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Influence of rapid thermal annealing (RTA) on CNT electrodes for enhanced electrochemical properties in DSSCs

J. H. Moon[1], S. H. Hwang[1], S. K. Lee[1], D. Y. Lee[2], D. H. Kim[1] and M. H. Jeon[1*]

[1]Department of Nano system engineering, Center for Nano Manufacturing Inje University
[2]Optoelectric Research Group, Korea Electrotechnology Research Institute, Korea

In order to improve the efficiency of dye-sensitized solar cell (DSSC), the electrochemical properties of rapid thermal annealed carbon nanotubes (CNTs) as counter electrode in DSSCs have been studied. It is known that electrochemical reactions of electrolyte redox couple on the surface of electrodes affect the performance of opto-electric energy conversion in DSSCs. In order to improve redox reaction, the rapid thermal annealing (RTA) treatments on the CNTs are carried out in the range of temperature 200 ℃ ~ 1000 ℃ for 1 min in the N_2 atmosphere. The CNTs on the p-type Si substrate are grown by thermal chemical vapor deposition (CVD). Structural properties of CNTs are investigated by Raman spectroscope, field-emission scanning electron microscope (FESEM), and transmission electron microscope (TEM). Electrochemical properties of CNTs are measured by electrochemical impedance spectroscopy (EIS). EIS measured that, in the inflection point exhibited by the impedance spectrum, the redox reaction frequency of annealed CNT electrode at 1000 ℃ is about 4 kHz and unannealed CNT is about 0.4 kHz. The total resistivity of the annealed electrode has much lower than that of unannealed electrode at the interface and also the electrode reaction is faster with increasing of annealing temperature. In the result, it is found that the thermal treated electrodes exhibit lower interfacial capacitance and a better frequency response. In this study, it is found that the peaks on bode plot and nyquist plot were shifted to high frequency and low interface reaction resistance. It is considered to improve efficiency of Dye-sensitized solar cell.

Keywords : CNT electrode, dye-sensitized solar cell (DSSCs), CVD, RTA