Visual luminescence thermometry based $KGaGeO_4$: Ce^{3+}, Cr^{3+}

A. George#, M. Szymczak#, L. Marciniak#

Institute of Low Temperature and Structure Research, Polish Academy of Sciences, Okólna 2, 50-422 Wrocław, Poland

Developing luminescent thermometers for visual thermal imaging involves designing luminescent materials whose emission properties in the Vis spectral range change with temperature. To achieve this, it is necessary to employ a phosphor exhibiting at least two emission bands within the visible spectral range, each characterized by a distinctly different temperature dependence. In this context, the combination of Cr^{3+} ion emission, associated with the ^2E /$^4T_2 \rightarrow {}^4A_2$ electronic transitions in the red region, and Ce^{3+} ion emission, originating from the $5d \rightarrow 4f$ transition in the blue-green region, appears particularly promising. The differing mechanisms governing the depopulation of the excited states of these ions enable a thermally induced change in the color of the emitted light [1]. The combination of these two dopants makes the constructive of a ratiometric luminescence thermometric which enhances sensitivity.

In this work, we investigate $KGaGeO_4$: Ce^{3+}, Cr^{3+} thermometer, where Ce^{3+} occupies dodecahedral sites and generating a broad $5d \rightarrow 4f$ emission while Cr^{3+} resides at the octahedral position, enabling dual emission where intensity ratio $\Delta = I(Ce^{3+})/I(Cr^{3+})$ provides ratiometric method for accurate temperature sensing. The relative sensitivity tunes through excitation conditions. Both visible emissions enable observable color changes with temperature making suitable for visual readable thermometry. These findings demonstrate that Ce^{3+}, Cr^{3+} doped $KGaGeO_4$ is a promising platform for high performance optical thermometry.

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corresponding author: a.george@intibs.pl, m.szymczak@intibs.pl, l.marciniak@intibs.pl