

Effect of different solvents on the structural and optical properties of zinc oxide thin films for optoelectronic applications

Abstract

Zinc oxide (ZnO) seed solutions were prepared using 4 different solvents, namely, methanol (MeOH), ethanol (EtOH), isopropyl alcohol (IPA) and 2-methoxyethanol (2-ME). The prepared seed solutions were used to synthesize ZnO thin films using a low-cost sol-gel spin-coating method. The effect of different solvents on the structural and optical properties of ZnO thin films was investigated by field emission scanning electron microscopy (FESEM), atomic force microscopy (AFM), and an ultraviolet-visible-near infrared spectrophotometer (UV-vis-NIR). The images obtained in the FESEM and AFM showed that the thin film prepared using 2-ME has the smallest grain size. Moreover, the X-ray diffraction (XRD) results showed that the synthesized ZnO films are polycrystalline with preferred orientation along the (002) plane, whereas the IPA-derived films have a preferred orientation on (101) plane. The ZnO thin film synthesized with 2-ME has the highest transmittance (>90%), lowest surface roughness of 3.131 nm and highest band gap energy of 3.28 eV. The experimental data are in agreement with the calculated results by specific models of refractive index.

Keywords; Zinc oxide, Solvents, Optical, Structural, Sol-gel