

Switching green to red emission in tridoped ZrO₂:Yb³⁺-Er³⁺-Bi³⁺ nanocrystals

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Optical Materials. Volume 48, October 2015, Pages 92–96

doi:10.1016/j.optmat.2015.06.041

Abstract.

Tridoped ZrO₂:Yb³⁺-Er³⁺-Bi³⁺ nanophosphor was synthesized by hydrothermal process and demonstrated the possibility of switching from a strong green–yellow broadband signal to red emission due to Bi³⁺ and Er³⁺ ion by changing excitation from 350 nm to 970 nm, respectively. The green–yellow band is associated to the transition $3P_1 \rightarrow 1S_0$ and was overlapped with the green band associated to the transition $2H_{11/2} + 4S_{3/2} \rightarrow 4I_{15/2}$ of Er³⁺ as a result of the energy transfer from Bi³⁺ to Er³⁺. The strong red band is associated to $4F_9/2 \rightarrow 4I_{15/2}$ transition of Er³⁺ and enhanced by a factor of 3 as a result of the forward and backward energy transfer process (Er³⁺ → Bi³⁺ → Er³⁺). This sink effect where electrons can be stored temporally and released back can be useful to enhance the emitted signal of other lanthanides.

Keywords

Nanomaterials; Visible emission; Upconversion; Energy transfer