PULSE LUMINESCENCE OF $Pb_xCa_{1-x}MoO_4$ SOLID SOLUTIONS UPON EXCITATION WITH PICOSECONDS ELECTRON BEAM

Lukashov A.S.[1], Zykova E.A.[1], Trofimova E.S.[1], Omelkov S.I.[2], Pustovarov V.A.[1]

[1)] Ural Federal University, Yekaterinburg, Russia
[2)] Institute of Physics University of Tartu, Tartu, Estonia
E-mail: alexand-11@mail.ru

Spectra and decay kinetics of pulse cathode luminescence of $Pb_xCa_{1-x}MoO_4$ solid solutions in temperature range of 5-295 K are analyzed.

Calcium molybdate crystals show good potential for laser physics and acousto-optics due to a combination of wide range of functional properties. Over the last decades there has been a growing interest towards $CaMoO_4$ (space group 4/m, scheelite structure) because of its applicability as a material for cryogenic scintillation detectors, for example, in the physics of elementary particles [1]. On the other hand, PbMoO4 crystals are used as cryogenic scintillation detectors, here it suffices to point out PbWO4 use in the Large Hadron Collider. Earlier, we studied the luminescent properties of $Pb_xCa_{1-x}MoO_4$ solid solution under stationary UV and X-ray excitation [2]. The aim of this work is the study of their time-resolved luminescence properties under picoseconds pulse cathode-beam excitation.

Crystalline powders were obtained by solid-phase synthesis in Institute of Solid State Chemistry UB RAS by Dr. V.D. Zhuravlev. The samples were certified using XRD and chemical analysis methods. The pulse cathodoluminescence (PCL) spectra and PCL decay kinetics were measured using a Radan-330A pulse electron gun (E=120 keV, pulse FWHM = 200 ps, rate 5 Hz) in University of Tartu (Estonia) in temperature range of 5-300 K. A 0.3 m Andor Shamrock 303i monochromator equipped with fast picoseconds MCP-PMT detector was used for the registration [3].

Some of the main results obtained at room temperature are presented in Figure 1.

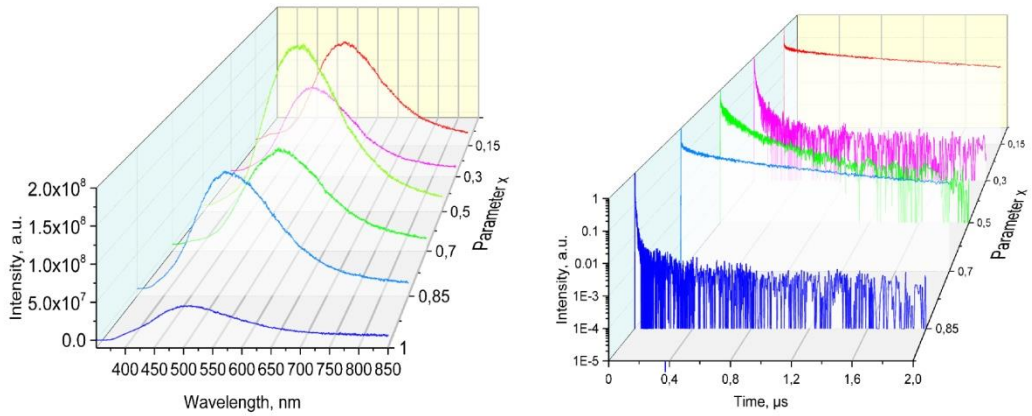

Fig. 1. Time-resolved PCL spectra and PCL decay kinetics at λ_{emis}=520 nm of $Pb_xCa_{1-x}MoO_4$ solid solution measured in 0-32 ns time window at different x parameters.

PCL spectra contains one wide emission band in region of 2.3 – 2.5 eV whose maximum position nonlinearly depends on x parameter. This emission band represents

the intrinsic emission which arises due to the radiative annihilation of excitons self-trapped at the $(MoO_4)^{2-}$ complexes, so-called STE luminescence. PCL output strongly depends on temperature. Moreover, PCL output and PCL decay kinetics strongly depend on the x parameter. These dependences are significant not linear, while XRD analysis shows that the unit cell volume of PbxCa1–x MoO4 linearly decreases with increasing of x parameter. That is, according to the XRD analysis, these samples are solid solutions and the well-known Vegard's law is fulfilled. The failure to comply with Vegard's law in the luminescence parameters is associated with features of their band electron structure.

In $CaMoO_4$ (x = 0) PCL decay kinetics contains components in μs time range only. The decay time is greatly reduced when the x parameter increases. At x = 1 ($PbMoO_4$), the PCL decay kinetics contains at room temperature exclusively the short components in the ns-range. PbMoO4 has the lowest PCL quenching temperature range (less than 100 K) and the fastest PCL decay kinetics at room temperature. Finally, we believe, that $Pb_xCa_{1-x}MoO_4$ solid solutions can have potential application in cryogenic scintillating bolometers.

1. V.B. Mikhailik, H. Kraus, J. Phys., D: Appl. Phys., 39 (2006).
2. A.O. Mufazalova, V.A. Pustovarov, AIP Conf. Proc., 2015 (2018).
3. S.I. Omelkov, V. Nagirnyi, E. Feldbach, R. Martinez Turtos, E. Auffray, M. Kirm, P. Lecoq, J. of Lumin. 191 (2017).

FERROELECTRIC DOMAIN ORIENTATION MAPPING USING ELECTRON BACKSCATTER DIFFRACTION AND DYNAMICAL SCATTERING SIMULATIONS

Lysakov M.N.[1], Chezganov D.S., Shur V.Ya.,[1]

[1)] School of Natural Sciences and Mathematics, Ural Federal University, Yekaterinburg, Russia
E-mail: makarkalisakov@gmail.com

We have applied EBSD and dynamical scattering simulations for orientation mapping of domains in several ferroelectric crystals and ceramics. We have shown that proposed approach allows to distinguish all kinds of domains namely c- and a-domains in ferroelectric materials.

The contribution of ferroelectric domains is important to the large permittivity and piezoelectricity in many ferroelectric materials [1]. Significant work has been carried out for understanding domain structure configurations [2]. Orientation mapping brings crucial information to study the relationship between microstructure and properties in crystalline materials. There are several techniques for domain structure imaging. The most common are optical microscopy, piezoresponse force, selective chemical etching accompanied by scanning electron microscopy and atomic force microscopy. These