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PHOTOCONDUCTIVITY STUDY OF TiO_2 THIN FILMS ANNEALED IN OXYGEN AMBIENT

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ABSTRACT

The main objective of this thesis is to present the research on photoconductivity of TiO_2 thin film annealed in oxygen ambient. Titanium dioxide thin films have been deposited on glass substrate by sol gel technique (dip coating method) at various oxygen flow rate. The electrical conductivity, surface morphology and optical properties of these thin films have been studied using Current Voltage (I-V) Measurement, SEM and UV-VIS-NIR Spectrophotometer, respectively. It is shown that in sol gel derived TiO2 thin films the oxygen adsorption has a great influence on photoconductivity. The photoconductivity depends on the ambient environment. A UV-VIS-NIR spectrum reveals all films exhibit high transmission (50%) in UV-NIR region. From I-V measurement result, the electrical properties were studied in dark and under illumination as a function of oxygen flow rate. Introduction of oxygen in TiO_2 based coatings induces an increase of their electrical resistivity. The reduction hardness of TiO_2 thin films with increase of the oxygen flow rate is discussed based on film structure that shown by SEM.

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CHAPTER 1: GENERAL

1.1 INTRODUCTION

TiO_2 films are extensively studied because of their interesting chemical, electrical and optical properties. TiO_2 is a high band gap semiconductor that is transparent to visible light and has excellent optical transmittance. TiO_2 has high refractive index and good insulating properties, and as a result it is widely used as protective layer for very large scale integrated (VLSI) circuits and for manufacture of optical elements.

Additionally TiO_2 films have potential uses for a number of electronic device applications such as dye-sensitized photovoltaic cells as well as antireflective (AR) coatings, gas sensors, electrochromic displays, and planar waveguides. The high dielectric constant of TiO_2 allows its consideration as an alternative to silicon dioxide for ultrathin gate oxide dielectrics used in memory and logic devices.

Several methods have been used to prepare titania films and these include chemical vapour deposition (CVD), pulsed laser deposition, reactive sputtering and sol-gel deposition. The sol-gel technique has emerged as one of the most promising techniques as this method produces samples with good homogeneity at low cost. To achieve optimum performance it is important to characterize the optical constants and thicknesses of thin TiO_2 layers accurately [1].