올리고머 전해질을 이용한 고효율 염료감응 태양전지

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Highly Efficient Dye-Sensitized Solar Cells Employing Oligomer-based Electrolyte

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Key words : Dye-sensitized solar cell, Oligomer-based electrolytes, Ion transport, Electron transport

Abstract : Dye-sensitized solar cell (DSC) has attracted great attention over the past decade owing to its high energy conversion efficiency and low production cost. Although a respectable photon-to-electricity conversion efficiency (~11.04 % @ 1 sun) has been achieved for photovoltaic cell employing organic liquid electrolyte, the leakage of liquid solvent from such cells has been suggested as the one of the critical factors limiting the long-term stability of the DSC. As analternative to volatile organic solvents, the use of polymer solvent with polar ligands has received considerable attention in recent decades. For successful application of polymer electrolyte in DSC, both high ionic conductivity (e.g. > 10^{-4} S/cm) of electrolytes and excellent interfacial contact between dye-attached TiO_2 and electrolytes should be achieved. To improve the interfacial contact between nanocrystalline semi-conductor and electrolyte medium, the balance between the coil size of polymer and the pore size of semi-conductor film should be considered. In this view, the use of low molecular weight polymers (referred to as "oligomer") may be essential to the easy penetration of such electrolytes into the nanopores of semi-conductor film and the superior ion conduction. In this work, we prepared oligomer-based electrolytes consisting of low molecular weight poly(ethylene oxide) (oligo-PEO) and three different types of iodide salts (i.e. alkalimetal salt (KI), imidazolium salt (DMHImI), and molten imidazolium salt (PMImI)). The ion transport properties of these electrolytes had been systematically investigated by means of the measurements of ion conductivity and diffusion coefficient. In addition, the influences of cations on the electron transport phenomena occurred in photoanode had been evaluated via the laser induced photovoltage and photocurrent decay measurements. The results show that the overall efficiency of the DSC is dominated by both the anionic conductivity and the specific property of cations. It was also concluded that the use of oligomer-based electrolytes promises both the excellent durability and the respectable energy conversion efficiency (7.18% @ 1 sun) of the DSC by the optimization of the electrolyte system.

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