論文 / 著書情報
Article / Book Information

題目(和文)	色素増感太陽電池用酸化亜鉛と酸化チタン光電極における界面電子移動に関する研究
Title(English)	Study of Interfacial Electron Transfer on Titanium Oxide and Zinc Oxide Photo-anode Based Dye Sensitized Solar Cells
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出典(和文)	学位:博士（工学）, 学位授与機関:東京工業大学, 報告番号:甲第9942号, 授与年月日:2015年6月30日, 学位の種別:課程博士, 審査員:脇　慶子,堀田　栄喜,沖野　晃俊,松下　伸広,伊原　学,大友　順一郎
Citation(English)	Degree:, Conferring organization: Tokyo Institute of Technology, Report number:甲第9942号, Conferred date:2015/6/30, Degree Type:Course doctor, Examiner:,,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

専攻： Department of	創造エネルギー　専攻	申請学位（専攻分野）： Academic Degree Requested	博士　（　工学　） Doctor of
学生氏名： Student's Name	陶　潤邦	指導教員（主）： Academic Advisor(main)	脇　慶子
		指導教員（副）： Academic Advisor(sub)	

要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

This thesis consists of six chapters. In chapter 1, the working principle, current development and research subject of dye sensitized solar cell (DSSC) are introduced. And parameters affecting efficiency of DSSC are stated. The research objective of this study is to understand what is the factors that decide the interfacial electron transfer and cell efficiency through electrochemical measurements and analysis for the cells using different photo-anode materials (ZnO, TiO_2), structure (nanorod, nanoparticle), dye sensitizers (ruthenium-based complexes, organic dyes) and electrolytes. The measurement principle and analysis method of electrochemical measurements employed in this study, including current-voltage characteristics, electrochemical impedance spectroscopy (EIS), intensity modulated photo-voltage spectroscopy (IMVS), intensity modulated photocurrent spectroscopy (IMPS) and charge extraction method, have been described in chapter 2. The study of chapter 3 reveals that by Al-doping of ZnO nanorod, one can control the nanorod size, resulting in different solar cell performance. The open-circuit voltage in DSSC employing ZnO nanorod based photo-anode with 5.0% Al addition reaches 0.732 V, which is about 0.1 V higher than the sample without Al addition. In order to investigate the mechanism, the impedance measurement was conducted. It indicates that the charge induced by Al-doping partially fill the surface traps and this shifts the Fermi level towards the conduction band edge, resulting in the increment of charge recombination resistance at the photo-anode/electrolyte interface. Although 0.5% Al-doping nanorod based photo-anode has the smallest surface area for dye adsorption due to its largest diameter, the reduction of electron transport resistance in this photo-anode is beneficial for charge collection efficiency, and finally resulting in highest photocurrent among the samples. The work of the study in chapter 4 is to quantitatively evaluate charge collection efficiency associated with different materials and structures of photo-anodes, by using IMVS and IMPS measurements. For ZnO based photo-anode, the charge collection efficiency of nanorod structure is 97.4%, which is higher than nanoparticle (92.5%). For the same nanoparticle structure, the charge collection efficiency of TiO_2 based photo-anode (89.5%) is lower than ZnO based photo-anode. It indicates that the advantage of ZnO material due to its high bulk electron mobility and the superiority of nanorod structure. However, ZnO based DSSCs show lower photocurrent, compared with TiO_2 samples. It can be attributed to the poor charge injection from Dye. Therefore, the developments of suitable dye sensitizers for improving charge injection efficiency of ZnO based DSSCs is an important research challenge. The study of chapter 5 focus on using stable TiO_2 porous thin film to study the change of electron transport in the crystal and charge transfer at the interfaces related to different electrolyte and dye combinations, based on impedance analysis. In this study, we suggest that the ratio of charge recombination resistance against transport resistance (R_{ct}/R_t) corresponding to charge mobility, is a significant parameter for DSSC evaluation. In chapter 6, the understanding of the interfacial electron transfer through this research is summarized.

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 1copy of 800 Words (English).

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