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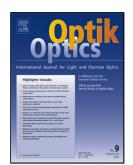
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ACCEPTED MANUSCRIPT

Synthesis and emission properties of Ca₃Nb₂O₈:Sm³⁺ phosphor and the emission improvement by Li⁺ ion

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Abstract: Ca₃Nb₂O₈:Sm³⁺ phosphor is synthesized by solid-state reaction method in air. Host Ca₃Nb₂O₈ emits blue light with excitation 260 and 314 nm, and its emission band peaking at ~ 460 nm is attributed to the ${}^{3}T_{1,2} \rightarrow {}^{1}A_{1}$ transations in [Nb₂O₈⁶⁻] group. Ca₃Nb₂O₈:Sm³⁺ phosphor with excitation 314 nm shows a systematically tunable emission by adjusting Sm³⁺ ion concentration, and only emits reddish-orange light with excitation 407 nm. Excitation band indicates that Ca₃Nb₂O₈:Sm³⁺ phosphor may be effectively excited by (~ 407 nm) near ultraviolet light-emitting diode chip. The optimal Sm³⁺ ion concentration is ~ 5 mol% in Ca₃Nb₂O₈:Sm³⁺ phosphor may be increased ~ 1.4 times by co-doping Li⁺ ions as charge compensator and fluxing agent roles. The experimental results will contribute to studying novel Sm³⁺-doped luminescent materials.

Keywords: Phosphors; Perovskite; Sm³⁺ ion; Optical properties; Energy transfer; Tunable emission

1. Introduction

Rare earth (RE) ions-doped luminescent materials have attracted much attention in many fields, such as fluorescent tubes, white light-emitting diodes (LEDs), field emission displays, solid-state laser, and biological labeling [1-4]. The fluorescence properties of Sm^{3+} (4/⁵) ion as RE ions are widely analyzed. Sm^{3+} -doped materials (e.g., crystals, glasses, and thin films) have been extensively reported because of the applications in color displays, fluorescent devices, and temperature sensors [5-8]. With excitation near ultraviolet (UV) light, Sm^{3+} -doped luminescent materials provide characteristic emission lines due to the peculiar electronic structure and energy levels of Sm^{3+} ion, which are almost independent of the host, however, the emission bandwidth and relative luminous intensities are governed by the characteristic of the host [9,10]. Therefore, it is important to select suitable compound as the host for the luminescent activator Sm^{3+} ion.

Niobate group materials have attracted much attention because of the good piezoelectric, electro-optic, pyroelectric, and non-linear properties and been used in many fields, such as phosphors, optical waveguides, and frequency doublers [11,12]. Niobate group materials containing niobium oxygen complex (NbO₆) with excitation UV light can emit visible light due to the charge transfer band (CTB) from O ligands to central Nb atoms within the complex [13]. In RE ions doped niobate materials, the RE ion activators can be excited by direct excitation or indirect energy transfer (ET) from the host and emit abundant fluorescence based on the 4f - 4f or 5d - 4f transitions of RE ion. At present, various RE ions doped niobates have been extensively studied and reported, such as KNbO₃:Eu³⁺, BaNb₂O₆:Eu³⁺, CaNb₂O₆:Yb³⁺, YNbO₄:Eu³⁺, YNbO₄:RE³⁺ (RE = Sm, Tb, Er), Ca₂AlNbO₆:Eu³⁺,

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