Improved sintering process of counter electrode for dye-sensitized solar cells

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초 록 : In interfaces between carbon black or Pt and FTO glass in dye-sensitized solar cell counter electrodes, a marginal resistant channel for electrons, we tried to improve the connection by modifying the sintering process. A stepwise sintering process for carbon black and Pt counter electrodes was applied and its effect on power conversion efficiency was studied. Power conversion efficiencies of built-in DSSC made by a one-step sintering process with carbon black and Pt counter electrodes were about 5.01% and 5.02%, respectively. Cells made with the stepwise sintering process were 5.96% and 6.21%, respectively, indicating an 20% improvement. Fill factor (*FF*) increased, and it was them main reason for the power conversion efficiency improvement. Step wise sintering increased the adhesion of the interface and reduced the film thickness and surface roughness. As a result, the resistivity of the counter electrode and EIS impedance of DSSCs decreased.

1. 서론

Dye-sensitized solar cells (DSSCs) are a next generation solar cell with low production costs compared to silicon solar cells. The counter electrode, one of three important components in DSSCs, provide an electron channel determining the power conversion efficiency of DSSCs. Counter electrodes transfer electrons from external circuits to tri-iodide in the redox electrolyte. In this study, the sintering process for counter electrodes made with either Pt or carbon black was investigated to improve the connection between the Pt or carbon black and fluorine doped indium oxide (FTO) glass. Stepwise sintering was applied and its effect on the power conversion efficiency of DSSCs was investigated.

2. 본론

Titanium oxide (TiO_2) paste (20nm, Solaronix) was uniformly coated by screen printed on the FTO glass as a working electrode. The TiO_2 eletrode was sintered at 500°C for 30 min. The sintered TiO2 electrdoe was immersed in 0.3 mM dye solution (N719, Solaronix) for 24 h.

a one-step sintered carbon black counter electrode, the precursor was coated using screen printing on FTO glass, and then it was sintered at 500 °C for 30 min, and for the step wise sintered counter electrode, it was aged at RT for 2 h, and dried at 80 °C for 2h in an oven and then sintered at 500°C for 30 min. The one-step Pt counter electrode was made by dropping 0.5 mM of $H_2PtCl_6 \cdot 6H_2O$ and DI water solution on the FTO glass followed by sintering at500° C for 30min, and for the step wise sintered counter electrode, the same drying and sintering procedure for the carbon black counter electrode was applied.

3. 결론

An improved sintering process for counter electrodes in DSSCs was investigated. The power conversion efficiency of DSSCs with a carbon black counter electrode was increased from 5.01% with one-step sintering to 5.96% with stepwise

sintering. In the Pt counter electrode, that increased from 5.02% to 6.21% with the stepwise sintering. Consequently, the improved sintering process for the carbon black and Pt counter electrodes made for an about 20% PCE upgrade, respectively. This was ascribed to the relatively lower resistivity of the counter electrode and reduced impedance for DSSCs with the improved stepwise sintering, and those originated from the dense counter electrode layer with a smoother surface, and better adhesion between the counter electrode and FTO glass.

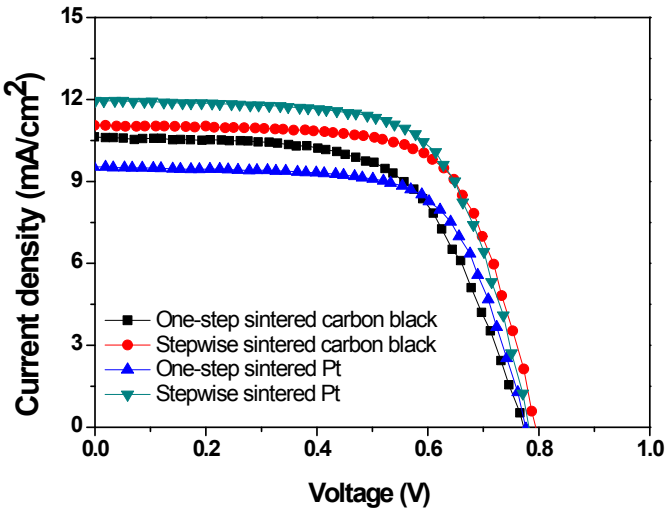

Fig. 1. Photocurrent-voltage curves of DSSCs as a function of a counter electrode under AM 1.5-100 mW/cm^2 light irradiation

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