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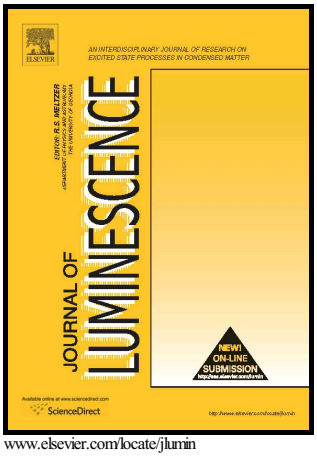

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Synthesis, structure and luminescence of $SrLiAl_3N_4:Ce^{3+}$ phosphor

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Abstract

Here we report a new phosphor, Ce-doped $SrLiAl_3N_4$, which can be effectively excited by green light at ~ 517 nm. A series of synthetic experiments are performed to find an optimal scheme. This phosphor has two emission bands at ~545 and ~610 nm corresponding to the *d-f* electronic transition of Ce^{3+}. Large centroid shift of 5d level results in a green light-excitable feature. Compared to other Ce^{3+}-doped nitrides, the crystal field splitting of 5d energy levels for this phosphor, i.e. about 11300 cm^{-1}, is much smaller due to larger volume and smaller distortion of coordination polyhedron of Ce^{3+}. The phosphor shows an excellent luminescent thermal quenching behavior. At 150 ^{o}C, the emission intensity retains about 93% of the initial value at room temperature upon 517 nm excitation. This property can be ascribed to rigid structure and large gap between 5d levels and bottom of conduction band.

Keywords: phosphor; Nitride; Ce^{3+}; Centroid shift; Crystal field splitting; Luminescent thermal stability.

1 Introduction

With the development of lighting technology, high-power white light-emitting-diodes (wLEDs) are inevitably applied in city square, stadium, port and dock, airport, long-distance flood lighting, underwater lighting, etc [1-3]. It is crucial to develop high-performance phosphor materials for high-power wLEDs. The narrow-band red-emitting $SrLiAl_3N_4:Eu^{2+}$ has attracted a lot of attention [4,5]. This phosphor can be efficiently excited by blue light, showing highly efficient narrow-band red emission at ~ 650 nm (full-width at half-maximum ~ 50 nm), very low luminescent thermal quenching (> 95% of its initial quantum efficiency at 200 ^{o}C) and a rise of 14% in luminous efficiency relative to commercial LED with high color rendering index (CRI) [4]. Based on its excellent performance, we have synthesized it by nitride precursors and tuned the luminescence spectra from 614 to 658 nm and 607 to 663 nm using chemical-unit cosubstitution strategy [6,7].

When 4f → 5d transition occurs for Ce^{3+}/Eu^{2+}, 5d electron is bare and extremely