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Nanowire-based solar cell

PEIDONG YANG, University of California

Excitonic solar cells – including organic, hybrid organic-inorganic and dye-sensitised cells (DSCs) – are promising devices for inexpensive, large-scale solar energy conversion. The DSC is currently the most efficient and stable excitonic photocell. Central to this device is a thick nanoparticle film that provides a large surface area for the adsorption of light-harvesting molecules. However, nanoparticle DSCs rely on trap-limited diffusion for electron transport, a slow mechanism that can limit device efficiency, especially at longer wavelengths. Here we introduce a new version of the dye-sensitised cell in which the traditional nanoparticle film is replaced by a dense array of oriented, crystalline ZnO nanowires. The nanowire anode is synthesized via mild aqueous chemistry and features a surface area up to one-fifth as large as a nanoparticle cell. The direct electrical pathways provided by the nanowires ensure the rapid collection of carriers generated throughout the device, and a full Sun efficiency of 2.5% is demonstrated, limited primarily by the surface area of the nanowire array.