ABSTRACT

Photoelectrochemical water-splitting is an environmentally friendly hydrogen-producing technology. This technology uses semiconductors as photoelectrodes in electrolytes to produce photocurrent. High photocurrent will produce high hydrogen. N-type semiconductor materials such as TiO_2 are used as photoelectrode film because they have an energy band gap of 3.2 eV which meets the potential for water-splitting of 1.23 V and resistant to corrosion, but are susceptible to charge recombination. Nanostructure modification with uniform vertical nanorod morphology with minimal agglomeration will increase photocurrent formation. The purpose of this study was to obtain TiO_2 nanorod film as photoanodes through variations in the hydrothermal duration process. TiO_2 film were grown through a hydrothermal process with a duration of 0.5 hour, 1 hour, 3 hours, and 6 hours. The crystal structure, morphology and optical properties were characterized using X-Ray Diffraction, Scanning Electron Microscope, and UV-Vis Spectroscopy. The performance of the TiO_2 film as a photoanode was tested using PalmSense4 to obtain the photocurrent value, photocurrent response, donor density, flat band voltage, and charge transfer. The X-ray diffraction pattern shows that the TiO_2 film has a tetragonal structure with a rutile phase. The addition of hydrothermal time produces a TiO_2 layer with agglomerated nanorod and higher light absorption. Uniform vertical nanorod morphology with minimal agglomeration was obtained at a hydrothermal process duration of 1 hour. The TiO_2 film as a photoanode with good performance was obtained at a hydrothermal process duration of 1 hour. This is indicated by the highest photocurrent, donor density of $7.60 \times 10^{16} cm^{-2}$ and the best charge transfer. Based on the results of this study, it shows that the performance of the TiO_2 film as a photoanode can be improved by increasing the layer thickness in the hydrothermal process duration range of 1 to 3 hours and increasing the density of the TiO_2 film nanorods.

***Keyword**: TiO_2, photocurrent, photoelectrochemical, hydrothermal process duration*