Data Article

Data on lateral collection length of charge carriers depending on pre-white-light soaking process for metal mesh transparent electrode based Cu(In,Ga)Se$_2$ solar cells

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Article info

Article history:
Received 10 July 2019
Accepted 9 August 2019
Available online 20 August 2019

Keywords:
Lateral collection length
Solar cells
CIGS
Transparent electrodes
Metal mesh
Silver nanowire

Abstract

The authors have recently reported silver nanowire based Cu(In,Ga)Se$_2$ solar cells [1,2]. Metal mesh based transparent electrodes other than the silver nanowire can be also employed or have a potential to provide a better performance for the solar cells. To select a suitable electrode for a solar cell among metal meshes, it is required to have data on the lateral collection length of charge carriers in the targeted cell. The method to determine the lateral collection has been reported in our previous publication [3]. Here, we report data on the effect of the light intensity during pre-white-light soaking on the lateral charge collection length for metal mesh transparent electrode based Cu(In,Ga)Se$_2$ solar cells.

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Table 1 summarize the intensity of pre-white-light soaking and 600 nm-narrow-bandwidth-light, and the photocurrent upon illumination of 600 nm-narrow-bandwidth-light immediately after a corresponding the pre-white-light soaking for four cases A, B, C, and D. The diameter of a disk-shaped Al/Ni top electrode formed on CdS/CIGS/Mo planar stack was 1.75 mm. The reflectance of the light off the front CdS surface was 0.09. Fig. 1 shows the variation of the measured photocurrents with illumination conditions for four cases A, B, C, and D. With increasing the intensity of pre-white-light soaking, the photocurrent upon illumination of 600 nm-narrow-bandwidth-light immediately after a corresponding the pre-white-light soaking increased. Fig. 2 shows the determined lateral collection lengths as a function of the intensity of pre-white-light soaking. The value increased from 15.4 to 23.4 μm with increasing the intensity of pre-white-light soaking from 0.11 to 1.0 sun. The lateral collection length data will be useful to design a suitable network for silver nanowire based CIGS thin film solar cells [1,2].

### Table 1

| Case | Pre-white-light soaking | 600 nm narrow bandwidth light |
|------|-------------------------|-------------------------------|
|      | Intensity 1.0 sun = 100 mW/cm² | Intensity (W/cm²) | Photocurrent (A) |
| A    | 0.11 sun                 | 7.3                          | $2.72 \times 10^{-7}$ |
| B    | 0.37 sun                 | 24.5                         | $1.13 \times 10^{-6}$ |
| C    | 0.61 sun                 | 40.4                         | $2.10 \times 10^{-6}$ |
| D    | 1.0 sun                  | 66.2                         | $3.75 \times 10^{-6}$ |
Fig. 1. The variation of the measured photocurrents with four different illumination conditions of case A, B, C, and D.
2. Experimental design, materials, and methods

The measured device has a structure of Al/Ni/CdS/CIGS/Mo. Al/Ni is disk-shaped, and formed by e-beam evaporation through a shadow mask on the CdS/CIGS/Mo planar stack. The reflectance of the light off the front CdS surface was measured using an UV–Vis spectrometer. Photocurrents were measured from the short-circuited device under light illumination generated by a solar simulator. The intensity of white-light, employed for pre-white-light soaking process, shining the device was controlled by adjusting the device-to-solar simulator distance. The 600 nm-narrow-bandwidth-light, which was employed to determine the lateral collection length of charge carriers, was generated by inserting a 600 nm-band pass filter between the device and the solar simulator. The lateral collection lengths were determined using equation (4) of our previous work [3].

Acknowledgments

This research was supported by the Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science and ICT (Grant No. NRF-2019R1F1A1058917).

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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