1882
doi:10.1017/S1431927616010254
Microsc. Microanal. 22 (Suppl 3), 2016

Synthesis of Mg doped ZnO with hexagonal shape by hydrothermal method

A. Corral-Aguado[1a], P. Martínez-Torres[1b], N. Gomez-Ortiz[2], J. Pichardo-Molina[3], Susana De la Rosa-García[4], S. E. Borjas-García[1b] and A. Medina[1c].

[1a.]Facultad de Ingeniería Química, [1b.]Instituto de Física y Matemáticas, [1c.]Instituto de Investigaciones Metalúrgicas, Universidad Michoacana de San Nicolás de Hidalgo, Morelia, Michoacán, México.
[2.] Department of Mechanical Engineering, University of California, Riverside, California, USA
[3.] Centro de Investigaciones en Óptica A.C., León Guanajuato, México.
[4.] División Académica de Ciencias Biológicas, Universidad Juárez Autónoma de Tabasco, Villahermosa, Tabasco, México.

ZnO is a semiconductor that has been extensively studied due to the high surface-to-volume ratio, intrinsic properties and beneficial physico-chemical properties as a nanostructured material where one of its applications is as biosensors [1]. Also, it has several applications in many fields, such as gas sensors, catalyst, LED, solar cells, and others. ZnO has been doped with various elements such as Mg, Cd, and Fe, in order to improve its optical and electrical properties [2]. Also, it is possible to tune the band gap of ZnMgO [3]. In this work we explore the possibility of Mg doped ZnO from a mixture of molar ratio Zn/Mg of 1:1 and control the size and morphology of the microstructures using hydrothermal treatment.

The synthesis of Mg doped ZnO was done from a mixture of $Zn(NO_3)_2$•$6H_2O$ (Aldrich, 98%) and $Mg(NO_3)_2$•$6H_2O$ (Aldrich, 99%) in a molar ratio Zn/Mg of 1:1 and then was prepared an aqueous solution of 0.4 M of 100 ml of this mixture which was vigorous stirring and heated at fixed temperature of 70 ºC. Once the solution reached the 70 ºC, 100 ml of the aqueous solution 0.8 M of NaOH (Aldrich, 98+%) was added drop by drop. Afterwards, the solution was transferred into a 45 mL Teflon lined stainless steel autoclave, which was sealed and maintained at 100, 160 ºC for 24 hr; a third sample was prepared by using one sample treated at 100 ºC for 24 hr and then it was treated at 160 ºC for other 24 hr. Finally, the product was centrifuged and washed with distilled water (18 MΩ cm) and ethanol (50:50 v/v) to remove the nitrates and sodium ions. The particles were dried at 40º C for 24 hr. The powder were analyzed by X ray Diffraction (XRD); the morphologies and microstructures were investigated using scanning electron microscopy (SEM), equipped with energy dispersive spectroscopy (EDS).

Scanning Electron Microscopy analysis shows the morphologies. Figure 1a shows hexagonal prism well defined with a size around of 200 nm of diameter and high around 300 nm with some small hexagons planes with sizes around 100 nm. Figure 1b shows a mixture of sizes of hexagons flakes with sizes around 100 nm to 300 nm maximum and finally figure 1c shows hexagonal flakes around 100 nm for small flakes and 300 nm for big flakes.

Energy dispersive spectroscopy analysis was conducted for the Mg doped ZnO nanostructures. EDS was used to get the composition of the Mg doped ZnO. Fig. 2a is the EDS spectrum of Mg-doped ZnO obtained when nZn/nMg is 40:40 (mmol:mmol) treated at 100°C, which gives the peaks of O, Mg and Zn. Their corresponding contents (atomic percent) are 60.04%, 14.12% and 25.84%, respectively. When is treated at 160° C (Fig. 2b), the EDS spectrum also shows the peaks of O, Mg and Zn, and their corresponding contents (atomic percent) are 60.08%, 16.41% and 23.51%, respectively. The third spectrum (Fig. 2c) of Mg doped ZnO obtained for a sample treated at 100 ºC for 24 hr then it was treated at 160° C for 24 hr, which gives the peaks of O, Mg and Zn. Their corresponding contents (atomic

percent) are 62.32%, 17.05% and 20.63%, respectively. EDS analysis shows that samples consist of Zn, O and Mg, which gives an evidence for the successful incorporation of Mg elements into ZnO nanostructures.

References:
[1] Alla Tereshchenko et al, Optical Biosensors Based on ZnO Nanostructures: Advantages and Perspectives.A Review, Sensors and Actuators B: Chemical http://dx.doi.org/10.1016/j.snb.2016.01.099
[2] Y. S. Wang, P. John Thomas, and P. O'Brien, J. Phys. Chem. B **volume** 110 (2006) 21412
[3] N. Guo et al, Applied Surface Science **volume** 317 (2014) 400

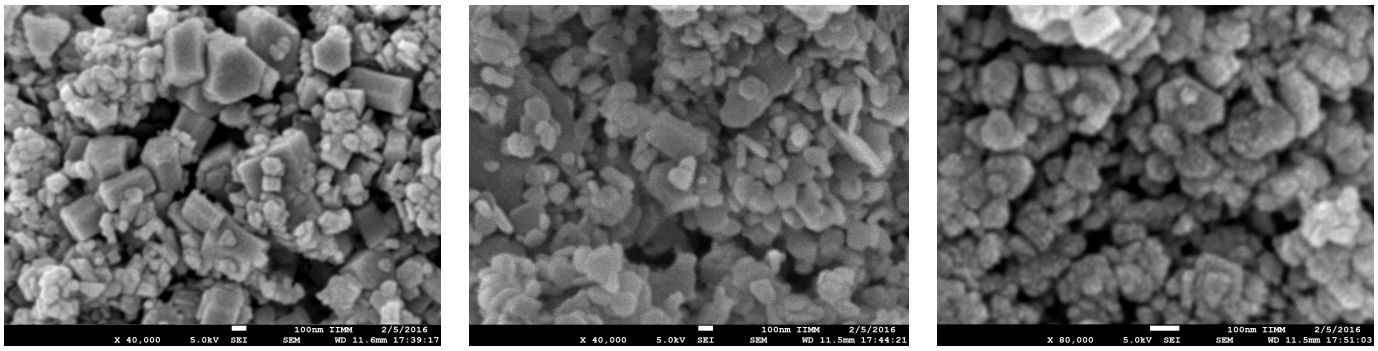

Figure 1. FESEM images of Mg doped ZnO nanostructures with different temperatures of hydrothermal treatment. a) 100 ºC for 24 hr., b) 160 ºC for 24 hr., and c) 100 ºC for 24 hr. plus 160 ºC for 24 hr.

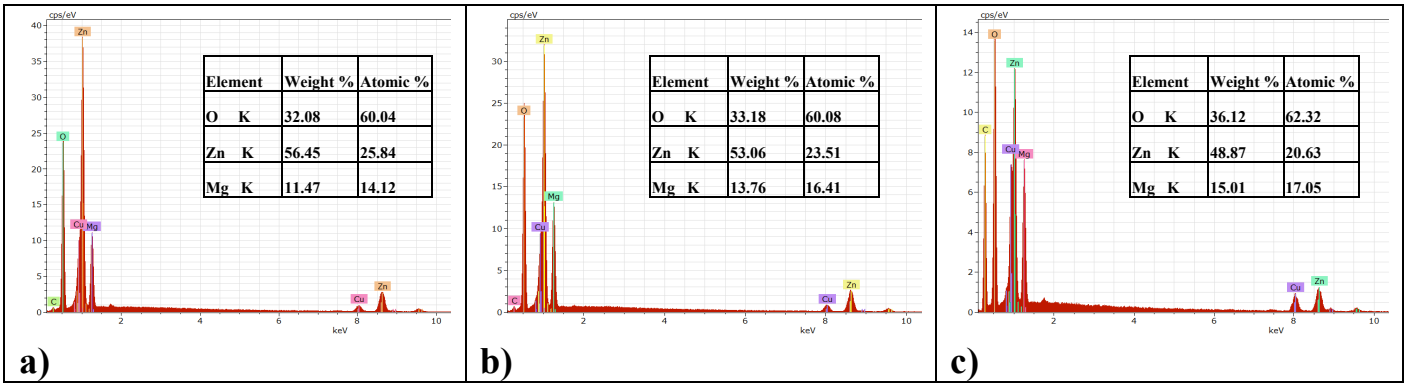

Figure 2. EDS images of Mg doped ZnO nanostructures with different temperatures of hydrothermal treatment. a) 100 ºC for 24 hr., b) 160 ºC for 24 hr., and c) 100 ºC for 24 hr. plus 160 ºC for 24 hr.

https://doi.org/10.1017/S1431927616010254 Published online by Cambridge University Press