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DEFECT-RELATED LUMINESCENCE IN $KLuP_2O_7$ DOPED WITH Pr^{3+} IONS AFTER IRRADIATION WITH FAST ELECTRONS AND NEUTRONS*

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Praseodymium ions are recently paid attention due to perspective of their usage as impurity ions instead of Ce^{3+}. In comparison with impurity Ce^{3+} ions, praseodymium emission is located in higher energy region and has shorter lifetime (20-30 ns instead of 30-60) [1-3]. Compounds with Pr^{3+} ions impurity demonstrate three main channels of emission: interconfigurational *f–f*, intraconfigurational *d–f* transitions and defect-related luminescence. The latter act as competitive channel of charge carriers capture. With irradiation of scintillating materials in crystal lattice structural changes are observed. Their peculiarities depend on such features, as type, intensity and duration of the irradiation. Those changes influence on spectroscopic properties of compounds.

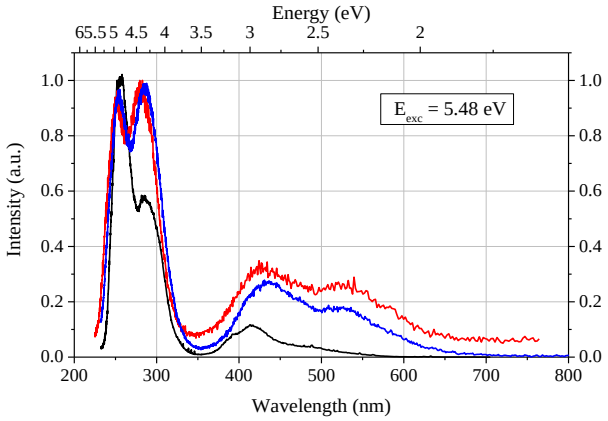

Fig.1. Photoluminescence spectra of $KLuP_2O_7:Pr^{3+}$ (1 %) upon UV excitation (E_{exc}), T = 295 K before (black) and after irradiation with 10 MeV electrons from LINAC (red), with neutrons (blue).

Crystalline powder $KLuP_2O_7:Pr^{3+}$ has been synthesized by a solid state reaction [4]. Luminescence spectroscopic properties upon UV-, X-ray and cathode-ray excitation have been previously studied in Refs. [4, 5]. These measurements approved promising characteristics of compound for scintillator applications.

To observe behavior of defect-related luminescence object was irradiated with electrons and neutrons. Fast electrons (E = 10 MeV) were obtained from linear electron accelerator in UrFU, Yekaterinburg. Fast neutrons (E > 1 MeV) flux was produced by pulse neutron reactor IBR-2 (FLNP JINR, Dubna). Both irradiation types cause defect formation inside lattice. Forming point defects is produced by impact mechanism – elastic collisions of particles with nucleus of lattice atoms. Redistribution of *d–f* transitions in 250-300 nm region is observed. In 450-550 nm region defect-relative radiative bands appear. These transitions are a sign of defects existing formed by radical groups of phosphorous and oxygen after interacting with irradiation particles.

REFERENCES

[1] M. Nikl, V.V. Laguta, A. Vedda, “Complex oxide scintillators: Material defects and scintillation performance,” Phys. Status Solidi (b), vol. 245, pp. 1701-1722, 2008.

[2] M. Nikl, H. Ogino, A. Yoshikawa, E. Mihokova, J. Pejchal, A. Beitlerova, A. Novoselov, T. Fukuda, “Fast 5d–4f luminescence of Pr^{3+} in Lu_2SiO_5 single crystal host,” Chem. Phys. Lett., vol. 410, pp. 218-221, 2005.

[3] A. Zych, M. de Lange, C. d. M. Donega, A. Meijerink, “Analysis of the radiative lifetime of Pr^{3+} *d-f* emission,” J. Appl. Phys., vol. 112, pp. 013536, 2012.

[4] M. Trevisani, K. Ivanovskikh, F. Piccinelli, M. Bettinelli, “Synchrotron Radiation Study of Interconfigurational 5*d*-4*f* Luminescence of Pr^{3+} in $KLuP_2O_7$,” Zeitschrift fur Naturforschung B, vol. 69, pp. 205-209, 2014.

[5] V.A. Pustovarov, K.V. Ivanovskikh, S.A. Kiselev, E.S. Trofimova, S. Omelkov, M. Bettinelli, “Testing performance of Pr^{3+}-doped $KLuP_2O_7$ upon UV-, sychrotron X-ray and cathode-ray excitation,” Opt. Mat., vol. 108, pp. 110234, 2020.

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