

Spectroscopic characterization of $\text{Ca}_3\text{Y}_2\text{Si}_3\text{O}_{12}:\text{Eu}^{2+}$, Eu^{3+} powders in VUV-UV-vis region.

Autorzy

Anna Dobrowolska

Eugeniusz Zych

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$\text{Ca}_3\text{Y}_2\text{Si}_3\text{O}_{12}$ powders activated with Eu (0.1–25%) were prepared by means of ceramic method. Their spectroscopic properties in VUV-UV-vis region were investigated. Luminescence measurements indicated that $\text{Ca}_3\text{Y}_2\text{Si}_3\text{O}_{12}$ prepared in a strongly reducing atmosphere of 20% N_2 –80% H_2 mixture contained both Eu^{2+} and Eu^{3+} ions, and both were able to generate their characteristic emissions. A superposition of the broad band luminescence of Eu^{2+} and narrower $4f \rightarrow 4f$ luminescent features of Eu^{3+} upon excitation with 395 nm light-emitting diode covered almost the whole visible part of spectrum. The ratio between Eu^{2+} and Eu^{3+} emissions was reproducible, and, with increasing content of Eu, the relative intensity of the red component from Eu^{3+} became systematically stronger. The Eu^{2+} luminescence in $\text{Ca}_3\text{Y}_2\text{Si}_3\text{O}_{12}$ was characterized by an extraordinary large Stokes shift of $\sim 8960 \text{ cm}^{-1}$ and most probably had an anomalous character with a defect, presumably O-vacancy located in the vicinity of Eu^{2+} , being involved in the emission generation. Excitation into the VUV-UV region with synchrotron radiation revealed that at 10 K, despite Eu^{3+} and Eu^{2+} ions, two kinds of intrinsic emissions, peaking around 340 and 420–440 nm, contributed to the luminescence of $\text{Ca}_3\text{Y}_2\text{Si}_3\text{O}_{12}:\text{Eu}$. Luminescence measurements in the range of 293–573 K and decay kinetics of Eu^{3+} and Eu^{2+} emissions revealed that the continuously decreasing fraction of Eu^{2+} ions contributed to the emission with increasing temperature, yet the thermal quenching of emission monitored by changes in its decay time could merely be seen above 500 K. The unusual temperature behavior of Eu^{2+} luminescence in $\text{Ca}_3\text{Y}_2\text{Si}_3\text{O}_{12}:\text{Eu}^{2+},\text{Eu}^{3+}$ was assigned to the instability of exciton-like state diffused over $[\text{Eu}^{2+}\text{-O}_{\text{vac}}]$ defect cluster involved in the luminescence of Eu^{2+} . Although the performance of the phosphor was not optimized, 40–44% of the quantum efficiency of the overall luminescence upon near-UV excitation was measured, proving its high potential.

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