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Yb³⁺/Er³⁺ co-doped Lu₂TeO₆ nanophosphors: hydrothermal synthesis, upconversion luminescence and highly sensitive temperature sensing performance

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Abstract: Upconversion (UC) nanophosphors of Lu₂TeO₆:Yb³⁺/Er³⁺ 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 Lu₂TeO₆:Yb³⁺/Er³⁺, 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 Yb³⁺ and Er³⁺ 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 Lu₂TeO₆:Yb³⁺/Er³⁺ (10/1) is investigated by employing the temperature dependent fluorescence intensity ratio (FIR) of two emission bands (²H_{11/2}/⁴S_{3/2} → ⁴I_{15/2}) of Er³⁺ 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: Lu₂TeO₆:Yb³⁺,Er³⁺; nanophosphors; upconversion luminescence; temperature sensing

1. Introduction

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