UNIVERSITI TEKNOLOGI MARA

THE OPTIMIZATION AND CHARACTERIZATION OF TITANIUM DIOXIDE NANOSTRUCTURES COATED GLASS SURFACE PROPERTIES FOR SELF-CLEANING AND ANTI-BACTERIAL APPLICATIONS

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

The preparation of TiDoNs was successfully prepared on the glass surface using two phases process; Phase I process is sol-gel spin-coating technique while Phase II process is new invented technique, heat sol-dispersions immersion technique. The TiDoNs coated glass surface was optimized with four different parameters in Phase I process which affects precursor molar concentration, spinning rate, annealing temperature and multilayer TiDoNs while in Phase II process affects growth temperature. An optimum sample of TiDoNs was optimized shows that the surface morphology is random distribution and uniform shape with growth of small TiDoNs thorn-like structures at 100°C. The height of TiDoNs thorn is 17.5 nm and mean of particle size is 9.46 nm. It has 0.316 nm and 2.631 nm of roughness and thickness, respectively whereas, the optical properties shows that TiDoNs has transmittance at 84.03% attributed for absorption coefficients and optical band gap energy is about 25.25 α and 3.60 eV, respectively. An optimum sample of TiDoNs was then characterized for self-cleaning (SC) and anti-bacterial (AB) applications. For application I, the results of self-cleaning application characterized using contact analyzer (CA) shows that the working efficiency and performance of hydrophilic TiDoNs coated glass surface was drastically decreased from 68.12° to 0.35° of contact angle after 2.30 minutes. For application II, the results of anti-bacterial testing indicated that after 24 hours, an *Escherichia coli* (E. Coli ATTC 25922) species bacterial was not seen growth at the middle of TiDoNs coated glass surface but it grew away from the coated area. After 40 hours, the bacterial species was found to be dead.

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CHAPTER ONE
INTRODUCTION

1.1 INTRODUCTION

Titanium dioxide (TiO_2) was discovered in 1918. It has been employed in research into various applications. Since 1959, the discovery of the nanometer scale materials has become a favourable research to scientists all over the world. It is due to many advantages such as has high surface area per volume ratio and specific surface area [1, 2], the ability to function at lower level dimension and have novel properties towards solar cell, anti-reflective coating, water purification and others applications. The first man who discovered the nanotechnology is Nobel Laureates Richard P. Feyman the receiver of Nobel Prize in 1959 [3]. At National Nanotechnology Initiative (NNI), according to the Richard Booker et. al., (2005) the nanotechnology is defined as the research and development technology of the materials in the range between 1 to 100 nm [4]. Due to that, the nanomaterial has been utilized and created towards their small size with various methods. These structures have novel properties and can be manipulated at the atomic level [4]. Afterwards, the nanotechnology continuously experience the era of evolution due to high demand from worldwide market to fulfill all aspects of applications. Among the fields that have experienced a large evolution are biotechnology, automotive industry, medicine, pharmaceutical, engineering manufacturing, energy and electrical, health, safety and security, and others. These fields have been using three dimensions of TiO_2 nanomaterial to fulfill the present demand. Based on nanometer scale materials, one dimension nanomaterial is nanocoating while two dimension is nanowires and nanotubes, three dimension is nanoparticles[5].

An example of a well-known and most favourable material in the nanomaterial research is titanium dioxide (TiO_2). It is due to its unique structural properties; existence in three phases is anatase [6], rutile [7] and brookite [8]. These properties have made TiO_2 most prominent and are widely useful in many applications. Among the three