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Photoluminescent propertied of AlN: Mn phosphors

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Abstract

White light-emitting diodes (WLEDs), which has high luminous brightness, longevity, low energy consumption and friendliness of environment, could be employed in diverse fields. Nevertheless, commercial phosphors are short of red light component. New phosphors which can emit red light are required. Mn^{2+} doped aluminum nitride (marked as AlN) red phosphors were prepared by a simple solid-state reaction. X-ray diffraction (XRD), scanning electron microscope (SEM), high-resolution transmission electron microscopy (HTEM), and X-ray photoelectron spectroscopy (XPS), as well as photoluminescence (PL) spectra were utilized to characterize the prepared samples. The preparing process of AlN phosphors, phase formation and crystal structure, morphology, and photoluminescence were detailedly investigated. For Mn^{2+} doped AlN phosphor(marked as AlN:Mn^{2+}), it exhibits an intense red emission caused by the $^4T_1(^4G)$-$^6A_1(^6S)$ transition of Mn^{2+}. The unusual red emission of Mn^{2+} is ascribed to the strong nephelauxetic and crystal field between Mn^{2+} and the tetrahedrally coordinated N^{3-}. The oxygen-related defects in AlN have a great influence on the photoluminescence properties of the Mn^{2+} doped AlN. The AlN:Mn^{2+} phosphor exhibits a high brightness, high color purity, and lower saturation, which makes it a great candidate of red phosphors for white light-emitting diodes (WLEDs).

Keywords: Mn-doped; AlN phosphor; photoluminescence properties

Introduction

With the growing scarcity of fossil fuels accompanying global warming, which makes some