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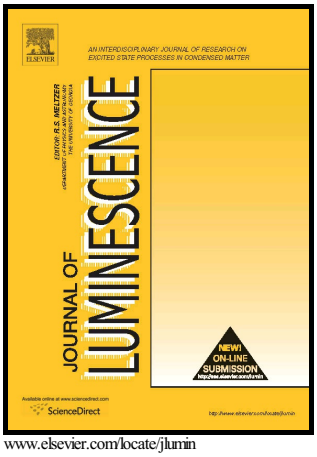

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A study on ratiometric thermometry based on upconversion emissions of erbium ions in gadolinium gallium garnet single-crystal

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Under 980 nm wavelength excitation, 530 and 550 nm green upconversion emission spectra of erbium-doped gadolinium gallium garnet single-crystal were measured in the temperature range of 298-423 K for ratiometric thermometry based on fluorescence intensity ratio (FIR). The crystal shows strong emission intensity, highly efficient ratiometric thermometric performance, as well as thermally stable emission spectral structure, it is thus a promising luminescent material for ratiometric thermometry. A multiple ratiometric thermometry is proposed and demonstrated in comparison with the usually adopted ratiometric thermometry based on integrated emission intensity. The multiple ratiometric thermometry considers six FIRs involving two component peaks of the 530 nm emission band and three component peaks of the 550 nm emission band, which result from an electronic transition from one Stark sublevel of the $^2H_{11/2}$ or $^4S_{3/2}$ state to another of the ground state $^4I_{15/2}$ of Er^{3+}. All the six FIR schemes show highly efficient sensing performances with slightly different temperature characteristics. The temperature is overall determined by the six FIR schemes, largely increasing the reliability of temperature measurement.

Keywords: Ratiometric thermometry; green upconversion emissions; erbium-doped gadolinium gallium garnet single-crystal.

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