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Recent Trends in Synthesis and Characterization of Futuristic Material in Sciences for the Development of Society

Organised by

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Combustion Synthesis and Luminescent Properties of Red-Emitting $Sr_{4-x}Al_6MoO_{16}$:xEu^{3+} Phosphors

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ABSTRACT

In the present work, Sr_{4-x} Al_6MoO_{16}:xEu^{3+}(x= 2,3,4 &5 %) red-emitting phosphors have been successfully synthesized by the combustion method and their photoluminescence characterization was performed. Photoluminescence spectra showed that the emission peaks at 593 ($^5D_0\rightarrow{}^7F_1$) and 615 nm ($^5D_0\rightarrow{}^7F_2$) for Eu^{3+} are observed after excitation at 270 nm (i.e. Mo–O charge transfer band). Intense red emission of Eu^{3+} in $Sr_{4-x}Al_6MoO_{16}$ host lattice show the occupation of a non-centrosymmetric site by the rare earth ions in the host lattice. The emission intensity of Eu^{3+} ions in the $Sr_{4-x}Al_6MoO_{16}$ host largely enhanced with the concentration increasing of activator (Eu^{3+}). Intense characteristic emissions show no concentration quenching up to 3 mol% concentration of rare earth ion and the emission intensity reached the maximum at x=4%. Among these phosphors, Sr_{4-x} Al_6MoO_{16}:xEu^{3+} synthesized at 750°C exhibits the strongest red emission and appropriate CIE chromaticity coordinates (x=0.637, y=0.359) close to the NTSC standard value. It is shown that $Sr_{4-x}Al_6MoO_{16}$:xEu^{3+} phosphors are demonstrating their potential suitability for application in solid state lighting.

Keywords: Phosphors; Combustion Method; Sr_{4-x} Al_6 MoO_{16} :xEu^{3+} ;Luminescence

I. INTRODUCTION

With the emerging global energy disaster and challenge caused by climate change, rare earth luminescent materials play a more and more important role in solid-state-lighting due to their exclusive electronic, optical, and chemical properties resulted from the 4f shell of the rare earth ions and are extensively applied to high performance luminescence devices, catalysts and other functional materials, etc [1]. In recent years, the light-emitting devices and optical phosphors of white light-emitting diodes (W-LEDs) have been paid much attention because of its wide applications as well as its advantages, for example, high color rendering index (CRI), long life time, high luminescence efficiency, low power consumption, and environment friendly [2–5]. Rare earth doped solid-state molybdates and tungstates exhibit outstanding chemical stability and long wavelength emission. Among these, rare earth doped scheelite-type (CaWO4) molybdates and tungstates have a large potential for use in WLEDs.[6–10] Recently a new application field has emerged for these materials as thermographic phosphors, due to their capacity to accurately visualize temperature gradients with high spatial resolution.[11] Due to charge transfer from oxygen to metal, tungstate and molybdate phosphors have intense, broad absorption bands in the near-UV region. Some scheelite-type compounds, such as $PbMoO_4$, $KGd(WO_4)_2$, $NaBi(WO_4)_2$ and MWO_4 (M = Pb, Cd, Ca) are well-known and used, while other $MLn(BO_4)_2$ (M = Li, Na, K, Ag; Ln = lanthanides, B = W, Mo) materials with Eu^{3+} cations are frequently suggested as red phosphors for WLEDs. For example, $NaEu(WO_4)_2$ and $KGd_{0.75}Eu_{0.25}(MoO_4)_2$ show strong, saturated red emission.[12-13]

To date, many methods have been used for the preparation of phosphor, such as hydrothermal method