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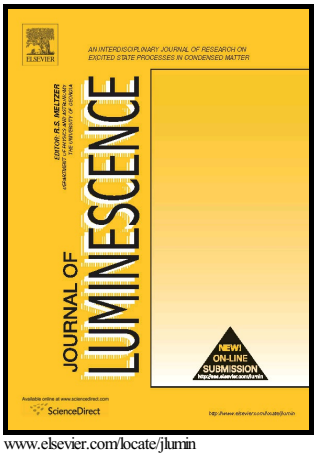

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Using the upconversion luminescence of the $CaWO_4:Yb^{3+}–X^{3+}$(X=Er/Ho/Tm) phosphors for ratiometric thermal sensing

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Abstract

Based on the luminescence ratiometric method, here we systematically investigate the relative sensitivity (*Sr*) of three pairs of typical thermally coupled energy levels (TCELs), that are, the $^2H_{11/2}/^4S_{3/2}$ levels of Er^{3+}, the two sub-Stark $^5F_5$ levels of Ho^{3+}, and the $^3F_3/^3H_4$ levels of Tm^{3+}, embedded in the $CaWO_4$ host. On the basis of the emission spectra of the $CaWO_4:Yb^{3+}–X^{3+}$(X=Er/Ho/Tm) phosphors, the gaps that separate the $^2H_{11/2}/^4S_{3/2}$, the two sub-Stark $^5F_5$, and the $^3F_3/^3H_4$ TCELs are calculated

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