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Imaging the Charge Carrier Distribution inside Solar Cell Using Kelvin Probe Force Microscopy

Abstract

The internal potential of the solar cell devices depends on the basic mechanism of photovoltaic effect, such as charge carrier generation, separation, transport, recombination etc. Here we report the direct observation of the surface potential depth profile across the cross-section of the solar cell at different wavelengths of light using Kelvin probe force microscopy (KPFM). However, KPFM, a modified version of Atomic Force Microscopy (AFM), is a non-contact surface technique used to measure the local contact potential difference (CPD) between a conducting AFM tip and the sample.[1,2] We have plotted the CPD profiles across the cross-section of the device and correlated the measured potentials with the material interface positions in the device. The topography and phase images across the cross-section of the solar cell were also observed, where the interfaces of the different layers in the device were well defined in nanoscale range. The influence of the different spectra of light on the generation and transport processes of the charge carriers inside the solar cell have been investigated here. Under steady state solar illumination, a sharp difference in electrical potential is observed across the active layers of the solar cell.[3,4] The results on the distribution of the charge carriers inside the solar cells under different illuminations help to understand the basic charge transport mechanism across the interfaces which open the possibility to design the high performance solar cells in future.

References

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Figure

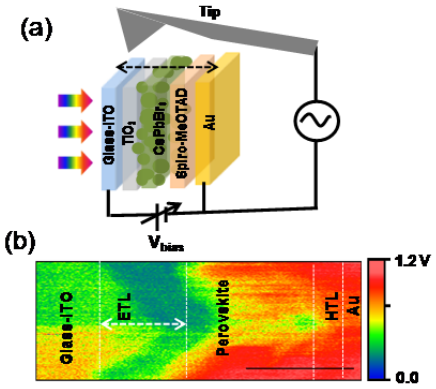

Figure 1: (a) Schematic diagram of the cross-sectional KPFM measurement system. (b) Surface potential image across the layers of the solar cell under solar illumination.