UNIVERSITI TEKNOLOGI MARA

SYNTHESIS AND CHARACTERIZATION OF ZnO GROWTH ON PMMA THIN FILM BY SOLUTION-IMMERSION METHOD AS A POTENTIAL IN UV RELATED APPLICATION

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ABSTRACT

In this study, preparation and characterization of ZnO grown on PMMA thin film was investigated. The procedure was divided into two steps; preparation of PMMA thin film followed by growing ZnO on PMMA thin film. The PMMA thin films were prepared using sol-gel spin-coating method. The AFM image showed that the homogenous thin film is obtained at 6×10^3 wt% of PMMA. It was found that the PMMA thin film gave good UV absorption for 7 layers of deposition on the glass substrate at annealing temperature of 100°C. The ZnO were next grown on PMMA thin film using solution-immersion method with $Zn(NO_3)_2.6H_2O$ as a precursor and $C_6H_{12}N_4$ as a stabilizer. The size of the rods decreased (from 2.430 μm to 0.497 μm) (almost ~79% of size reduction) as the precursor concentration was increased as seen by FESEM analysis. It was found that the precursor concentration of 0.10 M produced the highest intensity of (002) plane compared to the other concentrations (0.01 M, 0.05 M, 0.15 M and 0.20 M) in XRD analysis. In order to protect the properties of PMMA, low annealing temperature (< 200°C) was used to grow ZnO. ZnO annealed at 100°C for 30 minutes exhibit homogenous films with higher absorption of UV. The surface morphology, structural properties and UV absorption of ZnO rods on PMMA was significantly affected by the change of precursor concentration and annealing treatment. To determine the potential sample for UV related applications, a comparison study was carried out. It was found that the ZnO on PMMA thin film produced almost 84% increase in absorption at UV region. The UV absorption of the film almost covers the UV range up to about 400 nm and the visible light transmission was permitted. Thus, the sample was able to prevent the penetration of UV light and maintained transparent which could be applied in transparent UV-protective coating and UV-shielding windows.

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CHAPTER ONE
INTRODUCTION

1.1   NANOTECHNOLOGY

The term 'nanotechnology' was first used in 1974 by late Norio Taniguchi (University of Tokyo) as the ability to engineer materials precisely at the scale of nanometers. It is defined as the field of applied sciences aiming in the production and usage of materials and structures manipulated close to the atomic or molecular scale ranging from 1 to 100 nanometers in dimensions (Zhong Lin Wang, 2004).

Various forms of nanotechnology have significant impact on society. With variety of potential applications such as in medicine, electronic, biomaterials and energy production, nanotechnology is the key technology for the future (Cristina Buzea & Ivan Pacheco, 2007). Nanotechnology is also applied in fields of science such as surface science, organic chemistry, molecular biology, semiconductor physics and microfabrication which include the materials in a form of very thin films used in catalysis and electronics, two dimensional nanotubes and nanowires for optical and magnetic systems, and as nanoparticles used in cosmetics, pharmaceuticals and coatings (Zhong Lin Wang, 2004). Thus, much of fascination with nanotechnology stems from quantum and surface phenomena that matter exhibits at the nanoscale.

1.2   RESEARCH BACKGROUND

Polymer thin films are a novel class of materials that have found their way into a wide range of industrial and biomedical applications which now are an integral part of our everyday livess. Poly(methyl methacrylate) (PMMA) is a transparent thermoplastic polymer that has been extensively studied due to its broad commercial and industrial applications. It possesses desirable properties such as lightweight, high light transmittance, good tensile strength and resistance to weathering corrosion. Therefore PMMA has a wide range of potential application in the field of optical, optoelectronic applications and sensing devices (Gautam A & Khanna PK, 2016; I. Capan & T. Tanrisever, 2007; Mari Napari & Manu Lahtinen, 2015). Extensive work