UNIVERSITI TEKNOLOGI MARA

SYNTHESIS AND CHARACTERIZATION OF WASTE COOKING OIL-BASED POLYURETHANE SOLID POLYMER ELECTROLYTE FOR DSSC APPLICATION

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ABSTRACT

A dye sensitized solar cell (DSSC) was fabricated from waste cooking oil (WCO)-based polyurethane (PU) solid polymer electrolyte with lithium iodide (LiI) as conducting material. Epoxidation and hydroxylation reaction was used to convert WCO into polyol. Polyol mixed with 4,4-dimethylphenyl diisocyanate (MDI) at 85:15 ratio of polyol-to-MDI to form PU film. Then, PU solid polymer electrolyte (SPE) was synthesized by adding different amount of LiI using solvent casting method. WCO-based polyol synthesized consist of percent free fatty acid, acid value, hydroxyl value and iodine value of 184 mgKOH/g, 0.34 %, 0.677 mgKOH/g and 0.30 I_2/100g, respectively. FTIR showed the presence of OH peak at frequency around 3300 cm^{-1} indicates that polyol was successfully synthesized. The presence of urethane linkage on FTIR spectrum proved that PU film was successfully prepared. Thermogravimetric analysis showed WCO-based PU consist of four decomposition stages and prove WCO-based PU stable at room temperature until the first decomposition stage at 270 ^oC. The GPC analysis showed that PU film Mw and Mn was 60811 and 12128 respectively. The interaction of LiI with PU SPE structure was confirmed by observing the shifting of OH, C=O and C-O-C peak in FTIR. The surface morphology of PU electrolyte investigated using SEM showed no phase separation but increase in surface spherulite when LiI amount increase that indicate increasing of amorphosity. The glass transition temperature was investigated by using differential scanning calorimetry shows decreasing pattern upon addition of LiI due to decreasing the dipole-dipole interaction between PU structure. The ionic conductivity increases with addition of LiI resulted in the highest conductivity of 4.67×10^{-6} Scm^{-1} at 30 % LiI. These observations proved that increasing in LiI amount improved PU SPE properties. The transference number analysis show PU electrolyte charge transport was predominantly due to ionic conduction. A dye sensitized solar cell of FTO/TiO_2-dye/PU-LiI-I_2/Pt give response under light intensity of 100 mW cm^{-2} and the highest efficiency was obtained at 30 % LiI which is 1.5%. These properties exhibit the WCO-based PU solid polymer electrolyte have potential to be used as alternative for electrochemical devices

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