Basic study for the construction of wet solar cell using CdS photocatalysts, Na_2S_4 electrolyte, and inorganic photo-carrier transport materials

Takashi Mabuchi, Shun Yokoyama, Norihiro Shimoi, Hideyuki Takahashi, Kazuyuki Tohji
Graduate School of Environmental Studies, Tohoku University

e-mail: hideyuki@mail.kankyo.tohoku.ac.jp

1. Introduction

In recent years, dye-sensitized solar cells has attracted much attention since it can be produced lower cost than Si solar cell and shows high conversion efficiency which is more than 10%. However, dye material is not stable over extended periods of time because of their degradation and/or adsorption.

In previous study, it is considered that an adoption of stratified CdS photocatalysts, which showed shorter band gap than TiO_2 and high photocatalytic performance, as a semiconductor material of wet solar cell with long term stability and low cost. However, extremely low efficiency compared to theoretical limiting efficiency has been observed in above solar cell. It is regarded that low efficiency was due to inhibition of transfer of photoexcited electrons because of high resistance of CdS particles.

Therefore, in this study, the wet solar cell with the addition of inorganic photo-carrier transport materials to CdS particles was tried to construct.

2. Experimental

TiO_2, ZnS and ZnO as the electron transport materials and $CuAlS_2$ as the hole transport material are adopted as photo-carrier transport materials. CdS nanoparticles (N-CdS) and stratified morphology particles (S-CdS) were selected as semiconductor. Synthesized materials were analyzed by XRD (Rigaku Co.,Ltd) and HR-TEM/EDX (Hitachi Co.,Ltd., HF-2000 Field Emission TEM). Wet solar cell was constructed by using photo-carrier transport materials and CdS photocatalysts. Current-voltage characteristics of wet solar cells were measured by potentiostat/ galvanostat (Gamry Instruments, R600).

3. Results and discussion

Figure 1 (1) shows I-V curves of the wet solar cells with the electron transport materials and N-CdS under 1SUN light irradiation, and all of these cells shows photovoltaic effect. Therefore, the electron transport materials such as TiO_2, ZnS and ZnO have potential to improve the conversion efficiency of the wet solar cells as photo-carrier transport materials.

Figure 1 (2) shows I-V curves of the cells with the electron transport materials and S-CdS under 1SUN light irradiation. From this graph, the cells with TiO_2 and ZnO hardly show photovoltaic effect in contrast with the cells with N-CdS. This result is clearly caused by the morphology of CdS semiconductor particles. Therefore, the semiconductor with stratified morphology is not suitable for the wet solar cells with the addition of the electron transport materials.

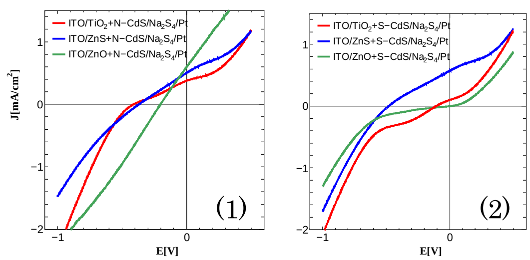

Figure 1 Current-voltage characteristics of wet solar cells with (1)N-CdS and (2)S-CdS

4. Conclusion

The electron transport materials such as TiO_2, ZnS and ZnO have potential of improve the conversion efficiency of the wet solar cell as photo-carrier transport materials.

In spite of the high photocatalytic performance, stratified morphology is not suitable for the wet solar cell with the addition of the electron transport materials.

As a future work, the control of the ratio of N-CdS to photo-carrier transport materials and the size of N-CdS and photo-carrier transport materials is intended to do. Other results, such as the performance of the wet solar cell using $CuAlS_2$ as the hole transport material, will be presented in our presentation.

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