Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Local excitation and local collection of photocurrent in thin-film polycrystalline photovoltaic devices NIKOLAI ZHITENEV, CNST/NIST, HEAYOUNG YOON, MARINA LEITE, YOUNGMIN LEE, SARAH KO, YUE ZHAO, Maryland Nanocenter/UMD and CNST/NIST, ANTHONY GIANFRANCESCO, Worcester Polytechnic Institute and CNST/NIST, PAUL HANEY, ALEC TALIN, CNST/NIST — The power conversion efficiency of commercial solar modules based on thin-film chalcogenide materials is well below the theoretical limits. To understand the underlying physical mechanisms limiting the efficiency, we investigate local photovoltaic properties isolating the difference between the grain bulk (0.5-2 mkm in size) and the grain boundary in CdTe absorber. Local current-voltage measurements are performed using nano-contacts in conjunction with local electron-hole pairs generation comparing multiple injection techniques. First, the carriers are excited using variable energy electron beam enabling measurements with a spatial resolution down to 20 nm. Second, we have developed a novel approach for high-resolution and high-throughput photocurrent imaging downconverting electron beam into a near-field optical source using a thin film (<50 nm) of phosphors. The electron beam is fully absorbed in the phosphors layer, and the cathodoluminescence is used as a local photon source. Third, we generate carriers using a near-filed optical microscope varying the excitation wavelength. The results show that, in a well-optimized material, a large fraction of grain boundaries displays higher photocurrent as compared to grain bulk effectively serving as a three-dimensional distributed photocurrent collector.

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Date submitted: 09 Nov 2012 Electronic form version 1.4