PERFORMANCE IMPROVEMENT OF DYE-SENSITIZED SOLAR CELLS BY MgO SURFACE MODIFICATION ON NANOPOROUS TiO_2 PHOTOANODE

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ABSTRACT

Dye-sensitized solar cells (DSCs) have been attracted due to its low-cost and high performances. DSC consists with photoanode, dye sensitizer, redox electrolyte and a counter electrode. In this study, nanoporous TiO_2 photoanode was prepared by spray pyrolysis deposition on fluorine doped tin oxide (FTO) substrate which empowers the efficient absorption of dye molecules using its large surface area. However, recombination of dye cations and the injected electrons limits the conversion efficiency of DSCs. The extent of recombination mainly depends on nature of TiO_2 surface, the structure and the mode of anchoring of the dye molecule to the TiO_2 surface. With intention of suppress the electron recombination and improve the power conversion efficiency of DSCs, TiO_2 photoanode surface was covered with a thin layer of MgO by immersing TiO_2/FTO substrate in a magnesium acetate solution. This ultra-thin MgO layer on TiO_2 surface prevents the tunneling of electrons from TiO_2 to the electrolyte interface. Scanning electron microscope images indicated the average particle size of TiO_2/MgO electrode was smaller than that of TiO_2 electrode. Both TiO_2 and TiO_2/MgO electrodes were soaked in a N719 dye solution overnight. UV-vis absorption spectra showed that dye coated TiO_2/MgO electrode had apparently enhanced dye adsorption compare to the dye coated TiO_2 electrode. Finally, space between the photoanodes and Pt counter electrode were filled with a liquid electrolyte (I^-/I_3^-) and solar cell performance was measured. Power conversion efficiency was increased from 9.8% to 11.0% as a result of blocking effect of MgO surface modification on TiO_2 photoanode.

Keywords: Dye-sensitized solar cell, Photoanode, Electron, TiO_2, MgO

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