光無線給電用フィルター付き太陽電池への散乱付与による見栄え改善

Improvement of appearance by scattering to color filters on solar cell for OWPT

東工大未来研 °Liu Yu, 宮本智之

FIRST, Tokyo Tech, °Yu Liu and Tomoyuki Miyamoto

E-mail: liu.y.bn@m.titech.ac.jp

1. Introduction

Optical wireless power transmission (OWPT) systems are attractive photonic systems. In the OWPT system, monochromatic light is effective and the NIR range is the best for mature Si and GaAs solar cells. These solar cell surfaces are black, and it limits the appearance of the OWPT equipment. We have reported to use visible color filters to control the appearance of solar cells [1]. In this report, we added frosted glass to improve the appearance characteristics.

2. Appearance control using filters and scattering

A light power receiving module using a 3D printer was fabricated using a five-series connected flexible-type GaAs solar cell module whose size was 5 cm×9 cm. As shown in Fig. 1 (left), two color filters of multilayers are set in the module to cover the solar cell module. In the case of a flat filter, we can see the electrical wires in the module and the electrode metal of the solar cell. In addition, reflection of the ceiling is recognized. These make the appearance worse.

In general, light scattering is important and is required for good appearance. To change the surface roughness of the module, we placed a piece of frosted glass on the filter. The appearance of the module has changed as shown in Fig. 1 (right). By adding a frosted glass, the surface becomes rough, and the electrodes of the solar cell and the reflection of the ceiling become almost vanished. In addition, it reduced the color dependency of the viewing direction.

3. Experimental characterization of OWPT

The scattering of light causes reduction of incident light into the solar cell. The experiment of optical wireless power transmission was carried out using solar cell and laser light. The light source is an 850 nm-VCSEL array with a maximum output power of 20 W, but was set to approximately 2.5 W in experiments.

The I-V characteristics and output power of the solar cell were measured as shown in Fig. 2. Since the transmittance of the filter without the AR coating on the substrate side is about 90%, the output power and current of the solar cell under the filter is slightly lower than that of the solar cell without the filter. Furthermore, when a frosted glass is placed on the filter, the short circuit current and output power of the solar cell are reduced by about 10%. This causes disadvantage of OWPT, however trade-off between appearance and transmission efficiency may by required. Further improvement in efficiency has been investigated by controlling the difference in scattering between visible and NIR light.

4. Summary

Under the OWPT light source, the appearance of the solar cell can be changed to some extent by a color filter having a scattering function without significant deterioration of the performance.

謝辞

本研究の一部は，NEDO 戦略的省エネ技術革新プロ「モビリティへの移動中給電用光無線給電の技術ポテンシャル -技術課題調査」により実施された．

References

[1] Y. Liu and T. Miyamoto, JSAP spring, 11p-W611-7, 2019.

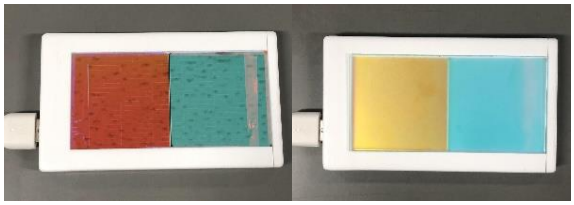

Fig. 1. OWPT receiver module with filters of DIF-RED and DIM-GRE without (left) and with (right) frosted glass.

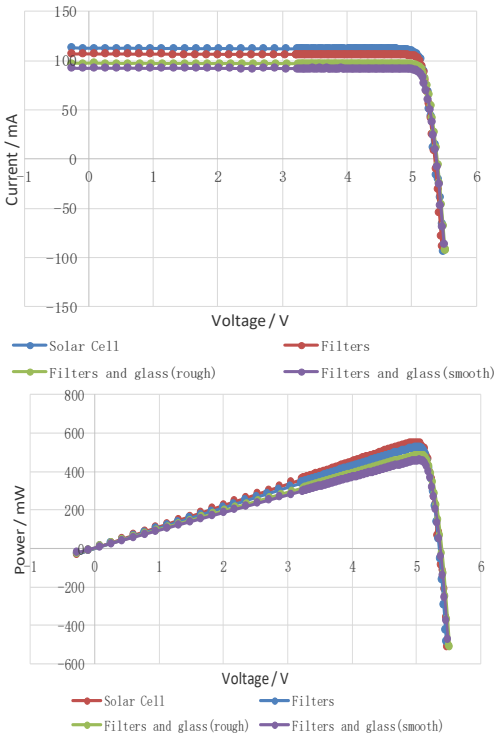

Fig. 2. I-V(upper) and power (lower) of module