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White Light Emission Characteristics of Tb^{3+}/Sm^{3+} Co-doped Glass Ceramics Containing YPO_4 Nanocrystals

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The Tb^{3+}/Sm^{3+} single-doped and co-doped glasses and glass ceramics containing YPO_4 nanocrystals have been synthesized by melt quenching method. The structural and luminescent properties of these glass specimens were investigated. Under 375 nm wavelength excitation, the emission spectra combining with blue, green and red bands were observed, which achieved the white light emission. Moreover, the energy transfer between Tb^{3+} and Sm^{3+} ions was validated by decay lifetime measurement and energy level diagram. The color coordinates (x=0.333, y=0.333), correlated color temperature (5595 K) and the color rendering index (R_a=80.5) indicated that the glass ceramics were considered to be good lighting source. Hence, the YPO_4-based Tb^{3+}/Sm^{3+} co-doped glass ceramics can act as potential matrix materials for white light-emitting diodes under ultraviolet excitation.

Key Words: Glass ceramics; YPO_4; Tb^{3+}/Sm^{3+} co-doped; Luminescent properties; White light-emitting diodes

1. Introduction

Nowadays, white light emitting diodes (W-LEDs) have attracted much attention and replaced conventional fluorescent lamps owing to their high stability, lower power consumption, high brightness, long lifetimes and environmental benefit. It is well known that there are two different methods to produce W-LEDs. One is to combine blue LED (440–465 nm, GaN-based) chip with a yellow-emitting $Y_3Al_5O_{12}:Ce^{3+}$ (YAG: Ce^{3+}) phosphor. Another method is tri-color white LED. The drawback of the former method is the independent degradation rate between the blue LED and yellow phosphor, which will cause chromatic aberration and poor white light performance after long