

C  
6  
AKI

**DYE SENSITIZED SOLAR CELL BASED ON  
HYDROTHERMALLY SYNTHESIZED TiO<sub>2</sub> NANOTUBES**

**A PROJECT REPORT PRESENTED BY**

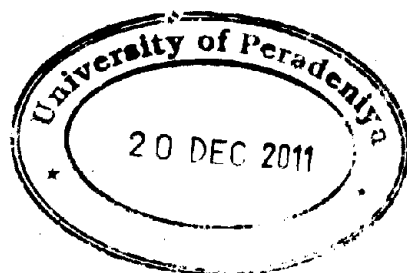
**JEGANATHAN AKILAVASAN**

to the Board of Study in Chemical Sciences of the  
**POSTGRADUATE INSTITUTE OF SCIENCE**

*in partial fulfilment of the requirements  
for the award of the degree of*

**MASTER OF SCIENCE IN NANOSCIENCE AND NANOTECHNOLOGY**

of the



**UNIVERSITY OF PERADENIYA**

**SRI LANKA**

**2010**

**P 0321**

## DYE SENSITIZED SOLAR CELL BASED ON HYDROTHERMALLY SYNTHESIZED TiO<sub>2</sub> 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 TiO<sub>2</sub> nanotubes instead of TiO<sub>2</sub> nanoparticles. In this investigation, titania nanotubes were synthesized via hydrothermal treatment of commercially available TiO<sub>2</sub> powder and they were fabricated into DSSC. In DSSC, random nature of the TiO<sub>2</sub> nanocrystalline particle network results in electrons to recombine as they travel through the surface of the TiO<sub>2</sub> nanocrystalline particle network reducing the cell performance. In order to reduce the charge recombination thereby improve the cell performance, TiO<sub>2</sub> nanotubes can be utilized instead of TiO<sub>2</sub> nanocrystalline particle as they provide effective straight path way to electron transport. TiO<sub>2</sub> nanotubes were synthesized via hydrothermal treatment of TiO<sub>2</sub> (P25 Degussa) nanoparticles. Formation of nearly 10 nm diameter and average length of 200 nm TiO<sub>2</sub> nanotubes was confirmed by Scanning Electron Microscopy analysis. TiO<sub>2</sub> nanotubes based working electrode was prepared on a conducting substrate (FTO/F: SnO<sub>2</sub>) by electrophoretic deposition method. Electrolyte for electrophoretic deposition was prepared based on two methods namely *Precipitate Method* and *Powder Method*. TiO<sub>2</sub> nanotube suspension prepared by ultrasonication of the precipitate is called *Precipitate Method* and TiO<sub>2</sub> nanotube powder made by freeze drying the precipitate is called *Powder Method*. The electrophoretic deposition method was employed to deposit TiO<sub>2</sub> 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 TiCl<sub>4</sub> 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.  $\text{TiCl}_4$  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  $\text{mA}/\text{cm}^2$  and the overall efficiency of 2.21 %.

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