efficient energy transfer from Pr^{3+} to Ce^{3+} ions in $\text{PrF}_3:\text{Ce}^{3+}$ crystals has been observed [1]. A light yield of Ce^{3+} ion luminescence caused by the energy transfer process is revealed to be higher than one for CeF_3 crystal. The high efficiency of energy transfer for Pr-Ce pair stimulates the search for similar processes in other compounds with a high concentration of Pr^{3+} ions. The $\text{APrP}_4\text{O}_{12}$ (Li, Na, K, Rb, Cs) polyphosphates with a high concentration of lanthanide ions are promising materials for this aim. For these systems the efficient energy transfer involving Gd-Ce pair has been revealed. In the case of $\text{NaGdP}_4\text{O}_{12}:10.0 \text{ at\% Ce}^{3+}$ powder sample a light yield of 21000 photon/MeV has been reported [2].

In the present work the spectral-luminescent characteristics of $\text{LiPr}_{1-x}\text{Ce}_x\text{P}_4\text{O}_{12}$ ($x=0.1; 0.02, 0.002, 0$) compounds considering the Pr-Ce pair as a suitable candidate for the increasing of scintillation efficiency are studied.

$\text{LiPr}_{1-x}\text{Ce}_x\text{P}_4\text{O}_{12}$ powder polyphosphates were prepared using melt solution technique and characterized by X-ray powder diffraction. The luminescence characteristics studies have been performed at the SUPERLUMI station at HASYLAB (DESY, Hamburg) upon the excitation by the synchrotron radiation and pulse X-ray laboratory source.

The luminescence spectrum of $\text{LiPr}_{1-x}\text{Ce}_x\text{P}_4\text{O}_{12}$ powder samples is composed of the d-f emission bands of Pr^{3+} - and Ce^{3+} - ions. In the excitation spectrum of Pr^{3+} -ion luminescence the bands typical for the f-d absorption transitions (160-220 nm) have been observed. As a result of a resonance interaction between Pr^{3+} - Ce^{3+} ions the energy transfer from Pr^{3+} to Ce^{3+} has been registered. In this case the excitation bands inherent for Pr^{3+} ion are observed in addition to the bands of Ce^{3+} ion in the excitation spectrum of Ce^{3+} emission.

The decay kinetics constant of 5d-4f luminescence of Pr^{3+} ions decreasing from 13 ns for pure sample to 0.5 ns for $\text{LiPr}_{0.9}\text{Ce}_{0.1}\text{P}_4\text{O}_{12}$ confirms the Pr - Ce interaction. The energy transfer to Ce^{3+} ions involving Pr-sublattice is also confirmed by the peculiar profile of the rise time of Ce^{3+} ions kinetics. The decay kinetics of $\text{LiPr}_{0.9}\text{Ce}_{0.1}\text{P}_4\text{O}_{12}$ luminescence upon the excitation in the region of 4f-5d absorption of Ce^{3+} and Pr^{3+} ions are identical. X-ray excited luminescence spectrum for our samples shows only the luminescence of Ce^{3+} ions with fast decay time component.

References

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- [2] Zhong J. et al. Chem. Phys. Letters 2007, 445, 32-36.
- [3] Zimmerer G. Radiations Measurements 2007, 42, 859-864.