Electrochemical study of the mediators for the Dye-sensitized solar cells

朱慶峰、姚品全

E-mail: 9601183@mail.dyu.edu.tw

ABSTRACT

In this study, the important process parameters in fabricating dye-sensitized solar cells(DSSC) such as the sintering temperature of TiO2 thin film, the additives during the film forming stage such as Triton X-100(surfactant for nano-powders dispersion) as well as polyethylene glycol(PEG, porosity control agent) were extensively studied. Besides, the electrochemical properties of the TiO2 working electrode were investigated by cyclic voltammetery in comparison with those described in published papers as a basis for further analysis. The results show that the sintering temperature of TiO2 thin film has prominent effect on the Voc and Isc of the DSSC. The Voc has its maximum value of 417 mV at T=450oC while the Jsc increase as the T was increased. Therefore, Jsc=0.99 mA at T=400 oC and elevated to Jsc=2.7 mA/cm2 at 550oC. As the sintering temperature increase, the fill factor (FF) diminished. Consequently, the suitable value for the sintering temperature of TiO2 thin film is 450~500oC. The surfactant, Triton X-100 has optimal addition amount of 0.05~0.1 ml/3g of P25 in which the DSSC has performance of Voc=518 mV, Jsc=2.1 mA/cm2 while the introduction of Triton X-100 ahs no effect on FF. The porosity control of TiO2 thin films by the introduction of PEG has been proven. In our study, adding small amount of PEG(0.9g/3g of P25) has improved the Jsc to as high as 3.9 mA/cm2, while more PEG has detrimental effects on Jsc owing to the residues of polymer. Besides, the PEG addition has minor effect on Voc of the as-prepared DSSC. Similarly, as PEG exceeded 1.2 g/3g of P25, the FF of DSSC decreased immediately for the similar reason described above. The electrochemical analysis(cyclic voltammetery) shows that the TiO2 films owns quite good electrochemical reversibility in which there is no evident faradaic current within the operation voltage of the solar cells.

Keywords : dye-sensitized solar cells, TiO2 , PEG, Triton X-100, cyclic voltammetery

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