INVESTIGATION ON DIPPING CYCLES OF TITANIUM DIOXIDE (TiO_2) THIN FILM BY DIP COATING TECHNIQUE FOR OPTICAL SENSOR APPLICATION

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ABSTRACT

Porous Titanium Dioxide, (TiO_2) thin films was deposited onto glass slides by the sol-gel dip coating method. The optical characteristics, thickness and surface of dip-coated thin films were characterized using UV-VIS NIR spectrometer, field emission scanning electron microscopy (FESEM), atomic force microscopy (AFM) and surface profiler. From this work, it is known that the more cycle of dipping, the more thickness of the thin films and increased the porosity of thin films been achieved. The resultant of TiO_2 thin films were investigated from 5, 10, 15, 20 and 25 dipping cycles. At 25 dipping cycles, AFM result revealed that the TiO_2 thin film has a good surface roughness and increased along with the thickness. FESEM shows that with 50K magnification, 25 dipping cycles shows the highest porosity value calculated which was 174nm. Optical properties result indicated the highest absorbance percentages value occurred at 25 dipping cycles indicated average of 0.10a.u and transmittance percentages value was vice versa. Furthermore, 25 dipping cycles too, indicated 3.10eV of optical energy band gap and all these results achieved after the thin films annealed at 450 °C.

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INTRODUCTION

1.1 INTRODUCTION

The discovery of porous forms of titanium oxide (TiO_2), in particular TiO_2 nanotube arrays, provides another candidate material for an optical sensor rather than using porous aluminia oxide (Al_2O_3) or silicon oxide (SiO_2). Therefore, this thesis allocated the work flow of finding the large porosity of TiO_2 deposited on the thin films by using dip coating technique.

1.2 BACKGROUND OF RESEARCH

Numerous nano-structural materials are well known for their various potential applications in sensor devices micro-mechanical, photovoltaic and electro optical[1],[2]. Titanium dioxide, (TiO_2), one of the material proved that had extremely high resistivity characteristic, defined as electrically insulating[3]. In addition, TiO_2 films are important optical films due to their excellent optical transmittance in the visible range[4], transparency over a wide spectral range and high reflective index [5]. Three phases exist in the TiO_2 crystal structure which are anatase, rutile, and brookite but, anatase and rutile are well discussed in optoelectronic applications [6], [7]. TiO_2 has wide energy band gap from 1.8eV to 4.1 eV energy range and labelled as to be high sensitive material[8],[9]. Furthermore, TiO_2 thin films are significant optical film due to their high reflective index[10] and transparency beyond a wide spectral range [11].

However, in previous work, there were some author claimed that porosity of other substances was less stable and lead to the discovery of other suitable substance which was more porous and greater aqueous stability[12]. In addition, there was no clear report especially about the porosity of the TiO_2 even doped with Fe[13]. Other than that, also there were work claimed that, reactions from photo-catalytic will firstly placed on the surface of TiO_2, where electrons will developed and cause the holes trapped [14]. The most important factor in order to identify the best and promising