Effects of Eu3+ on the morphological, structural and optical properties of BaTiO3@ZnO:Eu nanoparticles

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Abstract

Discovery of novel multifunctional photoluminescence materials are of great concern to the development of disciplinary crossing and integration. In this study, BaTiO3@ZnO multifunctional heterostructures and BaTiO3@ZnO:Eu were prepared via the combined sol-gel-hydrothermal methods. The structure, nanoparticle morphology, and optical properties of the heterostructure are discussed. X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), XPS, and Raman and photoluminescence spectra were used to characterize and monitor the heterostructure formation process. The results demonstrate that the Eu3+ ions were successfully incorporated into the ZnO matrix to form heterostructure thorn@ZnO:Eu. Moreover, the optical and photoluminescence properties were investigated. The X-ray diffraction pattern shows that the thorn@ZnO:Eu heterostructure is consistent with the relative intensities and positions of the peaks in the XRD, SAED and TEM spectra of thorn (BT) and ZnO:Eu, which are of rod-like shape. The intrinsic deep defect emission of ZnO and the transition emissions of both D-5(0)-> F-7(1) at 593 nm and D-5(0)-> F-7(2) at 616 nm, which are related to Eu3+, have been observed under excitation at 394 nm. The decrease in bandgap in response to increased doping and the addition of ZnO to BT can be attributed to the creation of sub-bands within the ZnO band range, thereby resulting in the continuous band effect and, consequently, band narrowing, which can provide guidance for the potential application for use in optical devices. (C) 2020 Elsevier B.V. All rights reserved.

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