Abstract Submitted
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Ultra-dense silicon nanowire array solar cells by nanoimprint lithography[1] PENG ZHANG, PEI LIU, STYLIANOS SIONTAS, ALEXANDER ZASLAVSKY, DOMENICO PACIFICI, Brown Univ, JONG-YOON HA, SERGIY KRYLYUK, Univ of Maryland National Institute of Standards and Technology, ALBERT DAVYDOV, National Institute of Standards and Technology — Nanowire (NW) solar cells have been attracting increasing interest due to their potentially superior light absorption compared to thin bulk films. In order to improve light trapping, we have used nanoimprint lithography (NIL) to fabricate high-density NW arrays with deep sub-micron pitch (P) and diameter (D). We have grown dense vertical arrays of Si axial $p-i-n$ junction NWs of D = 170 nm and P = 500 nm by vapor-liquid-solid epitaxy on seed arrays produced by NIL. The NWs were 9 m length long with a 5 m intrinsic section. The NW arrays were planarized using SU-8 photoresist, followed by reactive ion etching to expose the NW tips. Top n-contact was realized by sputter deposition of a transparent 200 nm IZO layer. The nanoimprinted NW array samples measured under AM 1.5 G illumination showed a peak external quantum efficiency of ˜8% and internal quantum efficiency of ˜90% in the visible spectral range. Three-dimensional finite-difference time-domain simulations of Si NW periodic arrays with varying P confirm the importance of high NW density. Specifically, due to diffractive scattering and light trapping, absorption efficiency close to 100% in the 400–650 nm spectral range is predicted for a Si NW array with an even smaller P = 250 nm, significantly outperforming a blanket Si film of the same thickness. Such pitch values are accessible to NIL and work on such arrays is in progress.

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