Influence of Fabrication Parametes in Nanocrystalline Tio2 Phtoanode to the Photoelectric Properties of Dye-Sensitized S

姜穎宏、姚品全

E-mail: 9601181@mail.dyu.edu.tw

ABSTRACT

In this study, nanocrystalline TiO2 were used as the working electrode (pHoto-anode) of the dye-sensitized solar cells(DSSC). The key process parameters in fabricating high efficiency of DSSC including the deposition of wide band gap semiconductor thin films, the sensitized dye(chromopHore), the mediator(redox couples, electrolyte), cell assembly, etc. It has been investigated by the preliminary tests for further detailed study later. The porous TiO2 thin films were indeed formed by the sintered nanocrystalline Degussa P25 powders,which resulting in being essential to deposited porous TiO2 thin film with controlled morphology both with large surface area as well as optimal porosity. Unfortunately,due to these two factors of contradiction each other: if the porosity becomes too large, the surface area of the films will decrease.;on the other hand, if the pore size of the porous films becomes smaller, the overall surface of TiO2 films will increase rapidly while the smaller the pore radius will hinder the diffusion of redox couple which can in turn decrease the photocurrent from the TiO2 photoanode. As for the most optimal cell performance, it is laborious to find the suitable parameters in DSSC fabrication. In this study, the process parameters in fabricating high efficient TiO2 working electrodes for the photo-injected electron transport had been investigated. Finely ground Nanocrystalline TiO2 paste(Degussa P25) was evenly deposited on ITO by spin coating. Different ratio additives, such as Pentanedione, Triton X-100, PEG were tested. The as-deposited films were further annealed at different temperature with different thickness of the TiO2 films. Two Iodide/Iodine electrolytes was used to compare the influence of redox mediator in regenerative photo-electrochemical reaction in this system. The results showed that the Triton X-100, being the binding agent for the Nanocrystalline TiO2 powder, had the role of surface area modifier of which the addition amount has decisive effect to decline the resistance of transfer for the photo-injected charge carriers across the grains interface. Besides, the addition of PEG was capable of manipulating the pore size of porous photo-anode by which the ions transferring rate at the counter-electrode interface was improved. Under higher annealing temperature, the sintering of TiO2 microstructures were more prominent while the crystalline phase might have transformed to the thermodynamically stable phase. The photocurrent conversion efficiency was closely related to the sintering crystalline phase of TiO2. The result of the preliminary results in this study shows that the best cell performance was under theses given conditions:VOC=0.514 V，JSC=4.107 mA/cm2，FF=0.44.17%，η ? 0.3543%，and Rs=65.52Ω. From the diode dark current analysis, it reveals that the series resistance(Ro) of our DSSC are closely related to the FF(filled factor). In addition to the process parameters, the choice of chromopHore is still another vital factor for high efficient DSSC. Owing to the unstable character and relatively low spectrum response, the sensitized dye used here suffered from low photocurrent and FF which need endeavor to recognize more efficient ones.

Keywords : Dye-sensitized solar cells ; process ; chromophore ; Degussa P25 ; system

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