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Phase Evolution of ZnFe_2O_4 in ZnFe_2O_4 - ZnO Nanocomposite Thin Films: Thickness-Dependent Structural and Antibacterial Applications

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Abstract:

This study investigates the synthesis and characterization of ZnFe_2O_4 - ZnO nanocomposite thin films, focusing on the effect of film thickness on the appearance of ZnFe_2O_4 in the composite. The films were prepared using the spray pyrolysis technique. Structural, optical, morphological, electrical, and magnetic properties of the thin films were systematically analyzed. X-ray diffraction (XRD) and scanning electron microscopy (SEM) confirmed the cubic morphology and crystalline nature of the films. Atomic force microscopy (AFM) was employed to further examine the surface topography, revealing the influence of thickness on the film's roughness and uniformity. The optical properties were studied through UV-Vis spectroscopy, revealing enhanced light absorption with varying film thickness. Impedance spectroscopy was used to assess electrical conductivity, showing a significant improvement with increased thickness, indicating enhanced electrical performance. The magnetic properties were investigated using vibrating sample magnetometry (VSM), demonstrating a notable increase in magnetic susceptibility. Additionally, the antibacterial activity of the nanocomposite films was evaluated, showing promising potential for application in antibacterial coatings. The results highlight the influence of film thickness on the properties and performance of the ZnFe_2O_4 - ZnO nanocomposites, particularly in terms of conductivity and magnetism, while underscoring their potential for practical applications in antibacterial technologies.

Abstract Category

Materials Physics

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