

Study of Optical and Morphological TiO₂ Nano-Films Properties Deposited by Magnetron Sputtering on Glass Substrate

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Abstract. In this paper, TiO₂ nano-films were deposited by RF magnetron sputtering using a TiO₂ ceramic target of pure Ti of 3" diameter and 0.250" thickness with a purity of 99.99%, onto heated glass substrates in a temperature range of 200 to 450°C. This study determines the temperature effect on the structural, optical and morphological properties of TiO₂ nano-films. For this, we used X-ray diffraction for structural characterization and optical transmission spectroscopy UV-Visible for optical characterization and atomic force microscopy (AFM) for morphological characterization of the films produced. The (101), (400), (112), (200), (105), (211), (213), (204) peaks of the anatase structure and the (210), (102), (-112) (710) peaks of the monoclinic structure are observed. In addition, the peaks are sharp and intense which implies a good crystalline structure. Otherwise, the films optical gap variation is proportional to the temperature variation from 3.9eV to 3.92 eV for T=200°C and T=450°C, respectively. The surface roughness of TiO₂ nano-films range from 1,031nm to 4,665nm.

Keywords: Thin films, sputtering, semiconductor, TiO₂ nano-films, gas sensors, Nano-films, RF Magnetron Sputtering, DRX, UV-Vis, AFM.

INTRODUCTION

The detection and identification of the level of CO₂ in closed spaces are very important spots and even necessary. During the past few decades, transparent conductive oxides (TCO) as thin films are widely investigated for gas sensors because of their well-suited electrical, low costs, rapid answer, electrical conductivity and optical properties, and ability to detect large number of gases [1]. Recently, due to their excellent physical and chemical properties, TiO₂ thin films has attracted the intension of more researcher for its optical properties, nontoxic character and a high chemical stability [2, 3]. TiO₂ exists as three polymorphs namely rutile, antase and brockite [4]. Nevertheless, the most commonly encountered structure in thin film form are namely antase and rutile [5]. Several chemical and physical techniques have been used to deposit TiO₂ thin films including pulsed laser deposition, sputtering, sol-gel and spray pyrolysis [6-9]. Among these methods, the RF magnetron sputtering is one of the techniques witch is widely used due to its several advantages. It can achieve uniform layers having good adherence to the substrate, high mechanical durability and industrial process applicable to large-scale production, possibility of composition control as well as structure of deposited layers and offers the possibility to deposit at a different: temperature, power, pressure and voltage [5]. Therefore, our study consists of a deposition high-quality TiO₂ nano-films and investigating the temperature effect on the structural, optical and morphological properties.