EFFECT OF Li, Cu AND N DOPING ON THE MORPHOLOGY, OPTICAL AND ELECTRICAL PROPERTIES OF ZnO THIN FILMS PREPARED BY SPIN-COATING TECHNIQUE

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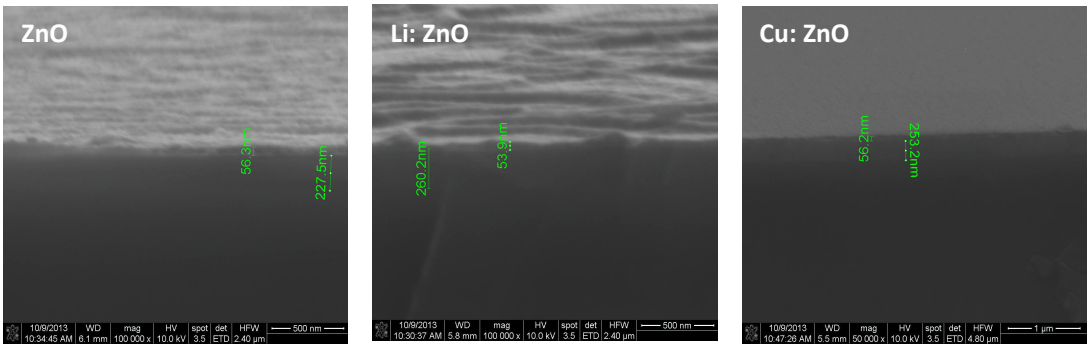
The effect of Li, Cu or N elements on the morphology, optical and electrical conduction properties of ZnO thin films has been studied for dopant concentrations in the range 1-5 wt.%. The films were deposited on p-type Si(100)/SiO_2 and glass substrates by sol-gel, spin-coating technique. A pre-heating treatment at 130 °C for 5 min was performed after each deposition and the multilayered films were annealed in a furnace at 500 °C in air atmosphere, for 1 h. Scanning Electron Microscopy investigation revealed that the surface morphology and porosity of the films are affected by the dopant type and doping concentration. Thus, Li:ZnO and N:ZnO films show rippled surfaces, while Cu:ZnO films surfaces appear smooth. The roughness decreases with increasing doping concentration. All the films present a good transparency with the transmittance in the visible region in the range of 80-83 % for Li:ZnO, 87-89 % for Cu:ZnO and 76-83 % for the N:ZnO films. The band gap energy calculated from the absorbance measurements varies from 3.21 eV in the case of undoped ZnO films to 3.22 eV for 5 wt.% Li:ZnO films, to 3.16 eV for Cu:ZnO films and increases to 3.24 eV for N:ZnO films. The blue shift of optical band gap observed in the case of Li and particularly N doping is attributed to the Burstein–Moss effect and suggests that these impurities are incorporated in the host matrix by creating shallow donor centers which challenge the formation of acceptor centers [1]. The optical band gap red shift which appears in the Cu doped films evidences that deep localized defect states are induced by Cu and can act as charge carriers traps [2]. The I-V characteristics of the films were measured in the dark and under the light conditions. The highest conductivity has been obtained in the case of 1 wt.% Li:ZnO films and 5 wt.% N:ZnO films. The optical and electrical properties of the films are discussed in relationship with the doping process parameters.



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[1] A. Janotti, C. G.Van de Walle, Rep. Prog. Phys. **72** (2009) 126501.
[2] M. Caglar, F. Yakuphanoglu, Appl. Surf. Sci. **258** (2012) 3039-3044.