

A COMBINATION OF ZINC OXIDE, POLY(3-THIOPHENYL  
ACETIC ACID) AND DYES AS HYBRID POLYMER  
TANDEM SOLAR CELLS

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MASTER OF SCIENCE  
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Lihat Sebelah

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ACID) AND DYES AS HYBRID POLYMER TANDEM SOLAR CELLS**

**WAN ALMAZ DHAFINA BINTI CHE WAN AHMAD**

**Thesis Submitted in Fulfillment of the Requirement for the  
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**A COMBINATION OF ZINC OXIDE, POLY(3-THIOPHENYL ACETIC ACID) AND DYES AS HYBRID POLYMER TANDEM SOLAR CELLS**

**WAN ALMAZ DHAFINA BINTI CHE WAN AHMAD**

**July 2014**

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**Schools : Ocean Engineering**

Nowadays, earth is facing the depletion of energy resources such as petroleum, natural gas and coal. Apparently, most of these resources produce harmful waste, endanger the living things on earth and this lead scientist to search a new way to substitute this conventional energy sources. Photovoltaic devices provide clean energy that can reduce world's dependency on this conventional energy sources. Tandem solar cell is a type of thin film solar cells which two solar cells were stacked together in means to improve the solar cell's performance. In preparing the tandem solar cell, multilayer coatings are crucial steps and the most appealing technique to fabricate the layers via spin coating. Spin coating technique allows the formation of very homogenous films even on large area yet its simplicity in handling the spin coater. In this work, the tandem solar cells consist of zinc oxide (ZnO) nanoparticles (NPs), ZnO nanorods (NRs), poly(3-thiophenyl acetic acid) (P3TAA), aurum (Au), copper

phthalocyanine (CuPc), chlorophyll (CHLO) and aluminium (Al) layers. Au layer served as middle electrode while Al layer as top electrode. ZnO NPs were synthesized via sol-gel technique while ZnO NRs were grown by using hydrothermal method. We had characterized the tandem solar cells in aspect of band gap, electrical conductivity and power conversion efficiency (PCE). The PCE value that have been obtained for bottom, top and tandem cell were 0.46%, 0.93% and 1.57% respectively.

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

**KOMBINASI ANTARA ZINK OKSIDA, POLI(3-TIOFENIL ASID  
ASETIK) DAN PEWARNA SEBAGAI SEL SOLAR POLIMER HIBRID  
TANDEM**

**WAN ALMAZ DHAFINA BINTI CHE WAN AHMAD**

**Julai 2014**

**Penyelia Utama : Profesor Madya Dr. Mohd Zamri Ibrahim, Ph.D.**

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**Pusat Pengajian : Kejuteraan Kelautan**

Pada hari ini, bumi berdepan dengan masalah kekurangan sumber tenaga seperti petroleum, gas asli dan arang batu. Ternyata, sumber tenaga ini menghasilkan bahan buangan sampingan yang berbahaya kepada kehidupan di bumi dan ini mendorong ahli sains untuk mencari kaedah baru untuk menggantikan sumber tenaga yang konvensional. Peranti photovoltaik membekalkan tenaga yang bersih dan dapat mengurangkan penggantungan dunia terhadap sumber tenaga lazim. Sel solar seiring adalah sejenis sel solar filem nipis dimana dua sel solar disusun bertindih dengan bertujuan memperbaiki persembahan sel solar tersebut. Dalam penyediaan sel solar seiring, teknik salutan berlapis adalah sangat penting dan kaedah yang paling mudah untuk digunakan adalah salutan berputar. Teknik ini bukan sahaja menghasilkan filem nipis yang sekata

walaupun di atas luas permukaan yang besar malah pengendalian alat salut berputar juga adalah sangat mudah. Dalam kerja ini, sel solar seiring terdiri dari lapisan partikel nano zink oksida (ZnO), rod nano ZnO, poli(3-tiofenil asid asetik) (P3TAA), aurum (Au), kuprum ftalosianain (CuPc), klorofil dan aluminium (Al). Lapisan Au berfungsi sebagai elektrod tengah manakala lapisan Al berfungsi sebagai elektrod teratas. Partikel nano ZnO disintesis menggunakan kaedah "sol-gel" manakala rod nano ZnO di tumbuhkan menggunakan kaedah hidrotermal. Kami telah mengkaji sel solar seiring dari segi jurang tenaga, kekonduksian elektrik dan efisiensi penukaran tenaga. Efisiensi pertukaran tenaga yang telah diperolehi dari sel bawah, atas dan seiring masing-masing adalah 0.46%, 0.93% and 1.57%.