



UNIVERSITI PUTRA MALAYSIA

**PREPARATION AND CHARACTERIZATION OF ELECTRODEPOSITED
CADMIUM TELLURIDE THIN FILM**

MOHD NORIZAM BIN MD DAUD

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**PREPARATION AND CHARACTERIZATION OF ELECTRODEPOSITED
CADMIUM TELLURIDE THIN FILM**

By

MOHD NORIZAM BIN MD DAUD

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Master of Science**

December 2011

DEDICATION

TO MY LOVELY FAMILY

Md Daud bin Md Amin

Hasnah@Hasanah binti Wahid

Mohd Hasnizam bin Md Daud

Mohd Salizam bin Md Daud

Thank you for the inspiration and encouragement in everything I do

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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Chairman: Professor Azmi Zakaria, PhD

Faculty: Science

The electrophoretic deposition (EPD) is the most potential techniques in fabricating low cost photovoltaic cells. In preparing CdTe film by EPD technique two factors play a role in determining the suitability and film thickness, i.e. bath temperature and CdTe colloid concentration. Previously, both of these factors were fixed, or with only one factor varied. Here the attempt is made to vary both of these factors in this EPD technique. For this aim, different type of CdTe films were developed from various CdTe colloid concentrations. These concentrations were obtained by mixing 1 to 4 wt% of CdTe powder to the 10 ml solution of equal mixture of methanol and toluene, and deposited at various bath temperatures from 30 to 60 °C.

The CdTe thin films obtained are polycrystalline nature of zinc-blend structure with the (111) orientation as the most prominent peak revealed from the XRD analysis. As the CdTe colloid concentration and bath temperature increase the crystallite size of

the film, in nano-size, increases and this affects the decrease in micro-strain and dislocation density hence decreases the lattice defect. The transmittance spectra of CdTe thin films shows slightly shift towards longer wavelength which agrees with the decrease of band gap energy with increasing of CdTe concentration and bath temperature for all films. The decrease of band gap energy is due to the increase in nano-crystallite size and the decrease in strain and dislocation density. Here band gap energy of nano-size is greater than that of bulk CdTe (1.44 eV). The CdTe thin film prepared at bath temperature of 30 °C and concentration of 3 wt% using EPD technique was found most suitable for the solar cell application because of the uniform surface, suitable band gap energy, 1.485 eV, and suitable thickness around 8 μm .

The surface morphology and thickness of the films were determined by AFM analysis. The film thickness increases with CdTe colloid concentration and increases with bath temperature. The increase of the thickness causes the increase of film surface roughness due to the larger crystallite size with increase of concentrations and bath temperatures. The established numerical expression for film thickness with respect to CdTe solution concentrations and bath temperatures agrees well with other literature work.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**PENYEDIAAN DAN PENCIRIAN ELEKTROENAPAN FILEM NIPIS
KADMIUM TELURIDA**

Oleh

MOHD NORIZAM BIN MD DAUD

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Pengerusi: Profesor Azmi Zakaria, PhD

Fakulti: Sains

Pengenapan elektroforetik (EPD) adalah teknik yang paling berpotensi dalam menghasilkan sel fotovolta kos rendah. Dalam penyediaan filem CdTe menggunakan teknik EPD dua faktor memainkan peranan dalam memnentukan kesesuaian dan ketebalan filem, iaitu suhu mandian dan kepekatan CdTe koloid. Sebelum ini, kedua-dua faktor ditetapkan, atau hanya satu faktor di bezakan. Di sini penyediaan di buat untuk mempelbagaikan kedua-dua faktor melalui teknik EPD. Bagi tujuan ini, berlainan jenis filem CdTe telah kembangkan daripada kepelbagaian kepekatan CdTe koloid. Kepekatan ini diperolehi dengan mencampurkan 1 hingga 4 wt% serbuk CdTe dengan 10 ml larutan methanol dan toluene yang sama isipadu, dan didepositkan pada pelbagai suhu mandian daripada 30 hingga 60°C.

Analisis XRD menunjukkan filem-filem nipis CdTe yang diperolehi adalah bersifat polihabluran struktur zink-blend dengan orientasi (111) sebagai puncak yang paling

menonjol. Apabila kepekatan koloid CdTe dan suhu mandian meningkat, saiz hablur filem, dalam saiz-nano, bertambah dan ini memberi kesan peningkatan terekan-mikro dan ketumpatan kehelan seterusnya menurunkan kecacatan kekisi. Spektra kehantaran filem nipis CdTe menunjukkan sedikit peralihan ke arah panjang gelombang yang lebih panjang yang mana bersesuaian dengan penurunan jurang jalur tenaga dengan peningkatan kepekatan CdTe dan suhu mandian untuk semua filem. Penurunan jurang jalur tenaga adalah disebabkan oleh peningkatan saiz hablur-nano dan pengurangan dalam terikan dan ketumpatan kehelan. Jurang jalur tenaga bagi saiz nano adalah lebih besar dari CdTe pukal (1.44 eV). Filem nipis CdTe yang disediakan pada suhu mandian 30 °C dan kepekatan 3 wt% menggunakan teknik EPD didapati paling sesuai untuk aplikasi sel solar kerana permukaan filem yang seragam, jurang jalur tenaga yang bersesuaian, 1.485 eV, dan ketebalan filem yang sesuai iaitu sekitar 8 µm.

Morfologi permukaan dan ketebalan filem telah ditentukan daripada analisis AFM. Ketebalan filem bertambah dengan kepekatan koloid CdTe dan bertambah dengan suhu mandian.. Peningkatan dalam ketebalan menyebabkan peningkatan kekasaran permukaan filem disebabkan saiz hablur yang lebih besar dengan peningkatan kepekatan dan suhu mandian. Hubungan berangka untuk ketebalan filem yang berhubung dengan kepekatan larutan CdTe dan suhu bekas telah di setujui oleh hasil kerja terdahulu.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Azmi Zakaria, PhD

Professor
Faculty of Science
Universiti Putra Malaysia
(Chairman)

Abdul Halim Shaari, PhD

Professor
Faculty of Science
Universiti Putra Malaysia
(Member)

Zulkarnain Zainal, PhD

Professor
Faculty of Science
Universiti Putra Malaysia
(Member)

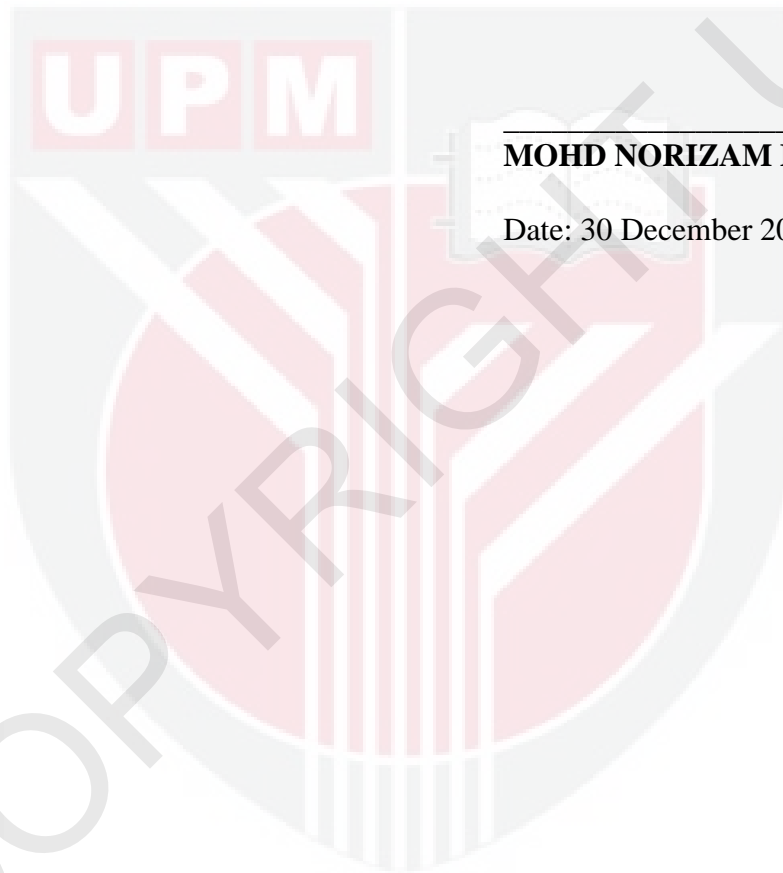
BUJANG BIN KIM HUAT, PhD

Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.



MOHD NORIZAM BIN MD DAUD

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