

課題番号 : F-15-HK-0051
 利用形態 : 機器利用
 利用課題名(日本語) :
 Program Title (English) : Plasmon-enhanced photocurrent generation with a controlled semiconductor thin film for perovskite solar cells.
 利用者名(日本語) :
 Username (English) : Ahmed Esmail Shalan
 所属名(日本語) : 北海道大学情報科学研究科
 Affiliation (English) : Graduate School of Information Science and Technology, Hokkaido University

1. 概要(Summary)

Plasmonics is a promising new approach to enhance the light harvesting properties of perovskite solar cells (PSCs). Metal nanoparticles support surface plasmon modes, which are used to couple light into the underlying optical modes of the semiconductor. Excitation of surface plasmons is characterized by strong scattering and enhancement of the electric field in the vicinity of the metal nanoparticle. In the present work, we studied the effect of Au Nanoislands (Au NIs) on enhancement of the photocurrent generation for PSCs. With the aid of the Au NIs, the optical absorption properties of the perovskite layer and the incident photon-to-current efficiency was improved.

2. 実験(Experimental)

• Apparatus

Pulsed laser deposition, Scanning electron microscope, X-ray diffraction, X-ray photoemission spectrometer, Helicon sputtering, Solar simulator

• Method

In brief, the perovskite precursor solution was deposited onto a PLD-NiO (with or without Au NIs)/ITO substrate by a spin-coating process. Subsequently, the [6,6]-Phenyl-C₇₁-Butyric Acid Methyl Ester (PCBM) layer was deposited by spin-coating. Finally, the device was completed with the thermal evaporation of 100 nm Ag contact electrodes in a high vacuum through a shadow mask. The schematic diagram of preparation of Perovskite solar cells is shown in Figure 1. The active area of the Ag electrodes in the fabricated device was 0.05 cm².

3. 結果と考察(Results and Discussion)

The photovoltaic performance was explored using PLD-prepared NiO films from a p-i-n type device. Furthermore, the light absorption enhancement

and electron transfer improvement in PSCs have been achieved by incorporating plasmonic Au NIs. The results expound that the location of NIs plays an important role for improving the charge extraction properties.

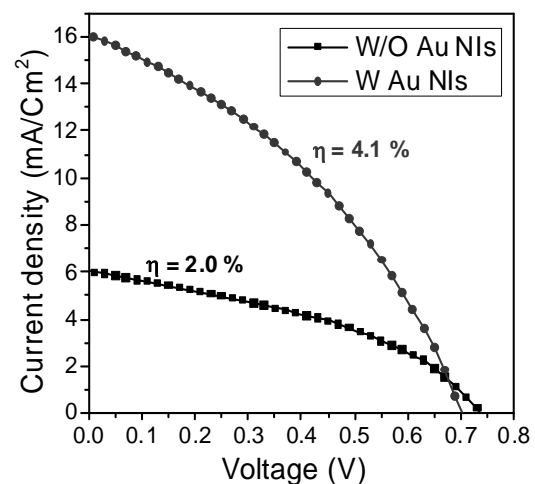


Fig.1 $J-V$ characteristics of PSCs composed of ITO/NiO/perovskite/PCBM/Ag with (●) and without Au NIs (■).

4. その他・特記事項(Others)

• Coauthor:

RIES-Hokkaido Univ.: Keisuke Nakamura, Hiroki Sawayanagi, Tomoya Oshikiri

National Chiao Tung University: Hui-Ping Wu, Eric Diau

5. 論文・学会発表(Publication/Presentation)

(1) Shalan, A. E. et al., The 96th annual meeting of Chemical Society of Japan, Doshisha University (Kyoto), Mar. 2016.

6. 関連特許(Patent)

なし