Power conversion efficiency (PCE) performance of backilluminated DSSCs with different Pt catalyst contents at the optimized TiO2 thickness

ABSTRACT

The Power Conversion Efficiency (PCE) of back illuminated dye sensitized solar cells (DSSCs) using Titanium Dioxide (TiO2) printed on Titanium foil photo-anode was investigated. It is essential to study the optimum volume of the Platinum (Pt) catalyst solution spin-coated on counter electrode and the TiO2 absorbance layer optimized thickness for optimum light harvesting in a back illuminated structure. In this study, we have concentrated on the optimized 11 μm thick of TiO2 film assembled on the photoanode using Doctor Blade printing method. The 11 μm thick films were tested in a constraint of Platinum contents obtainable from 30 μl, 50 μl and 70 μl volumes of Pt solutions. The same cells were also subjected to front illumination to compare the results. The back illuminated optimization was achieved with the 11 μm TiO2 film thickness which was at PCE = 2.99%, Jsc = 7.83 mA/cm2, Voc = 0.7V, FF = 0.55 with the minimum volume of the Pt solution. From the selected ideal thickness of 11 μm TiO2 film performances of the Fluorine Tin Oxide (FTO) glass as solid state photoanode during back illumination, a similar methodological structure was imposed on Titanium foil based anode cells where the achievement was indicated at PCE = 2.75%, Jsc = 4.62 mA/cm2, Voc = 0.71V, FF = 0.84 for a 70 μl volume of Pt solution. The results show that for a solid state photoanode substrate, 30 μl of Pt solution is sufficient to provide catalytic activities and at the same time allow light penetration to the active region, whereas the flexible photoanode requires a higher concentration of Pt solution for rapid catalytic capabilities.

Keyword: Back illuminated; Dye sensitized solar cells (DSSCs); TiO2; Titanium foil; Front illuminated