

論文 / 著書情報  
Article / Book Information

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種別(和文)	論文要旨
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## 論文要旨

THESIS SUMMARY

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要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words)

Throughout this study, the main aim was to build a specialized model which enables the analysis of carrier behaviors in BHJ. The overall focus was on enhancing the performance of OSCs. Specifically, the research uses the optical measurements of EFISHG which probe carrier behaviors in materials directly. The main conclusions that can be drawn from this dissertation are as follow.

Chapter 1 includes a good summary on background information regarding OSCs. Besides this, literature reviews and operational mechanisms of OSCs in materials were included ensuring they were based accurate information from the photovoltaic field. Once examining the first chapter of this study, the major intention is understood. When it comes to the structure of OSCs, although massive growth is noticed in power conversion efficiency of photovoltaic cells, a major gap is still present in comprehending some behaviors like carrier injection and transport process. According to, this work aims to solve some of these mysteries.

The second chapter presents the required information regarding the most suitable materials used for processing each layer of the OPV device. In addition, thorough information were provided for experimental deposition techniques, as well as measurement computations. To fully understand and select a systematic measurement technique, this chapter critically evaluates a technique called; electric field induced second-harmonic generation (EFISHG). At last, this chapter benefits from the Maxwell-Wagner model which is associated with physical actions for charge accumulation occurring in the interface.

Chapter 3 explores carrier behaviors in BHJ OSCs using EFISHG measurements. It is concluded that circuit response time between positive and negative voltages is approximately identical. However, for Maxwell-Wagner-type interfacial charging taking place between positive and negative voltages, a notable variation was noted for response time. In particular, this illustrated electrons accumulation (Qs) in the interfacial area between the donor and the acceptor. Consequently, it was found that accumulated electrons in the donor side (PCPDTBT) were lesser than electrons at the acceptor (PC71BM). In return, total efficacy of the bulk heterojunction OSCs was significantly impacted.

The fourth chapter emphasizes on the EFISHG measurement application in order to analyze the impact of adding 3 wt% DIO solvent to PCPDTBT: PC<sub>71</sub>BM (BHJ). From this chapter, it is

agreed on that altering the size of domains vitally enhances BHJ layer performance. To be more precise, BHJ's efficiency has increased by approximately 25%. In fact, by using SHG measurement, managing both electrons transportation and holes at donor and acceptor is possible. Thus, examining the associated electric field is feasible. However, it is necessary to justify laser wavelength. Furthermore, no influence was noticed in the internal electric field when DIO was added. In general, DIO additive is known to decrease all of relaxation time, interface charge and space charge field. Therefore, it is agreed on that optimizing domain size of the interface would affect the reduction of accumulated charge. Overall, the performance of the PCPDTBT: PC<sub>71</sub>BM based BHJ film was massively improved.

Chapter 5 points out some experimental work where the Z907 was tested with BHJ in solar cells. The measurements were carried out using electric-field-induced optical second harmonic generation (EFISHG) at laser wavelength. To study the influence of nanoparticles on carrier transport in fabricated BHJ solar cells, few prepared nanoparticles were added to Z907 dye. From EIS investigation, a drop in resistance was clearly observed to be from 5400 to 4300 in the device using the Z907. It is most likely that this fall in resistance has improved photoelectrons which are produced in the BHJ layer. Specifically, they reached the end of the electrode without any loss taking place. Occasionally, the findings from EFISHG measurements of the internal field, which was directed from Au to ITO electrode, have developed majorly. Besides, the internal field has also been improved due to Z907 additive. The enhanced performance of the OSCs when Z907 is used, a greater number of photons were scattered to the substrate in comparison to particle free solar cells. In conclusion, an improvement in carrier behavior in solar cells is perceived. This subsequently results in an enhancement of efficiency of about 45 %.

Eventually, below are several conclusions that are fully delivered from this thesis:

- EFISHG methods were utilized in order to investigate BHJ OSCs.
- The chosen probed SHG measurement is beneficial in examining both electrons and holes behaviors in BHJ OSCs.
- A clear picture for both carrier behaviors and interfacial charging of OSCs were established according to the field of dielectric physics.
- DIO alters the morphology of BHJ and causes balanced hole and electron transport in solar cells (efficiency higher by 25%).
- Adding metal complexes such as Z-907 contributes to enhance the charge extraction (efficiency higher by 45%).

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note: Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1 copy of 800 Words (English).

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