Effect on compact-TiO2 by spray pyrolysis technique and its interface between TiO2/Si layer for tandem solar application

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1. Introduction

Organic-inorganic hybrid halide perovskites have emerged as a promising material for photovoltaic technology, and the improved rate of the performance of the solar cells has accelerated, reaching a record value of more than 22% over the past few years (1). Here, we used a simple method of spray pyrolysis, which is low cost and effective for planar perovskite solar cells (PSCs) employing TiO_2 as electron selective layers (ESLs) (2).

However, this technique is applied at high temperature >300°C, which will influence to the performance of Si-solar cell in term of life time and decrease overall performance. The influence should be investigated.

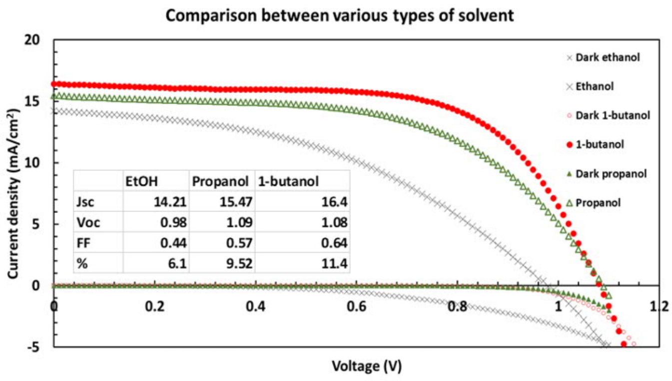

Fig.1 Comparison of J-V curve from various types of solvent.

2. Experiment

TiO_2 compact layer precursor were prepared from Titanium bis(acetylacetonate) (Tiacac) (0.15 M) in ethanol, propanol and 1-butanol for spray pyrolysis respectively. Spray pyrolysis temperature (Ts) was varied at 350, 420, 450°C, 10 min TiO_2 deposition for perovskite solar cell fabrication. After spray deposition, samples were annealed in furnace at 450ºC for 1 hr. Perovskite solar cell was fabricated by using 1-step deposition method and used structures composed of ITO/compacted-TiO_2/Perovskite/Spiro-OmeTaD/Au as a planar perovskite solar cell.

3. Results

Attempting to improve uniformity of Perovskite layer and to reduce the temperature effect of spray pyrolysis technique for Perovskite/Si tandem solar cell application, the spray temperature, post-annealing temperature and elapsed time after annealing were studied as a parameter for Perovskite/TiO_2, TiO_2 and TiO_2/Si layer. At spray temperature at 450 and 450 ºC, the growth morphology of TiO_2 nano-grains showed in FESEM shows that relationship between spray temperature and solvent boiling temperature in precursor resulted in impurity level on surface effect on performance of perovskite solar cell as shown in Fig.2.

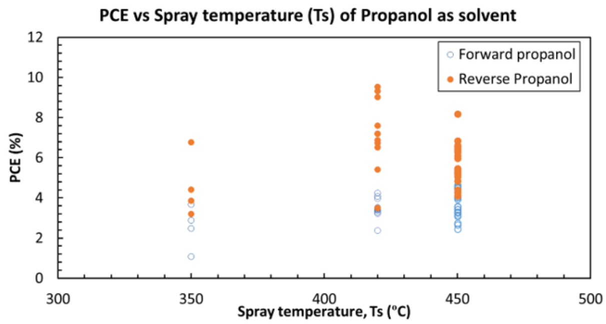

Fig.2 Distribution graph of variation of spray temperature (Ts) of TiO_2 layer prepared by using propanol as a solvent and PCE of perovskite solar cell.

Meanwhile, it was clearly seen that roughness of TiO_2 could be adjusted by changing the conditions. However, at this high temperature, life time of Si-substrate was reduced without porous TiO_2. Here, in this research work the optimized perovskite solar cell showed PCE about 11% (J_{sc} = 16.4 mA/cm^2, V_{oc} = 1.08 V and FF = 0.64) for an active area 0.54 cm^2 by using spray pyrolysis technique and solvent optimization as seen in Fig.3.

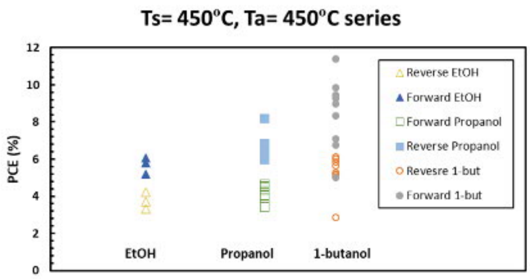

Fig.3 Distribution of PCE of perovskite solar cell vs TiO_2 from various types of solvent.

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