TEMPERATURE AND THICKNESS EFFECT OF NiO LAYER ON PHOTOCATALYTIC ACTIVITY OF NiO/ZnO HETEROSTRUCTURE BY ULTRASONIC SPRAY METHOD

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In this study, we have fabricated ZnO films, ZnO nanorods, NiO films, NiO/ZnO films, and NiO/ZnO nanorods. The aim of this study is to investigate the effect of deposition temperature (Ts=350-500 °C) on the structural, optical, morphological properties of NiO films; the effect of deposition temperature (Ts=350-500 °C) for NiO structural layer on the structural, morphological, electrical properties and photocatalytic activity of NiO/ZnO films, and the effect of NiO structural layer thickness (1, 2, 5 cycles) on the structural, morphological properties, and photocatalytic activity of NiO/ZnO nanorods. The samples were characterized by X-ray diffraction (XRD), UV-Vis spectroscopy, Fourier-transform infrared spectroscopy (FTIR), scanning electron microscope (SEM), Photoluminescence (PL), I-V measurement, and photodegradation of methylene blue (MB) aqueous solution under UV-B irradiation.

For NiO films, Increasing the deposition temperature (Ts) from 350 to 500 °C increased the crystallite size from 17 to 30 nm and increased the film thickness from 30 to 70 nm. FTIR showed that the carbon residuals in the films are reduced by increasing the Ts from 350 to 500 °C. Direct bandgap of NiO films is 3.65 eV if Ts≥ 400 °C. Annealing the NiO films at 600 °C enhanced the crystallite size and reduced the carbon residuals in the film.

For NiO/ZnO films, The I-V characteristics of NiO/ZnO films showed a pronounced rectifying behavior, confirming the formation of heterojunction between NiO and ZnO. Increasing the deposition temperature of NiO from 350 °C to 500 °C on ZnO film led to an increase of degradation efficiency of MB by NiO/ZnO films from 8% to 30%. The NiO/ZnO films which NiO layer was deposited at 500 °C exhibited a highest degradation efficiency of MB (30%) than ZnO film (26%).

For NiO/ZnO nanorod, by increasing the deposition cycles for NiO on ZnO nanorod from 1, 2, to 5 cycles, the degradation efficiency of MB by NiO/ZnO nanorod firstly increased from 60% to 64%, then decreased to 44%. The NiO/ZnO nanorod which NiO was deposited from 2 cycles showed the highest degradation efficiency of MB (64%) among NiO films, ZnO nanorod (48%) and NiO/ZnO nanorods.

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