



Journal Name

ARTICLE

Supplementary information

The interface degradation of planar organic–inorganic perovskite solar cell traced by light beam induced current (LBIC)

Yanqing Yao^{a,b}, Gang Wang^a, Fei Wu^a, Debei Liu^{a,b}, Chunyan Lin^{a,b}, Xi Rao,^{a,b} Rong Wu^c, Guangdong Zhou^{a,b}, and Qunliang Song^{a,b}*

^a *Institute for Clean Energy and Advanced Materials, Faculty of Materials and Energy, Southwest University, Chongqing 400715, P. R. China*

^b *Chongqing Key Laboratory for Advanced Materials and Technologies of Clean Energy, Chongqing 400715, P. R. China*

^c *Key Laboratory of Solid-state Physics and Devices, School of Physical Science and Technology, Xinjiang University, Urumqi 830046, China.*

* *Corresponding author. E-mail address: qlsong@swu.edu.cn*

1. The detail steps of LBIC setup

For illumination of the samples, we used laser (Cobolt 06-01, Spectral bandwidth < 1.2 nm) with wavelength 405 nm. The laser beam is focus onto the PSCs surface using a microscope objective lens. Because a shorter focal length lens or microscope objective can be used to achieve higher spatial resolution.¹⁻³ The cell was mounted on top of two computer controlled linear stages (TSA30-C, Zolix Beijing China) providing XY positioning of the cell in the XY plane normal to the laser beam with an accuracy of 0.625 microns (μm). We used a 2-axis Motion Controller/Driver (SC300, Zolix Beijing China) to control the stages. The generated photocurrent for each XY position is recorded using electrochemical workstation (CHI, 600D). Actually, during the measurement the spot was immobile. First, the spot falls on the lower right corner of the cell effective area, as scanning starting point and the origin of the axis. Second, the stage moved along the X-axis, while CHI recorded the i-t curve during the moving. Then the stage moved along the Y-axis. Repeated the above steps until the complete scanning of whole cell.

2. LBIC and I-V results

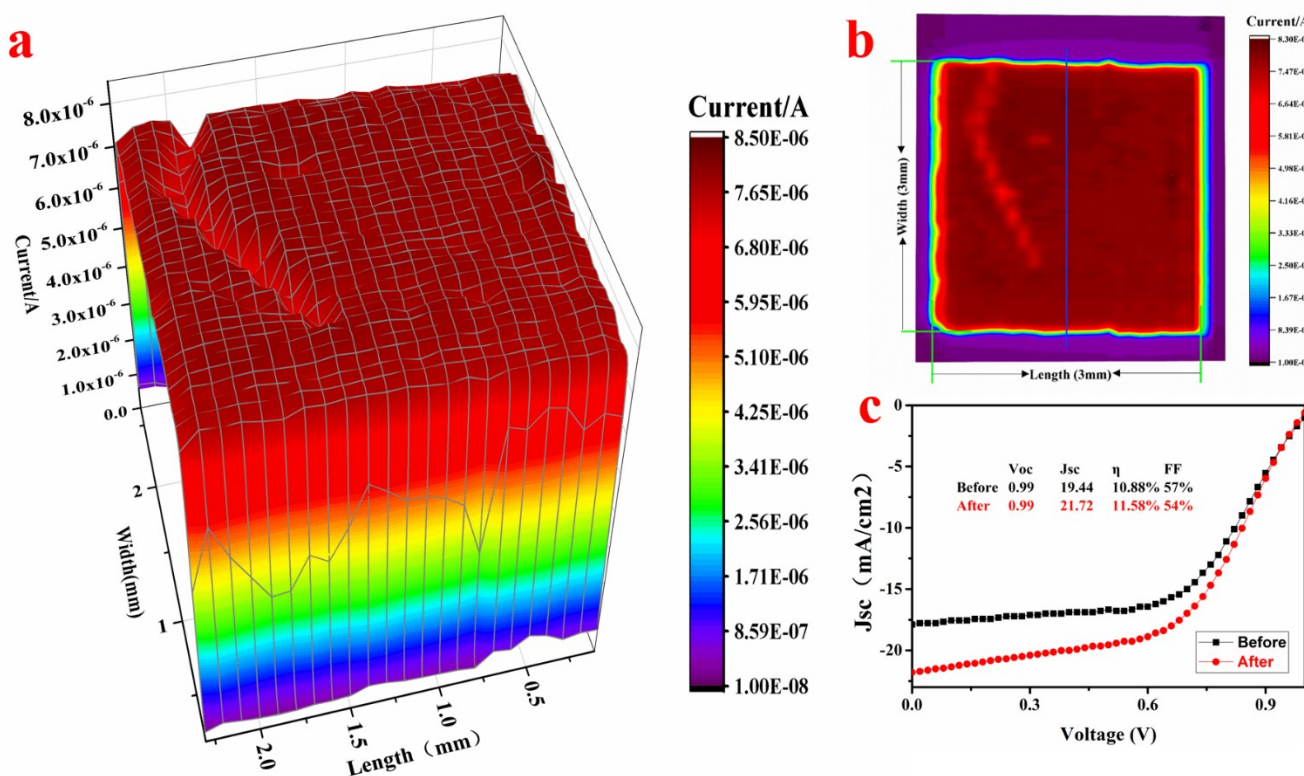


Figure S1 (a) Three-dimensional photoresponse shows the defects of PSC. (b) Cutting diagram of PCS. (c) The J-V characteristics of the device before and after cutting.

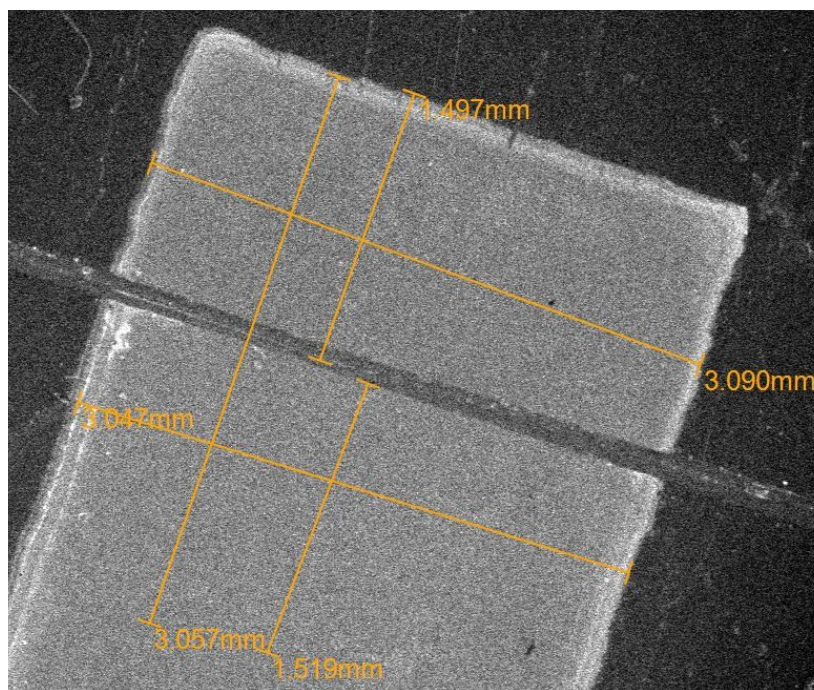


Figure S2 SEM image of the device after cutting. The device area is calculated based on this measurement.

3. Optical images

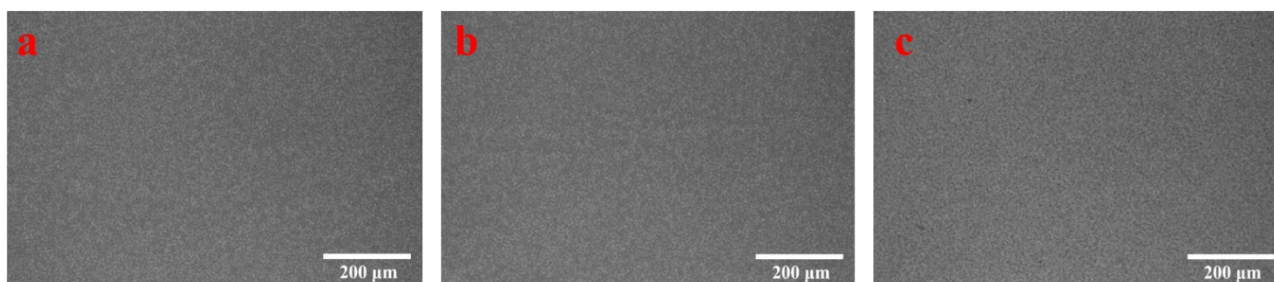


Figure S3 Optical images of the hole transport materials of the perovskite solar cells without top electrodes. (a) just after fabrication, (b) after 7 days storage in glove box, and (c) after 28 days storage in glove box.

4. EQE measurements

The labelled brown spots can be regarded as the measurement locations. As shown in the photograph, the green light spot is much smaller than device area. The apparent EQE values from the five labelled locations are given in the figure S4 (b), respectively.

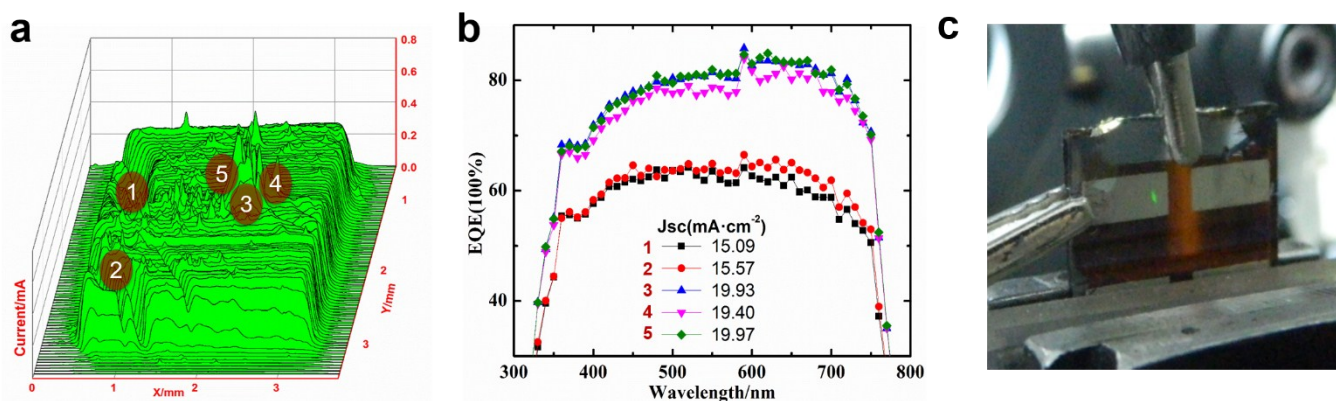


Figure S4 Schematic diagram of the five EQE measurements.

5. Stability test

The laser intensity was selected at the power of 0.1 mW, after it pass through the quartz glass and microscope objective lens the intensity is not determined. But, we are convinced that the laser illumination will not cause any damage during the measurement since long time laser illumination cause no photoresponse degradation, as shown below.

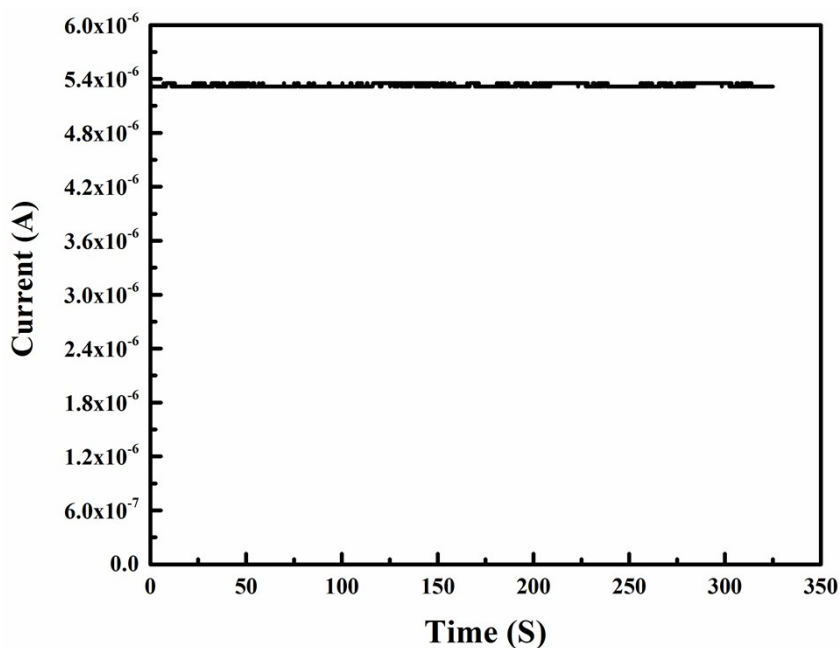


Figure S5 i-t curve of the PSCs for 300 seconds when the laser is illuminated on the device.

6. J-V curves

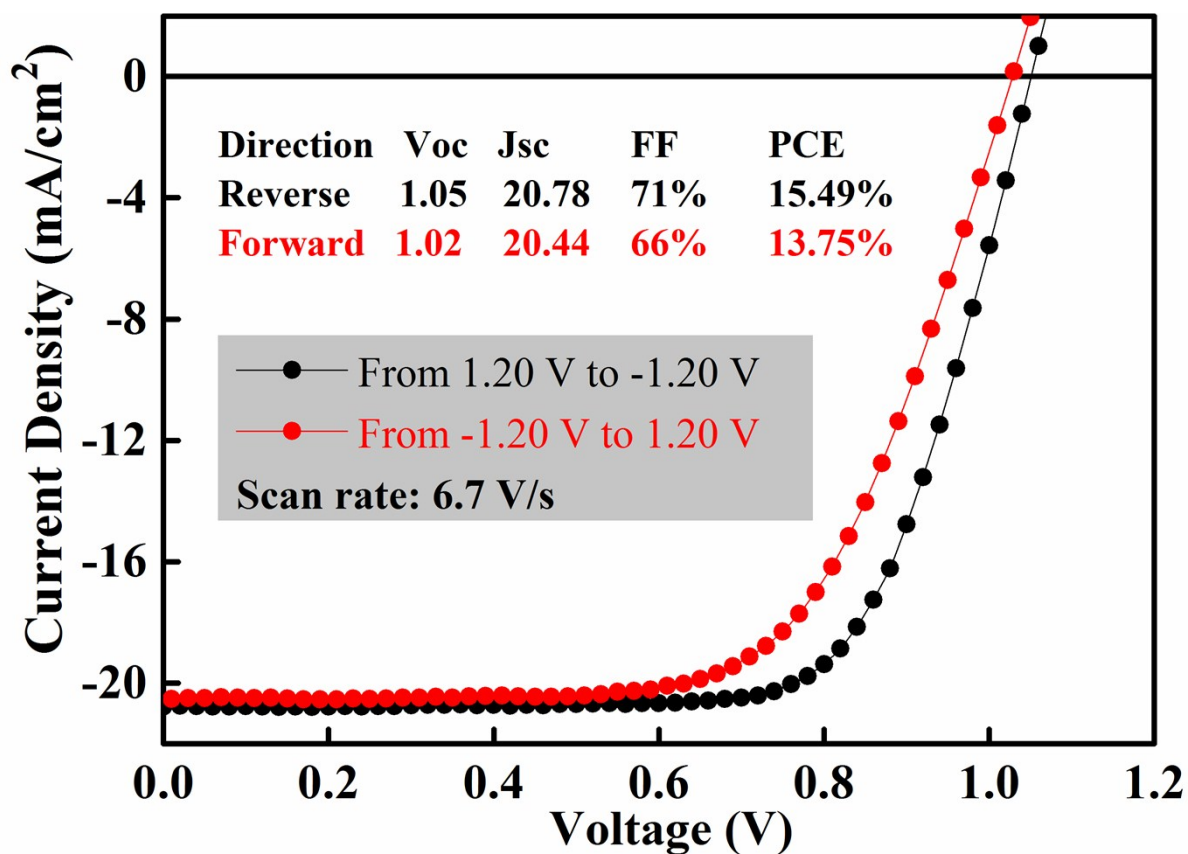


Figure S6 J-V curves of the n-i-p structure device with different scan direction at scan rate of 6.7 V/s.

Reference

- 1 S. Mastroianni, F. D. Heinz, J. H. Im, W. Veurman, M. Padilla, M. C. Schubert, U. Würfel, M. Grätzel, N. G. Park and A. Hinsch, *Nanoscale*, 2015, 7, 19653-19662.
- 2 Z. Tang, S. Tanaka, S. Ito, S. Ikeda, K. Taguchi and T. Minemoto, *Nano Energy*, 2016, 21, 51-61.
- 3 R. M. Geisthardt and J. R. Sites, *IEEE Journal of Photovoltaics*, 2014, 4, 1114-1118.