



E46995

**STUDY ON USING IN-HOUSE PRODUCED TCO GLASS TO REDUCE
THE COST OF THIN-FILM AMORPHOUS SILICON PV MODULES**

NIBONDH CHETSIRI

**A Thesis Submitted to the Graduate School of Naresuan University
in Partial Fulfillment of the Requirements
for the Doctor of Philosophy Degree in
Renewable Energy (International Program)
February 2011
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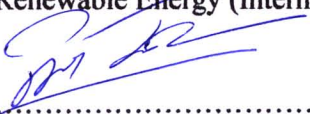
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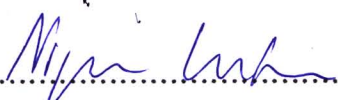
This thesis entitled “Study on Using In-house Produced TCO Glass to Reduce the Cost of Thin-film Amorphous Silicon PV Modules” submitted by Nibondh Chetsiri in partial fulfillment of the requirements for the Doctor of Philosophy Degree in Renewable Energy (International Program) is hereby approved.


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Nibondh Chetsiri

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ABSTRACT

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The propose of this study is to implement a new concept by producing own TCO glass which is a key raw material of a-Si PV module in the existing a-Si PV module manufacturing plant in Thailand in order to reduce the production cost of the PV modules. Initiation of the study was from the report made by a group of scientists who conducted a study on highly transparent and conductive thin film of $\text{SnO}_2\text{:F}$ and In_2O_3 (ITO) published in Brazilian Journal of Physics in 2006 that $\text{SnO}_2\text{:F}$ and In_2O_3 (ITO) films has suitable properties on both transmittance and resistivity for using a the optical windows and transparent electrical contact of thin film solar cells.

The study was conducted and project implemented at Bangkok Solar Co.,Ltd. in 2006 after investment analysis showed feasible cost reduction comparing to the commercial TCO glass. The project decided to produce own TCO glass with ITO layer instead of conventional $\text{SnO}_2\text{:F}$ (FTO) layer. This will be the first time that TCO glass with ITO layer is used as the optical windows and front contact of a-Si PV module. The simpler and less complicated PVD method was selected for forming of ITO layer on 3.2 mm. soda-lime glass substrate. This TCO glass is referred to as "In-house TCO glass" in this study.

The TCO glass coating line was ordered, delivered to the factory in 2008, commissioned and production tests in 2009. From the production cost calculation, in-house TCO glass will have 40% lower cost than commercial TCO glass which

contributes to cost reduction of 20% on the module level. From the tests and measurements made during the commissioning and production tests, in-house TCO glass rendered the sheet resistance of 14.07 Ohm/square which is within 12-15 Ohm/square requirement at the uniformity of 6.26% which better than +/- 10 % criterion set by the specification. In terms of optical window property, the transmittance curve of in-house TCO glass shows the transparency of 83% which is better than 80% criterion set between 400-700 nm wave-length of the visible light.

The study found that in-house TCO glass can meet all technical requirements on both contact resistance, layer uniformity and optical windows for a-Si thin film PV modules. This innovative concept can help reducing the cost of TCO glass by 40% or the total production cost of a-Si PV module by 20%.

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