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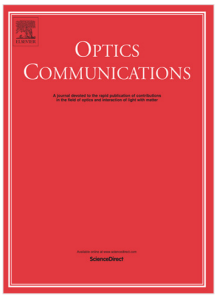

Photon management of full–spectrum solar energy through integrated honeycomb/cone nanostructures

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Photon management of full–spectrum solar energy through integrated honeycomb/cone nanostructures

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ABSTRACT: Photon management is an efficient way to increase the performance of photovoltaic (PV) devices with light trapping. However, the efficiency of PV is limited by the bandgap of materials. To take advantages of photons over the whole AM1.5G spectrum, thermoelectric (TE) devices are added to the bottom of PV as hybrid systems to utilize the rest solar energy through thermal utilization. In this way, photon management inside PV cells is extended to two aspects: the absorption of spectrally high–graded photons and the transmission of photons below the bandgap to TE devices. From this point of view, structures on both top side and bottom side in solar cells must be designed for the required management. In this way, double–side structures are presented on the surface of thin–film silicon, which consist of nanocones and bioinspired honeycomb–arranged holes. With optimized parameters, excellent anti–reflection property and near–infrared (NIR) transmission are achieved over the full–spectrum and NIR wavelength range, respectively. The integrated honeycomb holes will further enhance absorption with wavelengths of 300–1100 nm through combined gradient effective refractive index and scattering effects with