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Yb^{3+}/Er^{3+} co-doped Lu_2TeO_6 nanophosphors: hydrothermal synthesis, upconversion luminescence and highly sensitive temperature sensing performance

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Abstract: Upconversion (UC) nanophosphors of $Lu_2TeO_6:Yb^{3+}/Er^{3+}$ as temperature sensing material have been successfully synthesized via hydrothermal method followed by a subsequent heat treatment process. The phase and micrographs of the as-prepared phosphors were characterized by XRD, SEM, and TEM. Results indicate that the phosphors of hexagonal $Lu_2TeO_6:Yb^{3+}/Er^{3+}$, formed after heat-treatment at 800 °C for 5 h, consist of rice-like nanoparticles with size mostly distributed less than 200 nm in length. Under the 980-nm NIR excitation, the tellurite nanophosphors exhibit strong green and red UC emissions. The optimum Yb^{3+} and Er^{3+} concentrations for UC luminescence are determined to be 10 % and 1 %, respectively. The possible energy transfer mechanism implicated in the nanophosphors is discussed based on the pump power dependence of UC emissions. Furthermore, temperature sensing ability of $Lu_2TeO_6:Yb^{3+}/Er^{3+}$ (10/1) is investigated by employing the temperature dependent fluorescence intensity ratio (FIR) of two emission bands ($^2H_{11/2}/^4S_{3/2}\rightarrow{}^4I_{15/2}$) of Er^{3+} ion. The maximum sensitivity achieved in this developed material is as high as 0.0103 K^{-1} at 623 K. This work provides a new qualified UC nanomaterial for application in optical remote temperature sensing.

Keywords: $Lu_2TeO_6:Yb^{3+},Er^{3+}$; nanophosphors; upconversion luminescence; temperature sensing

1. Introduction