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Dr. Rahmat Hidayat / Osaka University

＜外国人研究者プロフィール Profile＞

国籍: Nationality:	インドネシア / Indonesia
日本留学時の滞在期間: Pereiod of Stay During in Japan:	2010 年 06 月 04 日 ～ 2010 年 08 月 02 日 Jun 4, 2010 ～ Aug 2, 2010
日本留学時の大学: Education Background in Japan:	大阪大学　大学院工学研究科 Osaka University Department of Electronic Engineering
専攻分野: Major Field:	電子工学 Organic Semiconductor Materials and Devices
現在の所属/職位: Present Institution / Status:	バンドン工科大学 / 講師 Bandung Institute of Technology / Assistant Professor

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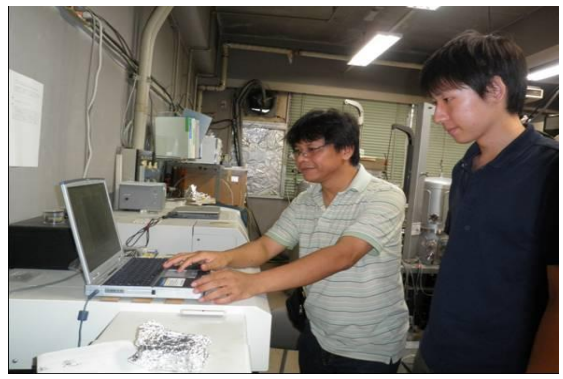
＜研究報告 Follow up Research Fellowship＞

受入研究者氏名: Research Adviser:	尾崎 雅則教授 / Prof. Dr. Masanori Ozaki
受入れ期間: Researching Period:	60日 / 60 days
研究課題: Theme of Research:	Hybrid Solar Cell with Doped-ZnO as Acceptor Layer Prepared by Sol-Gel Technique

■研究概要　Outline of Reserch

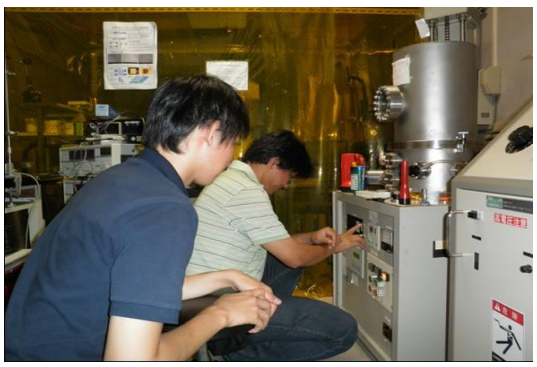
Hybrid organic–inorganic solar cells has attracted much attention as a promising approach to produce higher energy conversion efficiency than organic/polymer solar cells. One of most studied configuration is hetero–junction of conjugated polymer and metal oxide, which form a donor–acceptor (D–A) pair. We are interested in hybrid solar cells constructed of conjugated polymers and Al–doped ZnO. ZnO is an amorphous semiconducting materials , which can be doped to forms n– or p–type with higher conductivity. In such case, we may expect that the mean free path length of charge carrier may increase. In addition, ZnO can be prepared by wet chemical or sol–gel process, which are potentially applicable for large area cell fabrication with relatively easy fabrication technique. From the scientific viewpoints, it is interesting to clarify the function of ZnO as electron acceptor in such D–A pair and the effect of doping on the characteristics of solar cells. In organic based devices, the use of doped materials is often not recommended to prevent the gap states formations, which may act as charge carrier trap states. However, the use of Al–doped ZnO, in comparison to pure ZnO, may reduce the internal resistance and therefore increase the charge collection efficiency.



Doing measurement while discussion with a student in group

■研究成果　Result of Reseach

Al–doped ZnO layer has been prepared by sol–gel technique.The Energy Disperse Spectrum (EDS) analysis measured by Scanning Electron Microscopy (SEM) indicates the ZnO proportion of about 22.3% and the In2O3 proportion is 77.3% (originated from the substrate ITO layer). In order to be applied in solar cell structure, the thickness should be less than 100 nm with relatively small roughness. By controlling the reactant concentration and preparation, we can prepare ZnO layer with 30–50 nm in thickness and small roughness, although unwanted nano–pillars formation was also randomly found in the layer.



Doing fabrication of solar cells assisted by a student in group

This Al-doped ZnO layer and poly(hexylthiophene) (P3HT) were used to build the inverted type of hybrid solar cell with ITO/ZnO/P3HT/PEDOT:PSS/Ag structure. From the voltage-current characteristics measurements, this solar cell shows V-I curve of typical photovoltaic characteristic of solar cell, but the curve seems to be influenced also by Ohmic characteristic, either in dark or light illuminated conditions. Such characteristic is suggested due to the formation of electric conduction channels by the nano-pillars. Photocurrent transient measurements by using a nanosecond Nd:YAG laser show that photocurrent decay is in the order of hundred microseconds, which is much slower than that of P3HT/PCBM system. These results indicates the role of ZnO as electron acceptor but the charge transfer rate in this D-A pair is not large as in the P3HT/fullerene system.

■日本留学の思い出　Memories of Studying in Japan

I was really enjoyed the research facilities and atmosphere. I was really enjoyed the friendships with some friends, either inside or outside of the laboratory.

Together with students in student room