EFFECT OF DRYING TEMPERATURE ON TiO_2 THIN FILM BY SOL-GEL METHOD

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ABSTRACT

This project represents the effect of drying temperature on Titanium Dioxide (TiO_2) thin film. The thin films were prepared on glass substrate by using sol-gel spin coating method. Temperature has the most significant in the influence of thin films properties which may affect the properties of the TiO_2 therefore the thin films were dried at six different temperatures which are at room temperature, 50°C, 100°C, 150°C, 200°C, and 250°C. The sample was characterized into electrical, optical and structural properties. I-V measurement was taken in dark and under illumination by using two point probes solar simulator (BUKOH KEIKI-EP2000). The electrode was deposited using gold (Au) material onto the thin films. In this project, the bias voltage was applied from -10V to 10V. Based on the result obtained, it shows that the highest temperature gives highest current for both conditions in dark and under illumination and the sample dried at 250°C shows the best in all characterizations. The responsivity at 250°C is the highest compare to other samples and shows that the sample is able respond to light since there is much different between current in dark and under illumination. The resistivity decreased and conductivity increased with the increase of the temperature. The temperature at 250°C gives the lowest resistivity which is $1.30\times10^{3}(\Omega.m)$ and higher conductivity which is $7.71\times10^{-4(}S/m)$ among other temperatures. For optical properties, the optical spectra were measured in the visible region (300-850nm) by using UV-Vis spectrometer. The calculated optical spectra showed the lowest band gap is at 250°C which is 3.91ev for direct and 3.34ev for indirect band gap and the absorbance is the highest at 250°C among other temperature. The thickness of TiO_2 thin film was measured by surface profiler (VEECO/Dektak 150). The thickness of the thin film increased with the increased of temperature and shows the highest thickness at highest temperature which is 86.08 nanometer at 250°C.

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CHAPTER 1

INTRODUCTION

1.0 BACKGROUND STUDY

Titanium Dioxide (TiO_2) thin films are widely focussed due to its attractive synthetic, electrical and optical properties. TiO_2 is the subject of new discussion, yet it is a substance as old as the earth itself. It is one of the fundamental fifty chemicals conveyed around the world. It is a white, opaque and naturally. The interest in TiO_2 was mainly due to its non-toxicity and good stability in various environments. TiO_2 is a high band gap semiconductor that it is transparent to visible light and has excellent optical transmittance [1]. TiO_2 is considered as an inactive and safe material and has been utilized in many applications for a considerable length of time. In any case, with the advancement of nanotechnologies TiO_2 nanoparticles, with various novel and helpful properties are progressively made and used. TiO_2 has high refractive index and good insulating properties, and accordingly it is generally utilized as defensive layer for extensive scale integrated circuits and for assembling of optical elements.

In order to synthesis nanomaterial of TiO_2, a few methods have been utilized to prepare titanium dioxide thin film including chemical vapor deposition (CVD), pulsed laser deposition, reactive sputtering and sol-gel deposition [2]. However, sol-gel method has risen as a standout among the most promising method as this technique produces samples with great homogeneity at low cost.