XVII International Feofilov Symposium on Spectroscopy of Crystals Doped with Rare Earth and Transition Metal Ions

September 23–28, 2018, Ekaterinburg, Russia

Book of abstracts

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Book of abstracts of the XVIIth International Feofilov Symposium on Spectroscopy of Crystals Doped with Rare Earth and Transition Metal Ions (IFS2018), 23–28 September 2018, Ekaterinburg, Russia. – 250 p.

This book contains the abstracts submitted to the XVIIth International Feofilov Symposium on Spectroscopy of Crystals Doped with Rare Earth and Transition Metal Ions (IFS2018) held on September 23–28, 2018, in Ekaterinburg, Russia. The XVIIth Feofilov Symposium continues a series of International Feofilov Symposia started in 1965. These meetings are intended to provide opportunities for discussing advances in topical fundamental and applied research in spectroscopy of crystals doped with rare earth and transition metal ions. The first nine events were held as national meetings. For over 20 years, the symposia have been gathering researchers working in the fields of optical spectroscopy and condensed matter physics from all over the world. After the Xth (Saint Petersburg, 1995), XIth (Kazan, 2001), XIIth (Ekaterinburg, 2004), XIIIth (Lake Baikal, 2007), XIVth (Saint Petersburg, 2010), XVth (Kazan, 2013) and XVIth (Saint Petersburg, 2015) Symposia, IFS2018 returns back to Ekaterinburg. The invited, oral, and poster contributions cover various aspects of experimental and theoretical studies of the phenomena related to the *f*- and *d*-ions in

- *f*- and *d*-ions in crystalline and non-crystalline insulators and semiconductors
- Energy transfer, electron-phonon interaction and dynamics
- Relaxation of excited states and photoinduced phenomena
- Microwave-optical and teraherz spectroscopy
- Magnetic resonance spectroscopy
- Magneto-optical spectroscopy
- Nonlinear spectroscopy
- Resonant inelastic X-ray scattering
- Cooperative processes and coherent, phenomena
- Electron structure modeling and spectra simulation
- Microscopic theory of exchange and hyperfine coupling
- Charge transfer phenomena and charge ordering
- Solid-state lasers, scintillators, and phosphors
- Crystallography of optical materials
- Spectroscopy of photonic crystals
- Probing of organic and biomaterials

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Co-doped whitlockite-type phosphates for WLED application

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Materials with the whitlockite-type structure have a wide range of applications. Materials containing the rare earth ions (REE) recently are regarded as promising materials for LEDs [1] that can be used in wide fields, for example for the production of plants [2]. Besides, the compounds with the REE are interesting due to their luminescent properties. The whitlockite-type structure is a universal matrix for the implementation of the lanthanide luminescent properties.

The whitlockite-type structure phosphates with REE $Ca_9Gd_{(1-x-y)}Tm_xSm_y(PO_4)_7$, $Ca_8SrGd_{(1-x-y)}Tm_xSm_y(PO_4)_7$ x = 0.1; 0.2; 0.3; y = 0.05 were synthesized by standart solid-state reaction from stoichiometric amounts of $CaCO_3$, $CaHPO_4{\cdot}2H_2O$, $SrCO_3$, RE_2O_3 (RE= Tm^{3+}, Gd^{3+}, Sm^{3+}). Synthesis was carried out in the air for 120 hours with an intermediate mixing.

The photoluminescence spectra were measured for $Ca_9Gd_{(1-x-y)}Tm_xSm_y(PO_4)_7$, $Ca_8SrGd_{(1-x-y)}Tm_xSm_y(PO_4)_7$ system. As shown on PL spectra, which were registered at excitation wavelength 360 nm (fig. 0). The transitions of cations Tm^{3+} and Sm^{3+} in both systems were observed. Line at 450 nm corresponds to the transition of Tm^{3+} $^1D_2 \rightarrow {}^3F_4$; lines at 567 nm, 603 nm, 651 nm and 715 nm correspond to the transition of Sm^{3+} $^4G_{5/2} \rightarrow {}^6H_{5/2}$, $^4G_{5/2} \rightarrow {}^6H_{7/2}$, $^4G_{5/2} \rightarrow {}^6H_{9/2}$ and $^4G_{5/2} \rightarrow {}^6H_{11/2}$ respectively. In both systems is observed the increase of transition $^1D_2 \rightarrow {}^3F_4$ with addition thulium cation. In opposite to the Tm^{3+} transitions, the Sm^{3+} transitions show the decrease of transitions intensity (fig. 0).

The CIE coordinates are shifted from purplish pink to reddish purple [3] (fig. 0) due to redistribution of Tm^{3+} transition intensity, moreover, the CIE coordinates are close to white area.

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References:

1. D. V. Deyneko, V. A. Morozov, J. Hadermann, A. E. Savon, D. A. Spassky, S. Yu. Stefanovich, A. A. Belik, B. I. Lazoryak, J. Alloys and Compd, 2015, Vol. 64, pp. 965 - 972.
2. T. Nakajima, T. Tsuchiya, ACS Appl. Mater. Interfaces, 2015, Vol. 7, pp. 21398 - 21407.
3. Kelly, K. L. Journal of the Optical Society of America, 1943, Vol. 33, pp. 627-632.

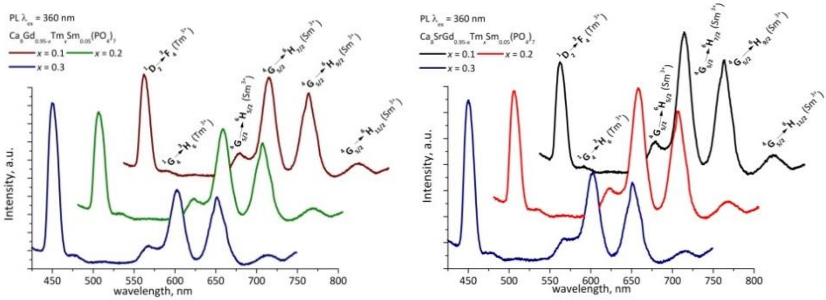

Fig. 1. PL spectra $Ca_9Gd_{(1-x-y)}Tm_xSm_y(PO_4)_7$ (right), $Ca_8SrGd_{(1-x-y)}Tm_xSm_y(PO_4)_7$ (left)

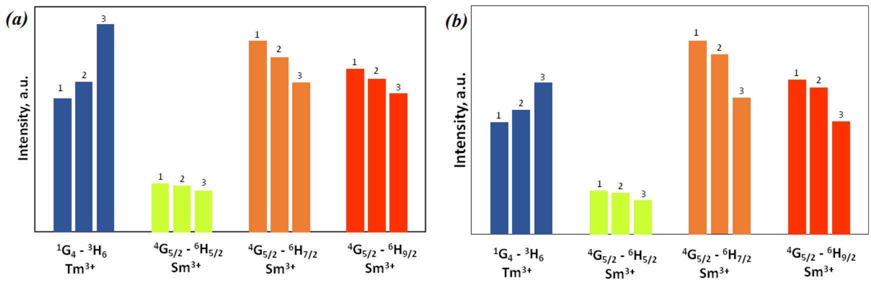

Fig. 2. Intensity of transitions in systems $Ca_9Gd_{0.95-x}Tm_xSm_{0.05}(PO_4)_7$ (a), $Ca_8SrGd_{0.95-x}Tm_xSm_{0.05}(PO_4)_7$ (b) x = 0.1; 0.2; 0.3

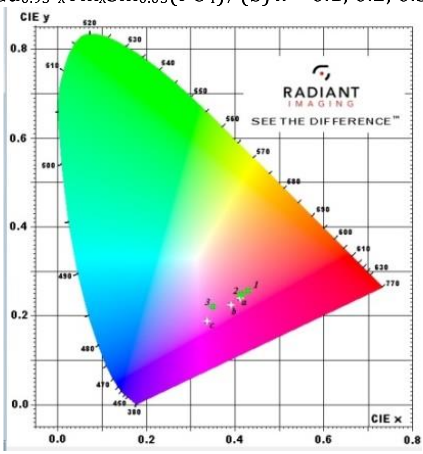

Fig. 3. CIE coordinates $Ca_9Gd_{(1-x-y)}Tm_xSm_y(PO_4)_7$ (white points), $Ca_8SrGd_{(1-x-y)}Tm_xSm_y(PO_4)_7$ (green points)