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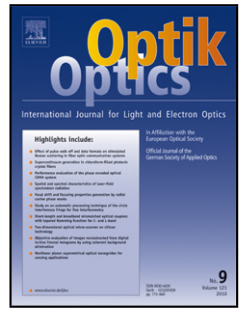

Title: Ellipsometric Study of Optical Properties of Sm-doped ZnO Thin Films Co-deposited by RF-Magnetron Sputtering

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<AT>1 Ellipsometric Study of Optical Properties of Sm-doped ZnO Thin Films Co-deposited by RF-Magnetron Sputtering

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<PA>***Corresponding author** 1.4 <ABS-HEAD>Abstract.

Non-volatile, rewritable and ultra-high-density optical memory necessitates photoreduction of valence state change of rare Earth elements. However, the sensitization of a nanoscale ultra-high storage medium possessing high optical transmission is a challenge.<remove picture pageno 1> Herein, we studied the optical properties of Sm deposited in ZnO thin film by Radio Frequency (RF) sputtering deposition method. The Sm^{3+} content, optical properties, and crystal structure were investigated via X-ray fluorescence (XRF), variable angle spectroscopic ellipsometry (VASE) and X-ray diffraction (XRD), respectively. X-Ray fluorescence (XRF) upheld the presence of Sm grains and verified its percentage increase with the deposition power. VASE data were fitted using effective medium approximation method (EMA) to determine the Sm^{3+} volume fraction and mass thickness (MT). XRD study verified the Wurtzite hexagonal structure stability of ZnO and no crystal structure or phase distortion occurred. The band energy gap of the composite decreased with Sm: ZnO content. The roughness and thickness uniformity of the thin films were determined by the VASE study and were confirmed using field emission scanning electron microscopy (FESEM) and atomic force microscope (AFM). The optimum Sm ions content of high transmittance has been determined.

<remove picture pageno 2> **Keywords:** Ellipsometry, RF sputtering, Rare Earth, volume fraction, mass thickness

<H2>1.5 1. Introduction

Nanostructured metals and metal oxides have inspected paramount attention because of their potential applications as active interconnect or main core materials in nanoscale electronic [1-3], optical [4-10], optoelectronic [11-14], electromechanical devices [15-25], magnetic catalysis [26-35], spintronics [36-41] and nanocarriers [42, 43]. Among them, ZnO nanomaterial has been widely studied owing to its wide direct band gap of 3.37 eV, large exciton binding energy of 60 meV, excellent chemical, mechanical, and thermal stability, and biocompatibility [44, 45] which render it to be used for high-technological applications ranging from photonic crystals [46] to gas sensors [47]. However, the structural, optical, and electronic properties of ZnO can be fine-tuned by doping with diverse types of elements [48, 49]. Metallic-doped ZnO has exhibited great potential in achieving improved or new types of electronic devices such as UV light emitting diodes, laser diodes, photodetectors and transparent conducting thin films [50, 51]. Despite the expected novel applications of Rare Earth (RE) elements-doped ZnO, they have not been studied extensively. However, novel applications of RE–doped metal oxides have emerged recently. 3D optical memories found their way in the field of high-density optical data storage [52]. Recently, it was reported that the change of the valence state of samarium ions helped the buildup of 3D rewritable optical memory with ultrahigh density [53]. These optical memories were found strongly dependent upon the variation of refractive indices of the deposited thin films. Therefore,