UNIVERSITI TEKNOLOGI MARA

POLYMETHYL ACRYLATE-POLYVINYL ACETATE BLEND POLYMER ELECTROLYTES FOR APPLICATION IN DYE SENSITIZED SOLAR CELL

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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 results of my own 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 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

The objective of this work is to study poly(methyl acylate)- poly(vinyl acetate) (PMA-PVAc) blend polymer electrolytes incorporated with tetrapropyl ammonium iodide (TPAI), 1-butyl-3-methylimidazolium iodide (BMII) and ethylene carbonate (EC) for the application in dye sensitized solar cells (DSSCs). The conductivity of the single polymer electrolyte was optimized by varying the concentration of TPAI. PMA show higher conductivity than PVAc. PMA/PVAc blends are miscible as indicated by dilute solution viscometry (DSV) and different scanning calorimetry (DSC). The highest conductivities achieved for PMA-TPAI and PVAc-TPAI system are 2.6×10^{-11} and 1.4×10^{-11} S cm^{-1}, respectively. The polymer blend electrolyte with the composition W_{PVAc} = 0.1 and W_{TPAI} =0.2 shows the highest conductivity of 4.97×10^{-11} Scm^{-1}. Then, BMII were introduced to the optimized system. The conductivity is found to increase up to 1.37×10^{-9} Scm^{-1} with W_{BMII} = 0.5. The DSSC fabricated using the highest conductiviting sample exibits the highest efficiency of 4.62 %. In the forth system, the mass fraction of EC, W_{EC} was varied while the masses of the other components were kept constant in order to study the dependence of dye-sensitized solar cell (DSSC) performance on EC concentration. Incorporation of EC in PMA/PVAc-TPAI-BMII has enhanced the efficiency of the DSSC. The efficiency enhancement is due to the increase in short circuit current density, J_{sc}, arising from the conductivity enhancement brought about by the EC. A DSSC with TPAI-BMII-EC liquid electrolyte was fabricated and its photovoltaic and stability performance were investigated and compared with DSSC with PMA/PVAc-TPAI-BMII-EC gel electrolyte. PMA/PVAc decreases the J_{sc} from 27.87 to 22.91 mA cm^{-2} and efficiency, η from 12.28 to 9.67 %. Linear sweep voltammetry studies reveal that PMA/PVAc decreases the ion motion in the electrolyte. Although PMA/PVAc deteriorates the performance of DSSC, but it improves the stability performance of DSSC by suppressing the recombination loss as evidenced from the increase in charge transfer resistance at the TiO_2 electrode and longer electron recombination lifetime calculated from EIS study.

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TABLE OF CONTENT