Electrochemical Properties of HNO3 Pre-treated TiO₂ Photocellode for Dye-SENSitized Solar Cells
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Abstract: Dye-sensitized solar cells (DSSCs) have been widely investigated as a next-generation solar cell because of their simple fabrication process and low costs. The cells use a porous nanocrystalline TiO₂ matrix coated with a sensitizer dye that acts as the light-harvesting element. The photo-exited dye injects electrons into the TiO₂ particles, and the oxide dye reacts with I⁻ in the electrolyte in regenerative cycle that is completed by the reduction of I₃⁻ at a platinum-coated counter electrode. Since TiO₂ porous film plays a key role in the enhancement of photovoltaic conversion efficiency of DSSC, many scientists focus their researches on it. Especially, a high light-to-electricity conversion efficiency results from particle size and crystallographic phase, film porosity, surface structure, charge and surface area to volume ratio of porous TiO₂ electrodes, on which the dye can be sufficiently adsorbed. Effective treatment of the photoanode is important to improve DSSC performance. In this paper, to obtain properties of surface and dispersion as nitric acid treated TiO₂ photocellode was investigate. The photovoltaic characteristics of DSSCs based the electrode fabricated by nitric acid pre-treatment TiO₂ materials gave better performances on both of short circuit current density and open circuit voltage. We compare dispersion of TiO₂ nanoparticles before and after nitric acid treatment and measured Ti oxidized state from XPS. Low charge transfer resistance was obtained in nitric acid treated sample than that of untreated sample. The dye-sensitized solar cell based on the nitric acid treatment had open-circuit voltage of 0.71 V, a short-circuit current of 15.2 mAcm⁻² and an energy conversion efficiency of 6.6 % under light intensity of 100 mWcm⁻². About 14 % increases in efficiency obtained when the TiO₂ electrode was treated by nitric acid.

Key Words: Dye-sensitized solar cell, Nitric acid, TiO₂, photocellode