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Semiconductor-free hot carrier devices for energy harvesting and photodetection. TAO GONG, JEREMY MUNDAY, University of Maryland, College Park — The maximum efficiency for a single-junction solar cell is around 30% by the Shockley-Queisser (SQ) limit. The energy loss is typically through a thermalization process between the excited high-energy carriers, e.g. hot carriers, and the lattice. Therefore, the collection of the hot carriers before thermalization would allow for reduced power loss. Recently, photodetectors based on metal-semiconductor Schottky junctions have been exploiting hot electron effects to allow sub-bandgap absorption and hence show promise as near IR wavelength detectors. Here we present a simple, semiconductor-free hot carrier device based on transparent conducting oxides (TCO) electrodes. We experimentally demonstrate the hot carrier generation and extraction under monochromatic and broadband light illumination of normal and oblique incidence. Under optimized conditions, a power conversion efficiency >10% is predicted for high-energy photon excitation. The performance of the device shows further improvement by employing nanostructures, which couple the incident light into surface plasmons, leading to absorption enhancement. This semiconductor-free device provides an alternative way of energy harvesting and photodetection.

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