Hot electron effect in ultrathin photovoltaic junctions T. KIRKPATRICK, K. KEMPA, M.J. NAUGHTON, Z.F. REN, A. HERCZYNSKI, Y. GAO, Boston College, J. RYBCZYNSKI, Solasta Inc. — The open circuit voltage in nanoscopically-thin p-i-n amorphous silicon solar cells is found to increase with optical energy (light frequency) [1]. We accredit this increased $V_{oc}$ to the extraction of hot carriers. The ultrathin nature of these junctions also leads to a large electric field, reducing carrier recombination and facilitating anomalously large current in addition to the increased voltage. The large $J_{sc}$ thus indicates improved carrier extraction despite reduced optical absorption for ultrathin absorber layers. The overall power conversion efficiency is $\sim 3\%$ with absorbers less than $1/20^{th}$ as thick as conventional a-Si solar cells (i-layer as thin as 5 nm). A simple phenomenological argument provides a semi-quantitative understanding of these effects, and may provide guidance for the design of high-efficiency, hot electron solar cells. MJN, KK and ZFR also at Solasta Inc.


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