Study of Energy Conversion Efficiency of D-131 Dye-sensitized Solid-state Solar Cell by Changing Absorbed Dye Amount

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Dye-sensitized solar cells (DSC) based on liquid electrolytes show high efficiency. However, the evaporation of the liquid when the cell is imperfectly sealed and corrosion by the volatile redox mediator may limit device stability. In this study, dye-sensitized solid-state solar cells (DSSC) were prepared and higher efficiencies were obtained by changing the amount of dye absorbed. A layer of TiO_2 nanoparticles was deposited on fluorine-doped tin oxide (FTO) glass plates by drop coating followed by sintering. TiO_2 coated electrodes were preheated and dipped in a 0.3 mM solution of D-131 dye for 12, 15, 24, and 48 hours for varying the amount of dye absorbed. CuI in acetonitrile and triethylamine thiocyanate solution was deposited on a 0.25 cm^2 of the oven-dried D-131 dye sensitized TiO_2 electrode. Pt-coated glass plate was attached to the TiO_2 photo anode in the construction of the solid-state dye sensitized solar cell. The DSSC prepared by dipping the TiO_2 electrode in D-131 dye solution for 24 hours showed a highest energy conversion efficiency (η) of 2.579% compared to that of other different dipped times. The energy conversion efficiency was measured by using solar simulator. Highest values for V_{OC} = 0.466 V, and J_{SC} = 10.293 mA/cm^2 were also observed. The incident photon-to-current conversion efficiency (IPCE) measured by a xenon light source showed a maximum IPCE value of ~57% at ~425 nm. HOMO and LUMO energies calculated by cyclic voltammetry and UV absorption spectra of D-131 dye were -5.30 eV, and -2.98 eV respectively.

Keywords: Dye-sensitized solar-cell, dye-sensitized solid-state solar cell, Fluorine-doped tin oxide