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Effect on compact-TiO₂ by spray pyrolysis technique and its interface between perovskite/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 TiO₂ 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.

2. Experiment

TiO₂ compact layer precursor were prepared from Titanium bis(acetylacetonate) (Ti(acac)₂) (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 TiO₂ deposition for perovskite solar cell fabrication. After spray deposition, samples were annealed in furnace at 450°C for 1 hr. Perovskite solar cell was fabricated by using 1-step deposition method and used structures composed of ITO/compact-TiO₂/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/TiO₂, TiO₂ and TiO₂/Si layer. At spray temperature at 450 and 450 °C, the growth morphology of TiO₂ 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.

Meanwhile, it was clearly seen that roughness of TiO₂ could be adjusted by changing the conditions. However, at this high temperature, life time of Si-substrate was reduced without porous TiO₂. Here, in this research work the optimized perovskite solar cell showed PCE about 11% ($J_{sc} = 16.4 \text{ mA/cm}^2$, $V_{oc} = 1.08 \text{ V}$ 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.

- (1) Ahn, N., Son, D. Y., Jang, I. H., Kang, S. M., Choi, M., & Park, N. G. *J. Am. Chem. Soc.*, 137(27), 8696-8699 (2015).
- (2) Perednis, D., & Gauckler, L. J. Thin film deposition using spray pyrolysis. *J ELECTROCERAM*, 14(2), 103-111 (2005).
- (3) Raut, N. C., Mathews, T., Chandramohan, P., Srinivasan, M. P., Dash, S., & Tyagi, A. K. *Mater. Res. Bull.*, 46(11), 2057-2063 (2011).

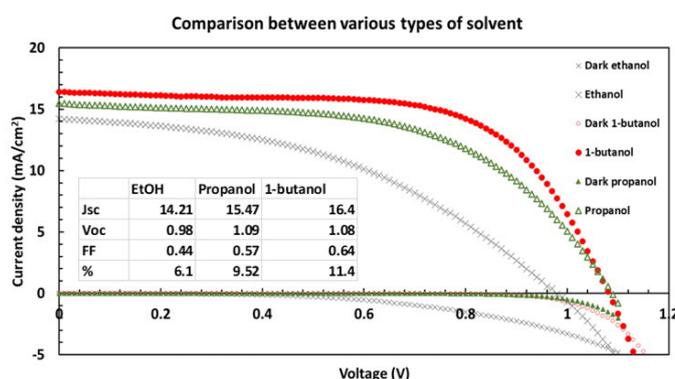


Fig.1 Comparison of J-V curve from various types of solvent.

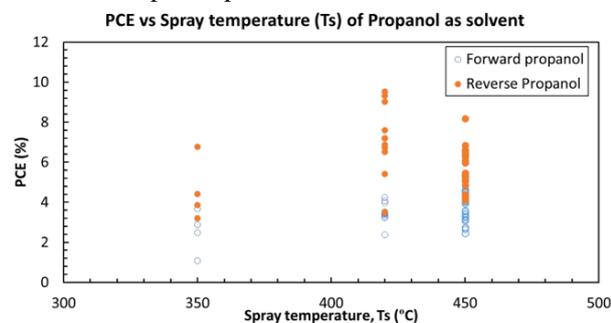


Fig.2 Distribution graph of variation of spray temperature (Ts) of TiO₂ layer prepared by using propanol as a solvent and PCE of perovskite solar cell.

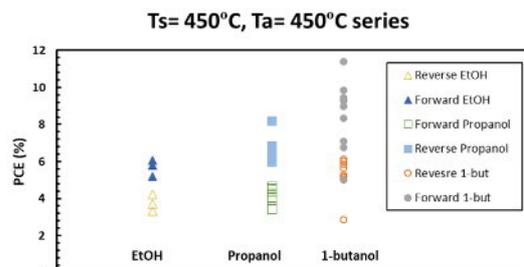


Fig.3 Distribution of PCE of perovskite solar cell vs TiO₂ from various types of solvent.