Improvement of photo-carrier transport efficiency from the semiconductor particles to electrode by using organic 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

Many researchers have vigorously studied on the development of low cost and high efficiency solar cells to solve the problems of fossil fuel shortage and global warming. Among various solar cells, wet solar cell which usually be sensitized with dye materials for high efficiency has attracted much attention since it can be produced lower cost than Si solar cell. However, high performance wet solar cell sensitized with dye materials is not stable over extended periods of time because of dye degradation and/or adsorption.

It is considered that an adoption of stratified CdS photocatalysts, which showed shorter band gap with high photocatalytic performance, as a semiconductor material alternatively to TiO_2 can improve the efficiency 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, photo-carrier pathway from semiconductor particles to electrode was tried to develop by using organic carrier transport materials.

2. Experimental

PEDOT/PSS, which is hole-transport material, and PBD, which is electron-transport material is adopted as photo-carrier transport materials. CdS nanoparticles were selected as semiconductor. Synthesized materials were analyzed by XRD (Rigaku Co.,Ltd, Rad-C system, CuKα, 40KV, 30mA) and HR-TEM/EDX (Hitachi Co.,Ltd., HF-2000 Field Emission TEM). Wet solar cell was constructed by using coating paste which is mixture of photo-carrier transport materials and CdS nanoparticles semiconductor.

3. Results and discussion

I-V curves of the wet solar cells with photo-carrier transport materials under dark condition were evaluated, and all of the above mentioned cells shows schottky junction. Therefore, the potential of photovoltaic effect is indicated.

Figure 1 shows I-V curves of the wet solar cells under 1 SUN light irradiation. From this graph, in spite of the formation of schottky junction, photovoltaic effect isn't observed in the cells with photo-carrier transport materials.

These results indicate that the contact between photo-carrier transport materials and electrolyte solution forms schottky junction. Therefore, to improve the efficiency of photo-carrier transport from the semiconductor particles to electrode, the adoption of photo-carrier transport materials which don't form the schottky junction with electrolyte solution is necessary.

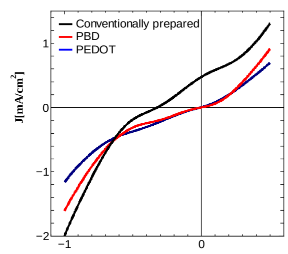

Figure 1 Current-voltage characteristics of wet solar cells under light irradiation

4. Conclusion

The wet solar cells with photo-carrier transport materials show the formation of schottky junction. However, the photovoltaic effect is not observed in the above mentioned cells. These results indicate that the contact between photo-carrier transport materials and electrolyte solution forms schottky junction. Therefore, to improve the efficiency of photo-carrier transport, the adoption of photo-carrier transport materials which don't form the schottky junction with electrolyte solution is necessary.

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