UNIVERSITI TEKNOLOGI MARA

PERFORMANCE OF CuInS/ZnS QUANTUM DOT PLASTISIZED CELLULOSE ACETATE GEL POLYMER ELECTROLYTE FOR 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

This dissertation focuses on the preparation and characterization of CA-salt complexes, plasticized CA-salt complexes and quantum dot dopped plastisized CA-salts complexes. In the present study, cellulose acetate as polymer host, ammonium iodide (NH_4I) as doping salt, ethylene carbonate (EC) as plasticizer and CuInS/ZnS quantum dot as co-sentisizer were used in the preparation of CA-NH_4I, Plasticized CA-NH_4I and quantum dot plasticized CA-NH_4I. All samples were prepared by the solution cast technique with different weight percent (wt. %) of NH_4I, EC and CuInS/ZnS. The conductivity of the samples were characterized by the impedance spectroscopy in the frequency range between 100Hz and 1MHz. Highest ionic conductivity of CA-NH_4I containing 25 wt.% NH_4I in CA-NH_4I-I_2 was $1.99x10^{-4}$ Scm^{-1}. Further enhancement of ionic conductivity obtained with addition of plasticizer into CA-NH_4I was $1.06x10^{-3}$ Scm^{-1} at 50wt. % for CA-NH_4I-I_2-EC. The ionic conductivity obtained for quantum dot plasticized CA-NH_4I was $1.\ 66x10^{-1}$ Scm^{-1} at 4wt.% CuInS/ZnS in CA-NH_4I-I_2-EC-CuInS/ZnS. The plasticized system was dispersed with CuInS/ZnS to form a quantum dot plasticized CA-NH_4I and hence improve the physical properties of the plasticized system for used in a dye sensitized solar cell. The modulus formalism studies showed that all electrolyte system behave as ionic conductor. ATR-FTIR spectroscopy justify the interactions between polymer and salt primarily due to the C=O and C-O of CA and NH_4^+ of salt. The shifting of the carbonyl peak C=O of CA at $1743cm^{-1}$ and C-O bend at 1224 cm^{-1} to the lower wavenumber indicates coordination takes place between ammonium cation and C=O to form $NH_4^+ \leftarrow O=C$ interaction. FTIR studies also confirm the addition of plasticizer just penetrated in between polymeric chain and create more free volume by reducing the polymer chain cross linking without perturbing the complexation of polymer-salt. Addition of quantum dot in plasticized CA-NH_4I complexes shows no interaction occurred between quantum dot CuInS/ZnS and other component in polymer system. XRD analysis confirmed the formation of polymer-salt complexes with the decreasing of peak intensity at $2\theta=8.5^o$ and 16.64^o of CA upon the addition of salt and plasticizer content. Besides that, XRD spectra analysis demonstrated the incorporation of plasticizer and quantum dot has reduced the crystallinity of CA-NH_4I-I_2 and Plasticized CA-NH_4I-I_2-EC promotes to ion migration easily hence lead to the ionic conductivity enhancement. This results was strongly agreed with AFM testing where the surface roughness decreased upon the addition of quantum dot. The energy band gap (E_g) found to decrease with increasing of salts, plasticizer, and quantum dot content by UV-Visible studies. The dopant (salt, plasticizer, and quantum dot) considered as defect in polymer which affects the optical band gap. The highest conducting for each electrolyte system was used to fabricate a dye-sensitized solar cell (DSSC) with a configuration ITO glass substrate/TiO2 N719 dye || Electrolyte || Gold-(Au) coated glass. Impedence analysis and current voltages characterization were performed to investigate the internal resistance and efficiency of the DSSC. For quantum dot plasticized CA-NH_4I shows when the DSSC was exposed to the light, the value of open-curcuit voltage, Voc, and short-current circuit, Isc, were 1.11V and 11.1 mA respectively. The fill factor, *FF*, and efficiency, η, were 65 and 8.02 % respectively.

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“Undoubtedly, with every hardship, there is ease” (Al-insyirah, verse 6)

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