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White light-emitting $Ba_{0.05}Sr_{0.95}WO_4$: Tm^{3+} Dy^{3+} phosphors

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Abstract Tm^{3+} and Dy^{3+} co-doped $Ba_{0.05}Sr_{0.95}WO_4$ phosphors were synthesized by a low temperature combustion method. The structures of the samples were $SrWO_4$ phase and were identified by X-ray diffraction. The surface topographies of $Ba_{0.05}Sr_{0.91}WO_4$: $0.01Tm^{3+}$ $0.03Dy^{3+}$ were tested by scanning electron microscope. The particles were ellipsoid, and their average diameter was approximately 0.5 μm. The emission spectra of $Ba_{0.05}Sr_{0.95}WO_4$: Tm^{3+} showed a peak at 454 nm which belonged to the $^3H_6 \rightarrow {}^1D_2$ transition of Tm^{3+}, and the optimum doping concentration of Tm^{3+} ions was 0.01. The emission spectra of $Ba_{0.05}Sr_{0.95}WO_4$: Dy^{3+} consisted of the $^4F_{9/2} \rightarrow {}^6H_{13/2}$ dominant transition located at 573 nm, the weaker $^4F_{9/2} \rightarrow {}^6H_{15/2}$ transition located at 478 and 485 nm, and the weakest $^4F_{9/2} \rightarrow {}^6H_{11/2}$ transition located at 660 nm, and the optimum doping concentration of Dy^{3+} ions was 0.05. A white light was achieved from Tm^{3+} and Dy^{3+} co-doped $Ba_{0.05}Sr_{0.95}MoO_4$ crystals excited at 352-366 nm. With the doping concentration of Tm^{3+} fixed at 0.01, the luminescence of $Ba_{0.05}Sr_{0.95}MoO_4$: Tm^{3+} Dy^{3+} was closest to standard white-light emissions when the concentration of Dy^{3+} was 0.03; the chromaticity coordinates were (0.321, 0.347), and the color temperature was 6000 K.

Keywords: phosphor, white light-emitting, luminescence, spectrum, $SrWO_4$

1. Introduction

In recent years, white light-emitting diodes (LEDs) have been widely used in various display, indicator, backlight and lighting applications due to their advantages of being pollution-free, having a long lifetime, and providing energy conservation and environmental protection [1-6]. The tungstate scheelite structure of AWO_4 (A=Mg, Ca, Sr, Ba) has been known to be important in optical materials [7, 8] because of its stable chemical properties and low phonon energy. The WO_4^{2-} ion has a tetrahedral structure and its central W^{6+} ion is coordinated by four O^{2-} ions. The outermost orbital of the ground state W^{6+} is filled with electrons. WO_4^{2-} will emit transition

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