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Simulation of thin nanowires for solar energy conversion: Operation as photoelectrodes and with discrete ohmic-selective contacts

MICHELLE PRICE, JUSTIN FOLEY, STEPHEN MALDONADO, University of Michigan — Nanostructured, high aspect ratio form factors can dramatically improve the performance of solar energy conversion devices made from low cost, earth-abundant materials that are otherwise limited by poor carrier transport properties. This poster presentation identifies and more precisely defines the limiting factors in the operation of thin nanowire photoelectrodes to facilitate their design and synthesis. Results from finite-element simulations used to model the key features of thin nanowire photoelectrodes under low-level injection conditions are shown that illustrate the respective effects of nonuniform doping, tapering along the length, variation in charge carrier mobilities and lifetimes, changes in nanowire radius, and changes in the density of surface defects on the photocurrent-potential responses. Also reported are results from simulations of nanostructures featuring near-intrinsic doping densities and discrete, ohmic-selective contacts operating under high-level injection conditions. The sensitivity of device operation to contact size, carrier mobility, surface recombination velocity, doping density and illumination intensity are reported. The presented work will address the hypothesis that the discrete, ohmic-selective contact photoelectrode design affords large solar energy conversion efficiencies with thin, lightly doped semiconductor nanowires.

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