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**DYE SENSITIZED SOLAR CELL BASED ON
HYDROTHERMALLY SYNTHESIZED TiO₂ NANOTUBES**

A PROJECT REPORT PRESENTED BY

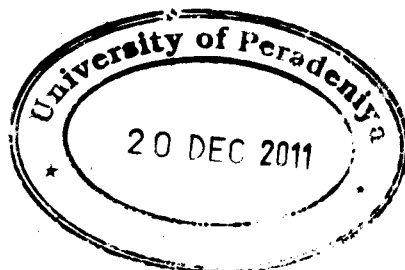
JEGANATHAN AKILAVASAN

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DYE SENSITIZED SOLAR CELL BASED ON HYDROTHERMALLY SYNTHESIZED TiO₂ NANOTUBES

J Akilavasan

Institute of Fundamental Studies
Hantana Road
Kandy
Sri Lanka

ABSTRACT

Dye Sensitized Solar Cells (DSSCs) are promising alternative devices for conventional Silicon based photovoltaic devices. Electron transport in DSSC could be enhanced by fabricating TiO₂ nanotubes instead of TiO₂ nanoparticles. In this investigation, titania nanotubes were synthesized via hydrothermal treatment of commercially available TiO₂ powder and they were fabricated into DSSC. In DSSC, random nature of the TiO₂ nanocrystalline particle network results in electrons to recombine as they travel through the surface of the TiO₂ nanocrystalline particle network reducing the cell performance. In order to reduce the charge recombination thereby improve the cell performance, TiO₂ nanotubes can be utilized instead of TiO₂ nanocrystalline particle as they provide effective straight path way to electron transport. TiO₂ nanotubes were synthesized via hydrothermal treatment of TiO₂ (P25 Degussa) nanoparticles. Formation of nearly 10 nm diameter and average length of 200 nm TiO₂ nanotubes was confirmed by Scanning Electron Microscopy analysis. TiO₂ nanotubes based working electrode was prepared on a conducting substrate (FTO/F: SnO₂) by electrophoretic deposition method. Electrolyte for electrophoretic deposition was prepared based on two methods namely *Precipitate Method* and *Powder Method*. TiO₂ nanotube suspension prepared by ultrasonating the precipitate is called *Precipitate Method* and TiO₂ nanotube powder made by freeze drying the precipitate is called *Powder Method*. The electrophoretic deposition method was employed to deposit TiO₂ nanotubes onto the conducting surface using two electrode system. The electro deposition potential and time was optimized as ~40 V for 5 minutes and ~40 V for 4 minutes for Precipitate and Powder Methods respectively at room temperature. Finally, electrodes were treated with TiCl₄ to improve the performance.

The DSSC performance was measured with Ru based sensitizer dye (N3), iodine/triiodine redox couple as electrolyte and Pt counter electrode under standard AM 1.5 G irradiation. TiCl_4 treated electrode which is prepared using Precipitate Method showed an Open circuit voltage (V_{oc}) of 728 mV, Short circuit current density of (J_{sc}) 5.24 mA/cm^2 and the overall efficiency of 2.21 %.

Keywords: Dye Sensitized Solar Cell, hydrothermal, nanotubes, nanocrystalline.