

Study on the N₂ Plasma Treatment of Nanostructured TiO₂ Film to Improve the Performance of Dye-sensitized Solar Cell

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Dye sensitized solar cell (DSSC) having high efficiency with low cost was first reported by Grätzel et al. Many DSSC research groups attempt to enhance energy conversion efficiency by modifying the dye, electrolyte, Pt-coated electrode, and TiO₂ films. However, there are still some problems against realization of high-sensitivity DSSC such as the recombination of injected electrons in conduction band and the limited adsorption of dye on TiO₂ surface. The surface of TiO₂ is very important for improving hydrophilic property and dye adsorption on its surface. In this paper, we report a very efficient method to improve the efficiency and stability of DSSC with nano-structured TiO₂. Atmospheric plasma system was utilized for nitrogen plasma treatment on nano-structured TiO₂ film. We confirmed that the efficiency of DSSC was significantly dependent on plasma power. Relative in the TiO₂ surface change and characteristics after plasma was investigated by various analysis methods. The structure of TiO₂ films was examined by X-ray diffraction (XRD). The morphology of TiO₂ films was observed using a field emission scanning electron microscope (FE-SEM). The surface elemental composition was determined using X-ray photoelectron spectroscopy (XPS). Each of plasma power differently affected conversion efficiency of DSSC with plasma-treated TiO₂ compared to untreated DSSC under AM 1.5 G spectral illumination of 100 mWcm⁻².

Keywords: Dye-sensitized solar cell, TiO₂ nanostructure, Atmospheric plasma, Plasma treatment, Nitrogen doping