

Optical properties of $K_3Tb(PO_4)_2$ green phosphor

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Rare-earth (RE) doped phosphates are considered as perfect materials for elaboration of phosphors for lighting applications [1]. Among them the terbium-containing compounds have been studied as green phosphors as well as hosts for some other RE ions. In particular, energy level schemes of Tb^{3+} and Eu^{3+} ions support energy transfer from former to latter resulting in sensitization of orange-red light emission of europium. It was shown earlier that $K_3Tb_{1-x}Eu_x(PO_4)_2$ reveals intensive visible luminescence under excitation in a wide range from vacuum ultraviolet up to visible light [2]. At the same time optical properties of $K_3Tb(PO_4)_2$ host attracted little attention so far. It is worth considering the structure and properties of undoped host in order to find ways for improvement of luminescence characteristics (e.g. intensity, quantum yield, lifetime, etc.) of the $K_3Tb_{1-x}RE_x(PO_4)_2$ compounds.

The title compound has been synthesized by fluoride-assisted flux method. The diffuse reflectance, IR transmittance, photoluminescence (PL) emission and excitation spectra as well as PL decay kinetics have been measured and analyzed. It was found that the samples reveal absorption bands in 280-400 nm which were ascribed to defects in $K_3Tb(PO_4)_2$ crystals, namely to formation of Tb^{4+} ions and oxygen vacancies. The Tb^{3+} ions green luminescence dominates in spectra when PL excitation takes place in 110 – 480 nm spectral range. This PL is characterized by lifetime 2.6 ms regardless of the excitation wavelength. In addition, for the first time, the violet PL with a band maximum at 410 nm was found under excitation in the 270-325 nm range. The PL kinetics measurements have showed this violet luminescence reveals two components with lifetimes below 20 ns. The peculiarities of optical properties of the $K_3Tb(PO_4)_2$, in particular, quantum yield dependence on excitation wavelength, have been explained by impact of Tb^{4+} ions formed in the compound under study.

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