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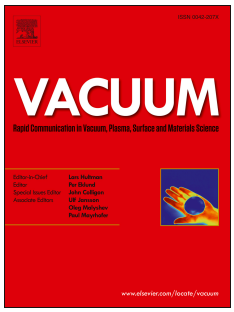


$Dy^{3+}$-, $Tb^{3+}$-, and $Eu^{3+}$-activated $NaCa_4(BO_3)_3$ phosphors for lighting based on near ultraviolet light emitting diodes

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# $Dy^{3+}$-, $Tb^{3+}$-, and $Eu^{3+}$-activated $NaCa_4(BO_3)_3$ phosphors for lighting based on near ultraviolet light emitting diodes

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## ABSTRACT

**A variety of $Dy^{3+}$-, $Tb^{3+}$- and $Eu^{3+}$-singly or doubly or triply activated $NaCa_4(BO_3)_3$ phosphors for light emitting diodes applications were synthesized via a high temperature solid state reaction technique under an ambient atmosphere. These phosphors were studied by X-ray diffraction, scanning electron microscopy, photoluminescence excitation and emission spectra, Commission International de I'Eclairage chromaticity coordinates, and correlated color temperatures. The emission colors of $Dy^{3+}$-, $Tb^{3+}$-, and $Eu^{3+}$-doped phosphors can be successfully tuned from green to yellow and then to white by appropriately changing the $Tb^{3+}$ content and the excitation wavelengths. The correlated color temperatures can also be tailored from cold color to warm color. Furthermore, the energy transfer process from $Dy^{3+}$ to $Tb^{3+}$ in the $Dy^{3+}/Tb^{3+}$ codoped phosphors exists, which is discussed based on the luminescence spectra and energy level diagram analysis. The $NaCa_4(BO_3)_3$:$Dy^{3+}$, $Tb^{3+}$, $Eu^{3+}$ phosphors reported here demonstrate promising applications in the fields of near ultraviolet based light emitting diodes.**

***Keywords:*** Phosphor; Light emitting diode; Luminescence; Energy transfer

## 1. Introduction

Nowadays, white light emitting diodes (W-LEDs) as green illumination technology have aroused increasing attentions due to their superior advantages of environmental friendliness, long

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