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Invited Speaker

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1st Edition of the International Conference on the Physics of Optical Materials and Devices-Asia

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Book of Abstracts

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TRIPLE RATIOMETRIC TEMPERATURE READ-OUT IN LUMINESCENCE THERMOMETRY WITH YAG:Dy,Cr

Vesna Đorđević [a,*], Zoran Ristić [a], Jovana Periša [a], Ivana Zeković [a], Aleksandar Ćirić [a], Željka Antić [a], Miroslav D. Dramićanin [a]

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Yttrium aluminum garnet ($Y_3Al_5O_{12}$, YAG)-based phosphors have been extensively studied and used in many fields, for example, as lasers or in LEDs [1,2]. When activated with rare earth or transition metal ions, YAG is an excellent temperature-sensitive phosphor. YAG:Dy^{3+} is well-known as a high temperature probe (up to 1700 K) the lifetime and intensity ratio thermometry [3], while YAG:Cr^{3+} shows the potential for use in thermometry in the temperature range of 77–600 K [4]. The aim of this work was to explore the of co-doped YAG:Dy^{3+},Cr^{3+} powders potential for luminescence thermometry by three luminescence intensity ratio (LIR) approaches, and to explore the energy transfer between the co-dopants.

For this aim, six samples were synthesized by Pechini metod with the final calcination temperature of 1100 °C and with the following compositions: YAG: 0.5Cr, YAG: 1Cr, YAG: 3Dy, YAG: 3Dy, 0.5Cr, YAG: 3Dy, 1Cr, and YAG: 3Dy, 1.5Cr. The X-ray diffraction measurement confirmed cubic garnet structure of YAG with no other phases, indicating that Dy^{3+} and Cr^{3+} ions were effectively integrated into the host lattice.

The usability of this material for luminescence thermometry was tested by three approaches:

1. LIR of Cr^{3+}/Dy^{3+} emissions, where in the temperature range from 200 K to 600K, Dy emission was slightly influenced by the temperature change, while the Cr^{3+} emission was strongly influenced;
2. Double excitation LIR, a novel approach to the temperature sensing, is applied by utilizing two excitation wavelengths in succession while measuring Cr^{3+} emission band. The excitations corresponded to two Dy^{3+} absorption transitions, the $^4H_{15/2} \rightarrow {}^4F_{9/2}$ and $^4H_{13/2} \rightarrow {}^4F_{9/2}$;
3. LIR Cr/Cr, where the intensity ratio of two Cr^{3+} emissions, the spin-forbidden $^2E_g \rightarrow {}^4A_{2g}$ and the spin-allowed $^4T_{2g} \rightarrow {}^4A_{2g}$, can be utilized above 200 K, when the ^2E_g and $^4T_{2g}$ states are in the thermal equilibrium.

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