UNIVERSITI TEKNOLOGI MARA

CHARACTERIZATION AND PHOTOELECTROCHEMICAL PERFORMANCE OF GOLD NANOPARTICLES MODIFIED TITANIUM DIOXIDE NANOTUBES BY PULSE ELECTRODEPOSITION

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MSc

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AUTHOR'S DECLARATION

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

Solar-energy conversion devices such as photoelectrochemical (PEC) cell is one of the eco-friendly and cost effective ways that uses solar light as energy source to convert solar energy into electricity. Titanium dioxide (TiO_2) is one of the metal oxides that is preferable used as photoanode in a PEC cell as it exhibits strong photocatalytic activity low cost and stable in aqueous solution. However, the wide band gap of TiO_2 (3.2 eV) only allows it to be activated upon irradiation of ultraviolet (UV) light. Therefore, in this study, TiO_2 nanotubes decorated with gold nanoparticles was used as substrate in order to determine the physicochemical properties as well as the photoelectrochemical properties. The nanotubes were fabricated via electrochemical anodization method and thereafter were loaded with gold nanoparticles by pulse electrodeposition method. For the incorporation of gold nanoparticles, several parameters were varied; applied deposition potential, concentration of gold solution, deposition time and duty cycle. The gold nanoparticles decorated TiO_2 (AuTNT) were characterized using FESEM, EDX, XRD and UVDRS. The quality of the film produced was tested with adhesion test whereby the photoelectrochemical performance of AuTNT was evaluated with PEC test to obtain AuTNT with extended light spectral response. The presence of gold on nanotubes was confirmed from XRD analysis(44.8^o and 65.6^o respectively) and further supported with EDX analysis(highest amount of Au detected is 4.11 w.t.% for 1000μMAuTNT). This study revealed that the morphology of AuTNT was influenced by the deposition potential and the amount of gold deposited increases with increasing deposition time. The use of duty cycle for the synthesis of AuTNT did not alter the sample morphology but instead affects the amount of gold. It was found that 10% duty cycle with -0.7V applied potential, at 30 minutes deposition time in 100μM gold solution is the optimum condition in fabrication AuTNT with the highest PEC performance (efficiency,η = 0.80) and able to decrease the band gap of TiO_2 from 3.2 eV to 1.6 eV (47% reduction). Thus, AuTNT can be utilized as photoanode in solar-energy conversion devices.

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