The Study Of The Magnetron Power Effect On ZnO:Al Films Properties Deposited by Layer By Layer Magnetron Sputtering Method

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Transparent conducting oxide (TCO) films are widely used in optical and electronic devices including solar cells, light emitting diodes, sensors, displays etc. Today the most widely used TCO is Indium-Tin Oxide (ITO). However this material presents severe drawbacks such as high cost, which is caused by the limited reserves of indium on the Earth. Therefore it must be replaced by cheaper material with similar properties. The intense research efforts are going on developing TCO materials for the ITO replacement. Among these TCO materials, ZnO has attracted much attention because it is abundant, inexpensive, non-toxic and friendly to human organism [1]. ZnO thin films are transparent in the visible region and can acquire high conductivity by doping with donor impurities (Al, Ga and In). The development of technology of aluminum doped ZnO TCO is the most cost-effective.

Many techniques have been used to deposit ZnO and ZnO:Al films on different substrates, including chemical vapor deposition, pulsed laser deposition, molecular beam epitaxy, magnetron sputtering, atomic layer deposition, spray pyrolysis, sol–gel and electrodeposition methods, etc. Magnetron sputtering is the preferred technique because of high speed film deposition and provides a composition of films close to that of the target material. To improve the electrical and optical parameters of aluminium doped ZnO films new approaches in magnetron sputtering technology are required.

Recently we represented new approach in magnetron sputtering of ZnO films: layer by layer growth when ZnO films are growing during several stages of deposition [2].

Therefore the aim of our work is studying the influence of magnetron power in proposed method on a structure, optical and electrical properties of ZnO:Al films. We change the power of magnetron from 100 to 250 W fixing other technological parameters such as substrate temperature, argon and oxygen working gas pressures, target-substrate distance.

The methods of X-ray diffraction analysis, atomic force microscopy, optical transmittance, Fourier transformed infrared spectroscopy, electrical resistivity and Hall measurements were used to reveal the magnetron power influence on aluminum doped zinc oxide films properties.

Our research has shown that the magnetron power strongly influences on the rate of films growth, the crystallite size, optical transmittance as well as electrical parameters. It should be noted that the application of layer by layer growth method for deposition Al doped ZnO thin films allow to decrease their resistivity compared with traditional magnetron sputtering. These data are discussed and represented in our presentation.

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[2] A.I. Ievtushenko, V.A. Karpyna, V.I. Lazorenko, G.V. Lashkarev, et al., *Thin Solid Films* **518,** 16, 4529 (2010).