Experimental study on pure and copper doped Zinc oxide thin films

Abstract

Pure and 1% Cu doped nanostructured ZnO thin films were deposited on glass substrates using sol gel spin coating technique under optimized conditions[1]. Structural, morphological and optical studies were carried out using XRD, FE-SEM and UV-Vis, respectively. Behavior of the fabricated ZnO thin films when going from pure to Cu doping has been reported. A comparison has been made, wherever possible, with other results [2, 3, 4].

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Introduction

Due to its wide band gap (3.31 eV) and large excitonic binding energy (60meV) [1], Zinc oxide (ZnO) is considered a promising material for a many applications in various electronic and optoelectronic devices such as light emitting diodes, photo detectors, solar cells, photo catalyst, gas sensors, transistors, supercapacitors, etc. This study is devoted to fabrication of pure and CZO wurtzite thin films [1] and to characterization of their structural, morphological and optical properties by many techniques like X-ray diffractometer (XRD), Atomic Force Microscopy (AFM), and Ultraviolet-visible (UV-vis) spectrophotometer.

Structural properties

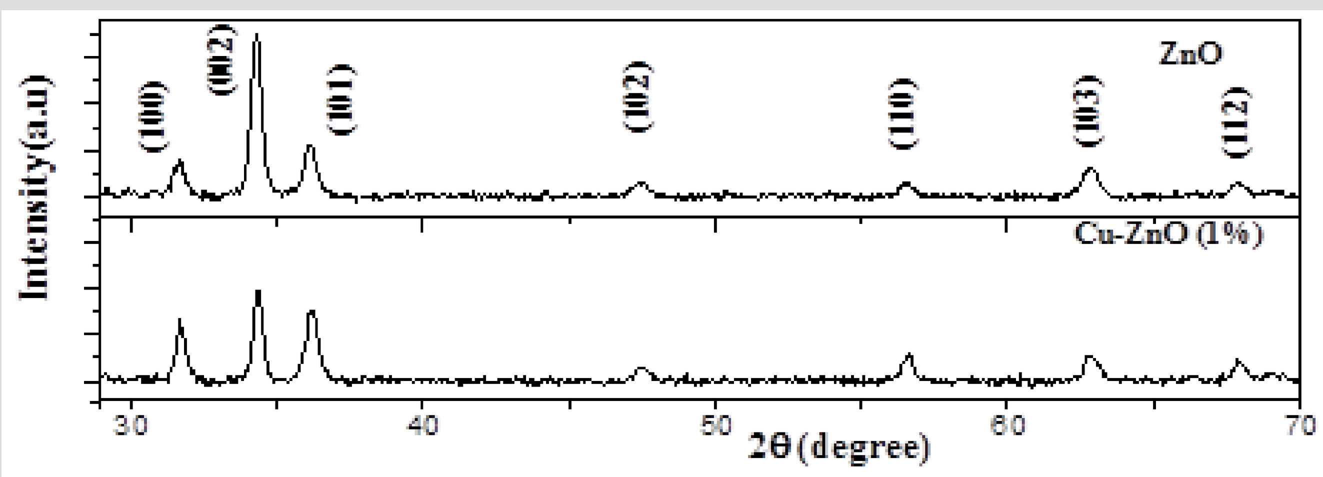

Figure 1. X-ray diffraction patterns of pure and CZO thin films

XRD pattern confirms the formation of polycrystalline with wurtzite hexagonal phase for pure and CZO thin films. No other phases were observed, indicating that hexagonal wurtzite structure of ZnO films isn't altered by Cu-doping. Unlike the intensity of (002) peak, (100) and (101) peak is generally enhanced,.

Morphological properties

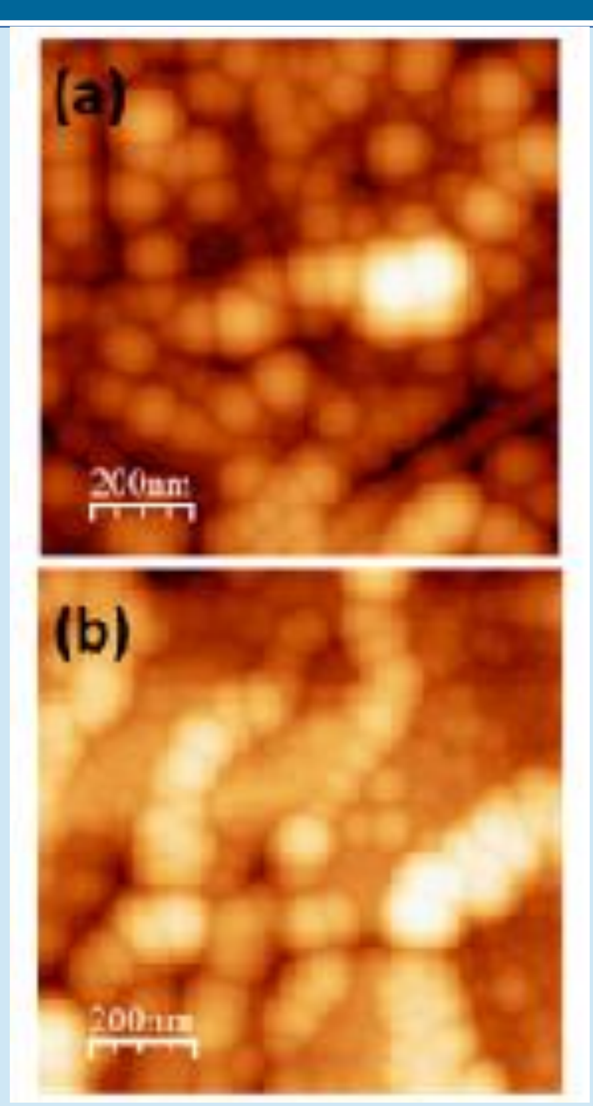

Figure1. 1.0 X 1.0 μm^2 2D AFM images are presented for pure (a) and Cu doped ZnO thin films.

Cu content %	2θ (°)	c (Å)	a (Å)	Strain ε_z (%)	Grain size from AFM (nm)
0	34.43	5.205	3.249	0.32	74.22
1	34.37	5.213	3.257	0.25	78.76

The grains, extracted from AFM images, are round shape and their average size increases with Cu doping .
Joshi et al. [19] remarked an increase in both crystallite size and grain size and a decrease in strain with Cu-doping

Optical properties

It can be seen that the transparency of films generally increases when going from pure to Cu-doped ZnO thin films in the visible region. This is due to the increase of grain size with Cu doping, which leads to reducing the grain boundary.
Saidani et al. [3] found similar behavior as the concentration of Cu was increased.

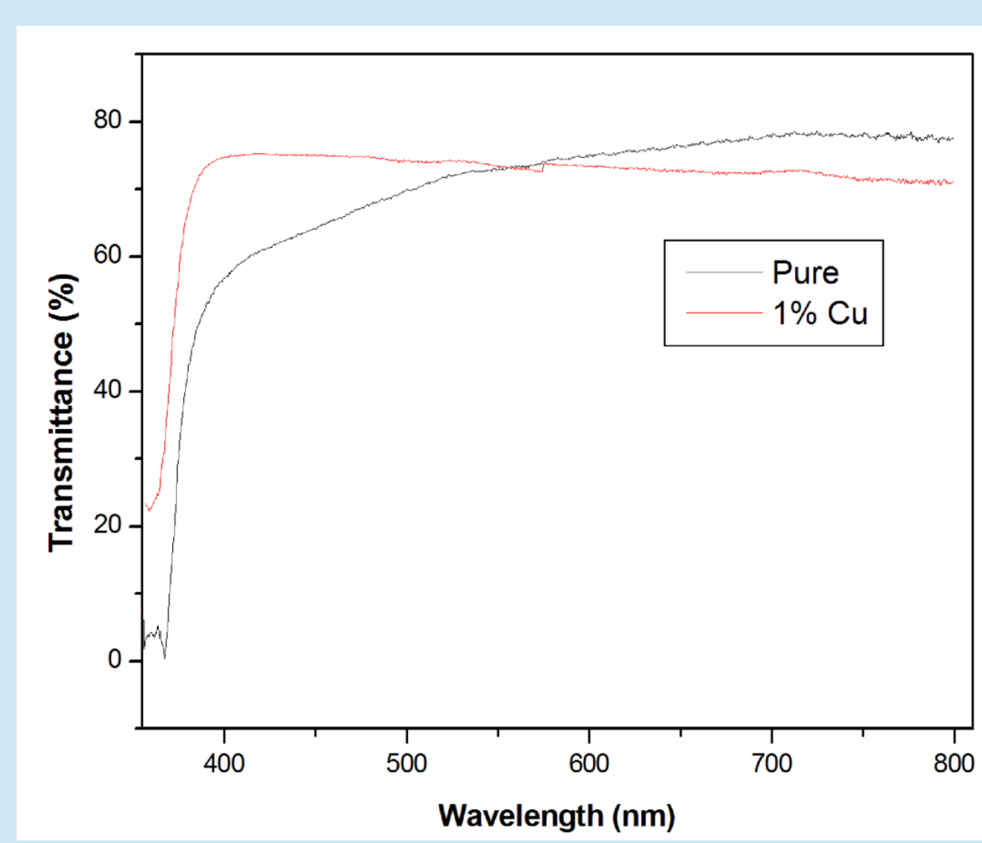

Figure 3. Optical transmission spectra of pure and Cu doped ZnO thin films .

Conclusion

Structural results show that all samples exhibited a polycrystalline with wurtzite hexagonal phase and both strain and growth mode were found influenced. Surface morphology reveals that grain size is affected by the Cu-doping. The transparency of films presents an increase in the visible region.

References.

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