Compounds with bright luminescence in the UV spectral region attract attention due to their application in photocatalysis and photochemistry, for disinfection, as persistent phosphors and scintillating detectors [1-3]. UV phosphors with the emission in the UV-C range (<280 nm) are of particular interest for medical applications. Their excellent bactericide properties are determined by high spectral overlap of the UV-C range and the germicidal effectiveness curve [3]. An intense emission in the UV-C spectral range is usually observed for wide-bandgap ($E_g > 7$ eV) phosphors doped with Ce$^{3+}$ or Pr$^{3+}$ rare-earth elements (REE) as well as Bi$^{3+}$ ions [4]. Compounds with intrinsic emission are also in the scope of interest for the UV phosphor applications, however, the luminescence of this type suffers from quenching processes at room temperature in the majority of compounds.

Solid solutions allow tailoring of phosphor properties for specific demands. The fluctuations of the energies of the electronic states, forming the conduction band bottom and valence band top, introduced by the electronic states of substitutional atoms promotes localization of charge carries, thus increasing the probability of radiative relaxation and enhancing thermal stability. Here, we present the results of our studies of structural and luminescence properties of undoped $Y_{1-x}Sc_xPO_4$ solid solutions. An intense emission in the UV-C spectral region has been detected in the $Y_{1-x}Sc_xPO_4$ solid solutions ($x$ emission band depends on the Y/Sc ratio, thus allowing to tune the emission wavelength for specific application. The emission is characterized by excellent thermal stability and high quantum yield at 300 K. The origin and characteristics of the luminescence are discussed in the presentation. Numerical simulation of substitutional atoms spatial distribution is performed using Monte-Carlo method. The simulation describes the fluctuations of potential at the conduction band bottom in case of the absence or presence of correlations in Sc/Y atoms distributions. It is shown that the ScSc correlation is preferable for excitations localization in $Y_{1-x}Sc_xPO_4$ solid solutions with low Sc content.

References


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