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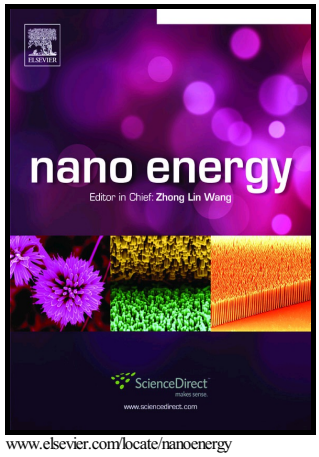

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Conductive-probe atomic force microscopy as a characterization tool for nanowire-based solar cells

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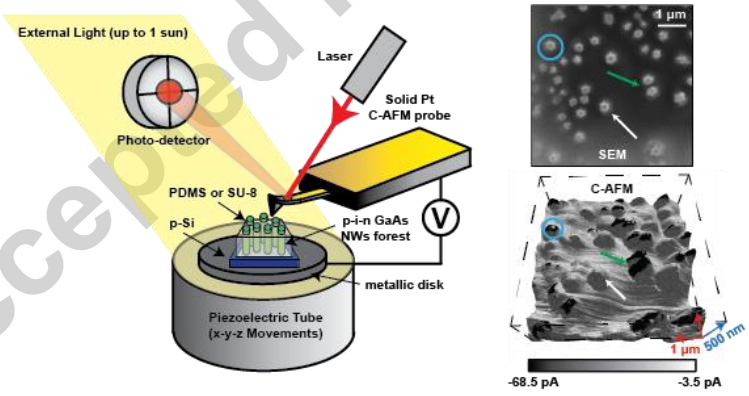
Abstract

The photonic properties of nanowires advocate for their utilization in next generation solar cells. Compared to traditional devices, the electric scheme is transformed from a single into an ensemble of pn junctions connected in parallel. This new configuration requires new schemes for the characterization. We show how conductive-probe atomic force microscopy, C-AFM, is an essential tool for the characterization and optimization of this parallel-connected nanowire devices. With C-AFM it is possible to obtain both surface topography and local electrical characterization with nanoscale resolution. We demonstrate topography and current mapping of nanowire forests, combined with current-voltage measurements of the individual nanowire juncitions from the ensemble. Our results provide discussion elements on some factors limiting the performance of a nanowire-based solar cell and thereby to provide a path for their improvement.

Graphical Abstract



Research Highlights

- The use of conductive atomic force microscopy (C-AFM) in nanowire-based solar cell devices is used to study the statistical properties of each nanowire pn-junction and compared to the performance of the large-area device.
- The C-AFM measurements reveal the non-uniformity of electrical properties between single NWs in ensemble.
- It is shown that a few poor-performing nanowire devices may not have a dramatic reduction on the nanowire ensemble performance.

Keywords

Next generation photovoltaics, nanowire-based solar cells, conductive-AFM, III-V semiconductors