Erbium luminescence in (Y, Er, Yb)$_3$Al$_5$O$_{12}$ powders

L. S. Khoroshko [1],

N. V. Gaponenko [2],

M. V. Rudenko [3],

K. S. Sukalin [4],

A. V. Mudryĭ (Foreign) [5],

Yu. V. Radyush (Foreign) [6]

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1, 2, 3, 4 Research Laboratory 4.5 «Nanophotonics», Enter the Scientific and technological cluster of micro- and nanoelectronics, Department of Micro- and Nano-Electronics, Belarusian State University for Informatics and Radioelectronics, Minsk, Belarus

5, 6 Foreign (Scientific and Practical Center for Materials Science of the National Academy of Sciences of Belarus, Minsk, Belarus)

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Abstract: In this work, the Stokes and anti-Stokes luminescence (upconversion) of erbium in powders of yttrium-aluminum garnet with various concentrations of erbium, as well as co-doped with erbium and ytterbium, synthesized by the sol-gel method using multistage thermal

processing, was investigated. It was established that the phase composition of the resulting powders corresponds to the crystal structure of garnet. For all powders, high-intensity Stokes luminescence with a maximum at 1.53 μm was observed due to the $I_{13/2}4 \rightarrow I_{15/2}4$ electronic transition, and anti-Stokes luminescence was observed with the most intense band in the region of 0.65–0.69 μm, associated with the $F_{9/2}4 \rightarrow I_{15/2}4$ transition of Er^{3+} ions. The highest intensity of the Stokes luminescence is observed for the maximum substitution of yttrium by erbium considered here, which corresponds to the $Yb_{1.5}Er_{1.5}Al_5O_{12}$ stoichiometry. The highest intensity of the anti-Stokes luminescence is for the lowest erbium concentration and for codoping with ytterbium with $Y_{2.71}Er_{0.29}Al_5O_{12}$ and $Y_2Er_{0.5}Yb_{0.5}Al_5O_{12}$ stoichiometries, respectively.

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