e-Journal of Surface Science and Nanotechnology

Online ISSN : 1348-0391
ISSN-L : 1348-0391

Regular Papers

Effect of Mg Doping on the Structural, Optical and NO_2-sensing Properties of ZnO Thin Films Prepared by Modified SILAR Method

Nabeel Thabet Abood ✉, Pradip Bhanudas Sable, Jamil Yassen, Gopichand M Dharne

Author information

Keywords: *Modified SILAR*, *Mg-doped ZnO*, *Flowers-like*, *NO_2 gas sensor*

JOURNAL OPEN ACCESS

2023 Volume 21 Issue 3 Pages 193-199

DOI https://doi.org/10.1380/ejssnt.2023-029

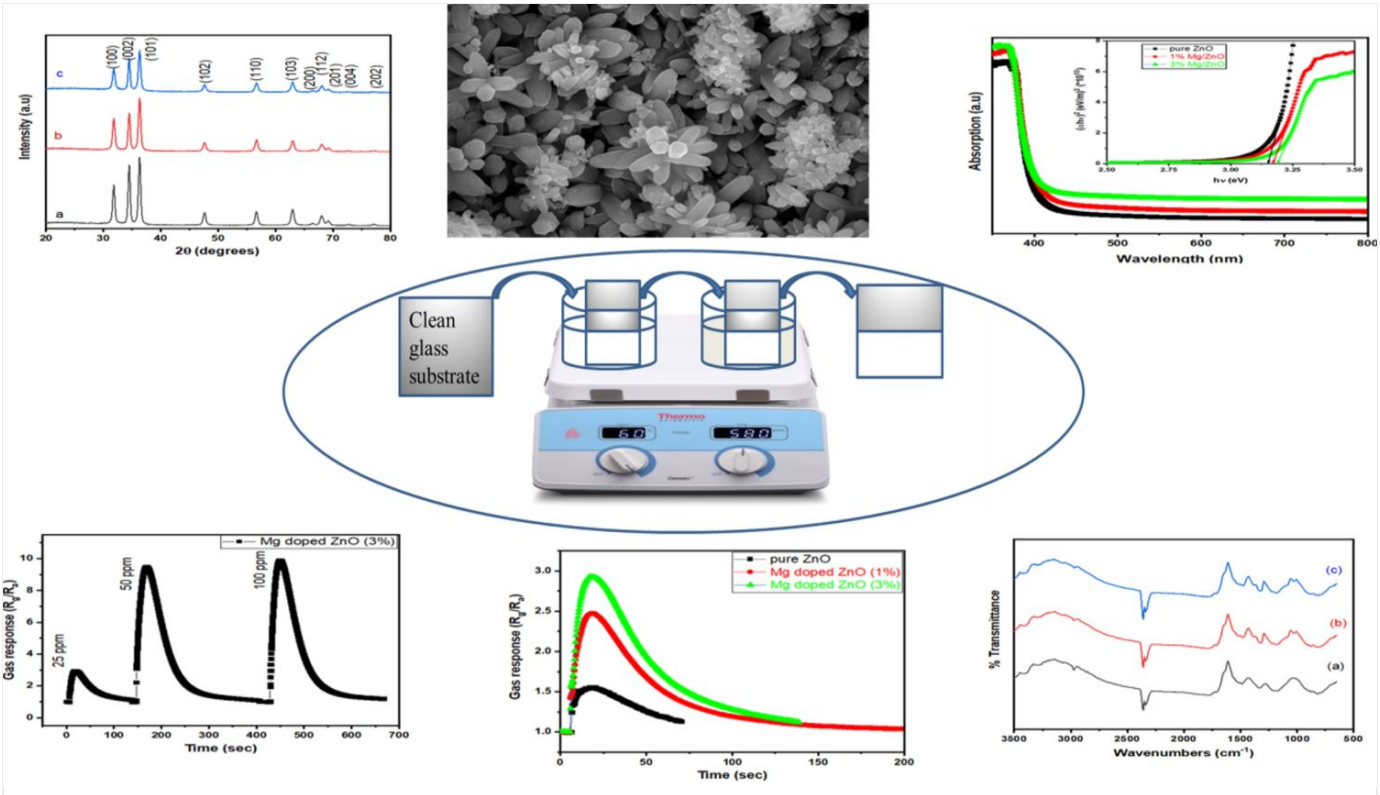
Browse “Advance online publication” version

Details

Abstract

In this report, we have prepared undoped and Mg-doped ZnO thin films by a modified successive ionic layer adsorption and reaction (SILAR) method. The structural, surface morphological, chemical compositional, and optical properties of pure and Mg-doped ZnO thin films were characterized by X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), energy dispersive X-ray spectroscopy (EDS), ultraviolet-visible (UV-VIS) spectroscopy, and Fourier transform infrared (FT-IR) spectroscopy. The XRD patterns of undoped and doped films have wurtzite crystal structures with preferential orientation along the (101) plane, without any secondary phases. Addition of Mg into host ZnO influenced surface morphology of the film. Predominant nanorods-like surface morphology of undoped ZnO turned to be predominant nanoflowers-like surface morphology after addition of Mg. UV-VIS spectra showed that the energy band gap of films increased with increase Mg doping concentration. EDS and FT-IR spectroscopy confirmed the successful Mg doping. Gas sensing properties of the undoped and Mg-doped ZnO thin films were tested based on the electrical resistance changes upon exposure to different concentrations of a NO_2 gas at 200°C operating

temperature. Mg-doped ZnO (3 wt%) showed higher response compared to other wt% and exhibited the highest responses of 2.95, 9.51, and 9.93 when exposed to 25, 50, and 100 ppm concentrations of the NO_2 gas at 200°C, respectively. The response/recovery time of the Mg-doped ZnO thin film were 6/75, 14/88, and 14/89 s at 25, 50, and 100 ppm, respectively.



Fullsize Image

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Edited and published by The Japan Society of Vacuum and Surface Science
Production services The Japan Society of Vacuum and Surface Science & Komiyama Printing Co., Ltd.