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Short communication

Nanocrystalline $YMnO_3$ through microwave reaction followed by Calcination: Insights into structural, optical, and chromaticity properties for potential light emitting device application

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ABSTRACT

In this present work, no reports are available on the chromaticity characteristics of microwave-synthesized $YMnO_3$ nanostructures for potential LED application. $YMnO_3$ material was synthesized under different microwave power irradiations (420, 560, and 700 W), followed by calcination at 1100 °C for 2h. Additionally, a 2 wt% yttrium nitrate-assisted $YMnO_3$ sample was prepared under 420 W irradiation. The synthesized $YMnO_3$ compounds were extensively characterized to evaluate their structural, morphological, optical, luminescent, and chromaticity features. XRD analysis confirmed the formation of a hexagonal crystal structure. Three characteristic peaks at ~424, ~566, and ~680 cm^{-1} in the FTIR spectra correspond to Y-O and Mn-O vibrations, further validating the formation of $YMnO_3$. At low magnification, the nanoscale morphology of the 420 W sample exhibited rice-like structures, while high magnification revealed agglomerated spherical particles. SEM images of the $YMnO_3$ at 560 and 700 W showed a non-uniform distribution of spherical particles and elongated spherical morphologies at magnifications of 1 μm, 300, and 200 nm. The 2 % yttrium-nitrate-assisted $YMnO_3$ (420 W) exhibited porous structures with numerous smaller spherical particles, as observed at both lower and higher magnifications (1 μm, 300 nm, and 200 nm). The particle size of $YMnO_3$ was tuned under different microwave power irradiations (420, 560, and 700 W), as confirmed by SEM analysis. EDX analysis confirmed the presence of Y, Mn, and O elements in the synthesized samples. UV–visible spectra of synthesized $YMnO_3$ revealed strong absorption in both the UV and visible regions, with a narrow optical bandgap of 1.37–2 eV. PL spectra showed UV and visible emission peaks, attributed to electronic transitions and oxygen vacancy defects. The chromaticity coordinates of the 420 W sample corresponded to blue-cyan emission, while the $YMnO_3$ samples synthesized at 560 W, 700 W, and the 2 wt% yttrium nitrate-assisted $YMnO_3$ (420 W) exhibited emissions in the yellow region.

1. Introduction

Materials with optoelectronic properties such as wide range UV and visible luminescence, broad light absorption, superior energy efficiency, and intense light emission have been gradually focused on the lighting industries. Recently, advancements in developing photoemission and sensing materials have become crucial. Although materials and composites like metal oxides, metal titanate, and metal chalcogenides exist

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