Modification of the Micro-structural and Optical Properties of Nanoparticulate Pb -doped Magnesia Thin Films

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Adel M. El Sayed[1,2]

[1]Department of Physics, Faculty of Science, Northern Border University, Arar 91431, Saudi Arabia.

[2]Department of Physics, Faculty of Science, Fayoum University, Fayoum 63514, Egypt.

Abstract

Magnesia (MgO) nano-sized material is one of the most fascinating oxides regarding the scientific and technological applications. Pure and Pb-doped MgO thin films were deposited on glass substrates by the sol-gel spin coating technique. $Mg(NO_3)_2.6H_2O$, C_2H_5OH, and HNO_3 were used as the source material, solvent, and stabilizer, respectively. The structural, morphological, chemical composition and optical properties were studied using X-ray diffraction (XRD), atomic force microscopy (AFM), energy dispersive X-ray Spectroscopy (EDS) and UV-Vis-NIR spectroscopy, respectively. XRD results show that all films are of a cubic polycrystalline structure and their crystallite size decreased from 28 nm to 13.2 nm with increasing Pb content from 0.0 to 6.0%. AFM illustrates that the films' surfaces consist of spherical particles of uniform distribution with a very large number of particles per unit area. EDS measurements show that [O]/[Mg] is in the range 0.60 - 0.65, and confirm the existence of Pb in the MgO matrix. The films are highly transparent in the IR region and their transmittance in the visible region depends on Pb content. The optical band gap of the films decreased significantly with Pb doping. The effect of Pb loading on the extinction coefficient, refractive index, and other structural and optical parameters are also discussed.

Keywords: Magnesia; Pb -doped MgO; Refractive index; Nanoparticulate thin films; Band gap; Urbach energy.