TECHNOLOGY

Photovoltage Force Microscopy

OVERVIEW

Background:
Imaging methods based on atomic force microscopy (AFM) techniques have been extensively used to characterize the structural and electrical properties of PV materials and full devices. In particular, Kelvin probe force microscopy (KPFM) has been implemented to probe the electrical characteristics of a variety of PV materials and devices, ranging from organic materials, and oxides to III-V semiconductors for multijunction designs and polycrystalline thin-films. The local optoelectronic properties and changes in material composition have also been mapped using near-field scanning optical microscopy (NSOM) probes as local sources of excitation. Very recently, photoluminescence has emerged as a promising tool to map charge recombination and carriers diffusion with high spatial resolution. Nevertheless, none of these imaging techniques provide a direct measurement of Voc within the material. A straightforward, universal, and accurate method to measure the Voc (and hence non-radiative recombination processes) with high spatial resolution in PV materials is still missing.

Innovation:
Researchers at the University of Maryland have developed a new method to spatially resolve and image the open circuit voltage (Voc) in partially and fully processed optoelectronic devices with nanoscale resolution. Photovoltage Force Microscopy (PVFM) enables the investigation of photovoltage with
Nanoscale resolution with an atomic force microscope (AFM) and a conductive probe. Spatial measurement of Voc enables Researchers to diagnose how nanoscale topographic features (eg. grain boundaries) hinder or enhance the macroscopic Voc in devices such as solar cells. Moreover, it can be used to determine if specific device processing steps are beneficial or harmful for the ultimate performance of a functional semiconductor material.

APPLICATIONS

Nanoscale Voc image analysis

ADVANTAGES

Non-destructive analysis
Applicable to any optoelectronic device
No Post-processing image analysis needed

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Additional Information

INSTITUTION

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PATENT STATUS

Pending

EXTERNAL RESOURCES

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