UNIVERSITI TEKNOLOGI MARA

FABRICATION OF HYBRID ORGANIC SOLAR CELL USING MEH-PPV: I-MWCNT AS AN ACTIVE LAYER

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of the requirements for the degree of
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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Attention in incorporating inorganic nanostructures into organic optoelectronic devices has been growing in the past few years. These so-called hybrid organic-inorganic nanocomposites systems are being studied more closely due to its possibility in combining the advantageous characteristics of inorganic and organic components. Within a single composite, the properties can easily be changed or tuned by varying the size of nanoparticle, material composition, and concentration in the composites to match the device requirement. The most important thing, they can maintain the fabrication advantages of organic device such as easy processing, low production and material cost, and manufacturing the devices on large and flexible substrates. These are important in device application and commercialization. Therefore, research on improving the performance of organic solar cells by incorporating inorganic nanostructures in the organic materials has become important topic of research. The nanocomposited photoactive layer thin film which is MEH-PPV:MWCNT were prepared and characterized. The parameters that involved in the optimization are different composition of MWCNT in tetrahydrofuran (THF) and toluene, different composition of Iodine doped Multiwalled Carbon nanotubes (I-MWCNT) with low and high concentration of I-MWCNT. The characterizations involved are current-voltage (*I-V*), absorbance, transmittance and photoluminescence measurements and physical properties measurements which involved Field Emission Scanning Electron Microscopy (FESEM) and Atomic Force Microscopy (AFM). It was found that annealed MWCNT gave the best results in physical, electrical and optical properties. Meanwhile, comparing THF and toluene, THF convey the best results in all characterizations. The composition of I-MWCNT that was chosen to be used in organic solar cells was 60 wt% of I-MWCNT. In this work, bulk-heterojunction solar cells based on poly (2-methoxy-5-(2'-ethyl-hexyloxy)-p-phenylene vinylene) (MEH-PPV) and a highly conductive multiwalled carbon nanotubes (I-MWCNT) were fabricated and characterized by white light *I-V* and external quantum efficiency measurements. The influences of different temperature treatment of the nanocomposite layer, the various concentrations of Iodine and different metal contact used as cathode on the solar cell device performance were studied. It was found that the optimized temperature occurred at 75 °C with optimized Iodine concentration of 1g. The best metal contact with high efficiency was given when Platinum (Pt) was used. The achieved highest short circuit current density and energy conversion efficiency is 0.052mA/cm^2 and 0.001%. Lastly, a new structure used Titanium dioxide (TiO_2) as n-type layer in organic solar cells was prepared. This layer act as hole blocking layer that prevents a direct contact between MEH-PPV:I-MWCNT and Indium Tin Oxide (ITO) substrates. The nanocomposited MEH-PPV:I-MWCNT with 60 wt% of I-MWCNT was prepared on ITO using Gold (Au) as the anode. It was found that interfacial area between MEH-PPV and TiO_2 has slight improved. Therefore, there is tendency to adapt device efficiency, short-circuit current (J_{SC}), open-circuit voltage (V_{OC}) and the fill factor (FF). The initial values for both short circuit current density and power conversion efficiency are 0.115006 mA/cm^2 and 0.414 x 10^{-3} % respectively.

TABLE OF CONTENTS