UNIVERSITI TEKNOLOGI MARA

THE DEVELOPMENT OF NANOSTRUCTURED ZINC OXIDE THIN FILMS FOR HYBRID SOLAR CELL 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 sol-gel dip coating and sonicated sol-gel immersion technique were successfully employed to synthesize nanostructured Zinc Oxide (ZnO) thin film. The thin film was deposited on Corning 7740 glass substrate. The electrical properties of the synthesized nanostructured ZnO thin film were investigated using current-voltage (*I-V*) measurement to study the electrical resistivity behavior of the thin films. The structural properties of ZnO thin films were characterized using X-Ray Diffraction (XRD) for determining the crystallinity of the thin films and for particle size estimation. The surface morphologies of prepared ZnO thin films were observed using Field Emission Scanning Electron Microscopy (FESEM) to investigate the physical formation of the ZnO particles. The optical properties of were examined using UV-Vis-NIR spectrophotometer for transmittance, absorption coefficient, energy band gap estimation, carrier concentration, Urbach energy study, and porosity. The optical properties of ZnO thin films were also studied by photoluminescence spectrometer (PL) to investigate the luminescence properties, crystallinity and defects state of the materials. In this work, several primary parameters of the seed layer: precursor molar concentration, withdrawal speed, annealing temperature and doping concentration were optimized, and an optimized film was determined to grow the vertically aligned ZnO based nanorod structured. An ordered bulk heterojunction hybrid solar cell based on MEH-PPV [poly (2-methoxy-5-(2-ethylhexyloxy)-1,4-phenylenevinylene)] and oriented Al doped ZnO nanorod arrays was fabricated. To the best of our knowledge, preparation of an aligned Al doped ZnO nanorod arrays on an optimized Al:ZnO thin film for this type of solar cell fabrication has not been reported by any research group. The hybrid solar cell has been characterized using a solar simulator measurement system and the power conversion efficiency reached 0.287 %. Through this study, the optimum preparation parameters for ZnO thin film have been identified. This work provides an opportunity and a clear pathway to the development of hybrid solar cell that might be able to replace the existing conventional solar cells today.

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