

Effect of aluminum doping on the photocatalytic activity of ZnO thin films synthesized by spray pyrolysis route

HAFSA Loubna^{1*}, HADJERIS Lazhar¹, DJEBABRA Sara¹, HERISSI Labidi^{1, 2}.

¹LMSSEF, Larbi ben M'Hidi University, Oum El Bouaghi, Algeria.

²Department of Matter Sciences, Larbi Tebessi University, Tebessa, Algeria.

Code CCO 6

Email*: loubna.hafsa@univ-oeb.dz

Introduction & Objectives:

Heterogeneous photocatalysis is nowadays one of the most promising tools for a future sustainable development. In fact, the possibility of exploiting clean and renewable solar light harvested by cheap, abundant and non toxic metal oxides is highly appealing in view of the environmental and energetic challenges of the future [1]. Zinc oxide has several advantages over other photocatalysts because of its physical and chemical properties [2]. The present investigation aims to clarify the features responsible for the enhanced photocatalytic activity by means of a thorough characterization of 5% Al doped ZnO thin films prepared by a simple ultrasonic spray pyrolysis method. The physico-chemical properties of the prepared thin films were characterized by several techniques: X-Ray Diffraction (XRD), and Ultraviolet-Visible Spectroscopy (UV-Vis).

Methodology (Material and methods):

For the preparation of Al doped ZnO thin films nanostructures; 0.1 M of Zinc chloride ($ZnCl_2$), dissolved in 50 ml of deionized water was stirred vigorously by magnetic stirrer. Then, Aluminum Nitrate, ($Al(NO_3)_3 \cdot 9H_2O$) of preferred mole (0.1 M) prepared in 5ml aqueous were mixed. The resulting solutions were sprayed on the heated glass substrates by ultrasonic spray pyrolysis system.

Results and Discussion:

XRD analysis: The X-ray diffraction pattern of undoped and Al (5%) doped ZnO shows the recorded peaks indicate the wurtzite structure of ZnO according to the JCPDS 36-1451 [3]. All of the XRD peaks were attributed to ZnO, and no other undesired peaks.

UV-Vis spectroscopy analysis: The thin films obvious different average transmittance 24%, 10% for undoped ZnO and 5% ZnO-Al.

Photocatalytic activity: The photocatalytic activity is improved when ZnO is doped with Al atoms. Undoped ZnO shows 53 % degradation of MG after \approx 120 min of UV exposure, whereas, 5 % Al-ZnO sample shows 63 % degradation same time.

Conclusion: Thin films of undoped ZnO and doped with Al have been successfully synthesized by ultrasonic spray pyrolysis. The main structure of all thin films is wurtzite, in the form of grains size from 29 to 30 nm for undoped ZnO and doped with 5% Al respectively. The synthesis of the thin films doped with 5 % Al have an almost certain influence on the improvement of the photocatalytic activity obtained in this study.

Keywords: Spray pyrolysis, Photocatalytic, Al doping, thin films, Methyl green.

References

1. V. Khandegar, A.K. Saroha, (2013), Electrocoagulation for the treatment of textile industry effluent. a review, J. Environ. Manage. 128 949-963.
2. A. Fujishima, K. Honda, (1972), Electrochemical photolysis of water at a semiconductor electrode. Nature 238 37-38, <https://doi.org/10.1038/238037a0>.
- 3.F. Bourfaa, A. Boutelala, M.S. Aida, N. Attaf, Y.S. Ocak, (2020), Influence of seed layer surface position on morphology and photocatalysis efficiency of ZnO nanorods and nanoflowers, J. Nanomater. 2020 1-9.

