Abstract No: 237 ***Physical Sciences***

EFFICIENT DYE-SENSITIZED SOLAR CELL CONTAINING BINARY SALT ELECTROLYTE AND IRRADIANCE LEVEL DEPENDANCE OF THEIR PERFORMANCE

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Liquid electrolytes (LEs) are being used as electrolytes in Dye-Sensitized Solar Cells (DSSCs) due to their superior conductive properties and versatility. The electrical contact between electrolytes and porous electrodes can be easily achieved using LEs since LEs readily diffuse into pores and voids of electrodes. Therefore, in general, LE-based DSSCs deliver higher efficiencies. However, the adverse effects of liquid electrolytes, such as electrolyte leakage, volatility, and flammability, should be mitigated to prepare chemically and physically statable DSSCs. In this study, the performances of new LE-based DSSCs have been investigated. DSSCs exhibit enhanced charge transport properties, leading to higher efficiency for photoelectrochemical energy conversion applications. The effect of the frequency dependence of the real and imaginary components of the AC conductivity on the dielectric polarization of the electrolyte was investigated to comprehend the capacitive effect of the cell. The novel liquid electrolyte investigated in this study comprised ethylene carbonate (EC), propylene carbonate (PC), 1-butyl-3-methylimidazolium iodide (BMII), 4-tert-butyl pyridine (4TBP), tetrahexylammonium iodide (Hex4NI), and lithium iodide (LiI). The combination of iodide salts establishes a binary system of small and large cations instead of a conventional single-salt electrolyte. The ambient temperature conductivity of the electrolyte was 11.43 mS cm^{-1}, which is high enough to prepare efficient DSSCs. This electrolyte, previously optimized TiO_2 multi-layer photoelectrodes, and standard Pt counter electrodes were used in assembling DSSCs. When observed under definitive 1,000 W m^{-2} simulated solar irradiation, the highest conversion efficiency was 8.37%. The corresponding short circuit current density (Jsc) was 16.61 mA cm^{-2}, the open-circuit voltage (Voc) was 720 mV, and the fill factor (FF) was 69.99%. However, when the light intensity was reduced to 397 W m^{-2}, a significantly high efficiency of 10.57% was observed. Further, it was observed that the heavy ions as a binary salt system improve the performance of the studied liquid electrolyte without compromising the short-term stability.

Financial assistance from the Postgraduate Institute of Science (PGIS), University of Peradeniya Research Grant (Grant No. PGIS/2020/05) is acknowledged.

Keywords: Liquid electrolyte, Dye-sensitized solar cells, Ionic conductivity, Impedance spectroscopy