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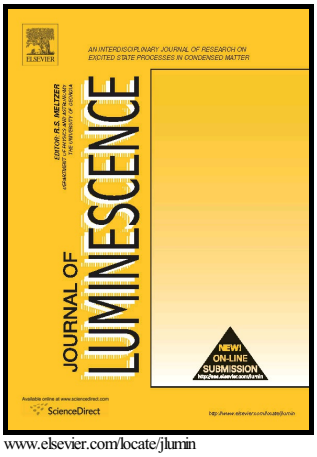

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PII: S0022-2313(17)31917-8
DOI: https://doi.org/10.1016/j.jlumin.2018.03.001
Reference: LUMIN15420

To appear in: *Journal of Luminescence*

Received date: 10 November 2017
Revised date: 1 March 2018
Accepted date: 1 March 2018

Cite this article as: Li Lin and Tang Wanjun, Effects of Tb^{3+} doping on luminescence properties of $NaMg_4(PO_4)_3:Eu^{2+}$, *Journal of Luminescence,* https://doi.org/10.1016/j.jlumin.2018.03.001

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Effects of Tb^{3+} doping on luminescence properties of $NaMg_4(PO_4)_3:Eu^{2+}$

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ABSTRACT

Eu^{2+} and Tb^{3+} co-doped $NaMg_4(PO_4)_3$ phosphors have been synthesized via a combustion-assisted synthesis method. A detailed study of the role of Tb^{3+} concentration on the luminescence properties of Eu^{2+} in $NaMg_4(PO_4)_3$: Eu^{2+},Tb^{3+} has been carried out. $NaMg_4(PO_4)_3:Eu^{2+},Tb^{3+}$ phosphors exhibited a broad excitation band ranging from 220 to 400 nm and two broad emission bands that peaked at 424 and 546 nm, which were ascribed to the allowed $4f^65d^1 \rightarrow 4f^7$ transition of Eu^{2+} ions and the $^5D_4 \rightarrow {}^7F_5$ transition of Tb^{3+} ions, respectively. Initially, the emission intensity of Eu^{2+} decreases with increasing Tb^{3+} concentrations, which is related to the energy transfer (ET) from Eu^{2+} to Tb^{3+}. Then, the Tb^{3+}-doped enhances the emission intensity of Eu^{2+} obviously. This can be ascribed to the possible oxidation-reduction process between Eu^{3+} and Tb^{3+} to give Eu^{2+} and Tb^{4+}, as confirmed by X-ray photoelectron spectroscopy and luminescence studies. The combined effects of ET_{Eu-Tb} and oxidation-reduction process between Eu^{3+} and Tb^{3+} on luminescence and emission color of $NaMg_4(PO_4)_3:Eu^{2+},Tb^{3+}$ phosphors are systematically investigated.

Graphical abstract:

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