TIO_2 PHOTO-ANODE WITH N-DOPED TIO_2 FOR EFFICIENCY ENHANCEMENT IN DYE SENSITIZED SOLAR CELLS.

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ABSTRACT

Dye sensitized solar cells (DSSCs) first reported by Grätzel et al in 1991 have been extensively studied as a low-cost alternative to conventional silicon solar cells. DSSCs mainly consist of a dye adsorbed nanocrystalline semiconductor such as TiO_2 as the photo-anode, a redox electrolyte and a counter electrode. The efficiencies of these devices essentially depend on the properties of the semiconductor, the dye and the electrolyte. In recent years, a considerable progress has been made on TiO_2 doped with metal dopants such as Zn, Nb, Au, and Ag etc. and non -metal dopants such as N, B and C etc. In this work, we explore the possibility of efficiency enhancement in DSSCs by incorporating N-doped TiO_2 in the normal TiO_2 electrodes generally used in DSSCs. N –doped TiO_2 powder was synthesized by using slightly modified chemical wet method with aqueous ammonia and nitrogen gas purging on titanium tetra isopropoxide (TTIP). Three types of TiO_2 photo-anodes of essentially same thickness were prepared by using N-doped TiO_2 powder, commercially available TiO_2 powder (Degussa P25) and double layered structure of Degussa P25 and N-doped TiO_2 powder. These photo-anodes were prepared by the doctor blade (DB) technique. In order to see the effect of double layered structure of P25 TiO_2 and N–TiO_2 in these DSSCs, solution electrolyte based DSSCs were fabricated and characterized using IPCE spectroscopy measurements, J-V measurements and EIS measurements. These three devices showed average efficiencies of 4.02%, 5.81% and 7.00% respectively under the illumination with 1000 W m^{-2} (AM 1.5) simulated sun light. The lower efficiency for N-doped TiO_2 based DSSC appears to be due to adhesion problem of TiO_2 powder to FTO substrate. A high conversion efficiency of 7.00% was achieved for the double layered structure made with P25 TiO_2 and N-doped TiO_2, which was 20% higher than that of the P25 TiO_2 based DSSC.

Key words: N-doped TiO_2, Dye-sensitized solar cells, Photo-anode.